G06F

ELECTRIC DIGITAL DATA PROCESSING (computer systems based on specific computational models G06N)

Definition statement

This place covers:

Electrical arrangements or processing means for the performance of any automated operation using empirical data in electronic form for classifying, analyzing, monitoring, or carrying out calculations on the data to produce a result or event.

References

Limiting references

This place does not cover:

Computer systems based on specific computational models G06N

Informative references

Attention is drawn to the following places, which may be of interest for search:

Programme-control systems G05B 19/00
Digital computers in which all the computation is effected mechanically G06C
Computers in which a part of the computation is effected hydraulically or pneumatically G06D
Computers in which a part of the computation is effected optically G06E
Self-contained input or output peripheral equipment G06K
Computer displays G09G
Impedance networks using digital techniques H03H

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Handling includes processing or transporting of data.

Data processing equipment An association of an electric digital data processor classifiable under group G06F 7/00, with one or more arrangements classifiable under groups G06F 1/00, G06F 5/00 and G06F 9/00-G06F 13/00.
G06F 1/00
Details not covered by groups G06F 3/00 – G06F 13/00 and G06F 21/00 (architectures of general purpose stored program computers G06F 15/76)

References
Limiting references
This place does not cover:

| Security arrangements for protecting computers or computer systems against unauthorised activity | G06F 21/00 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Details of data-processing equipment | G06F 3/00 - G06F 13/00 |

G06F 1/04
Generating or distributing clock signals or signals derived directly therefrom

Definition statement
This place covers:
Generation and/or distribution of clock signal(s) within a computer system.

G06F 1/10
Distribution of clock signals {, e.g. skew}

Definition statement
This place covers:
Distribution of clock signal(s) within a computer system, in a typical case the goal to be achieved is to minimize the skew.

G06F 1/105
{in which the distribution is at least partially optical}

Definition statement
This place covers:
Clock distribution wherein the clock signal(s) are distributed entirely optically or partially optically and partially electrically.
**G06F 1/16**

Constructional details or arrangements

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Instrument details</th>
<th>G12B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructional details common to different types of electric apparatus</td>
<td>H05K 7/00</td>
</tr>
</tbody>
</table>

**G06F 1/1603**

{Arrangements to protect the display from incident light, e.g. hoods}

**Special rules of classification**

Used also for hoods protecting displays of portable computers.

**G06F 1/1607**

{Arrangements to support accessories mechanically attached to the display housing (**G06F 1/1603, G06F 1/1605** take precedence)}

**Special rules of classification**

Used also for accessories attached on displays of portable computers.

**G06F 1/1613**

{for portable computers (cooling arrangements therefor **G06F 1/203**; constructional details or arrangements for pocket calculators, electronic agendas or books **G06F 15/0216**; constructional details of portable telephone sets: with several bodies **H04M 1/0202**)}

**Definition statement**

*This place covers:*

Portable computers in the sense of computers able to be used as stand alone computers with their own integrated user interface and designed to be carried by hand (e.g. hand held computers or laptop computers) or worn on the user's body (wearable computers).

Docking stations and extensions associated with the portable computers which may be mechanically attached to them.

**Relationships with other classification places**

Telephone sets including user guidance or feature selection means facilitating their use: **H04M 1/247**

Cordless telephones: **H04M 1/725**

Pagers: **G08B 5/222**
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling arrangements for portable computers</td>
<td>G06F 1/203</td>
</tr>
<tr>
<td>Constructional details or arrangements for pocket calculators, electronic agendas or books</td>
<td>G06F 15/0216</td>
</tr>
<tr>
<td>Anti-theft locking devices</td>
<td>E05B 73/0082</td>
</tr>
<tr>
<td>Constructional details of cameras</td>
<td>G03B 17/00, H04N 5/225</td>
</tr>
<tr>
<td>Hand held scanners</td>
<td>G06K 7/10881</td>
</tr>
<tr>
<td>Casing of remote controls</td>
<td>H01H 9/0235</td>
</tr>
<tr>
<td>Constructional details of portable telephone sets: with several bodies</td>
<td>H04M 1/0202</td>
</tr>
</tbody>
</table>

Special rules of classification

In this field, main mechanical aspects of the housing (single housing, foldable or sliding housings) are classified in G06F 1/1615 - G06F 1/1626, while all the other constructional details (enclosure details, display, keyboard, integrated peripherals, etc) are classified in G06F 1/1633 in complement to this main aspect.

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "Laptop", "Palmtop", "PDA"
- "cell phone", "mobile phone", "smart phone"

G06F 1/1615

{with several enclosures having relative motions, each enclosure supporting at least one I/O or computing function (constructional details of portable telephones comprising a plurality of mechanically joined movable body parts H04M 1/0206)}

Definition statement

This place covers:

Portable computers having a plurality of enclosures which can't be classified in anyone of the subgroups, e.g. multiple enclosure with loose mechanical link (single wire, expandable or/and flexible link, rollable part), computer split in several housings with no mechanical connection and wirelessly connected, complex mechanical link with multiple degrees of freedom.

Illustrative examples:
**References**

**Limiting references**

This place does not cover:

Constructional details of portable telephones comprising a plurality of mechanically joined movable body parts

**H04M 1/0206**

---

**G06F 1/1616**

(with folding flat displays, e.g. laptop computers or notebooks having a clamshell configuration, with body parts pivoting to an open position around an axis parallel to the plane they define in closed position)

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Foldable portable telephones

**H04M 1/0214**
G06F 1/1618

{the display being foldable up to the back of the other housing with a single degree of freedom, e.g. by 360° rotation over the axis defined by the rear edge of the base enclosure}

Definition statement
This place covers:
Also when the hinging part is composed of two parallel rotation axes.

G06F 1/162

{changing, e.g. reversing, the face orientation of the screen with a two degrees of freedom mechanism, e.g. for folding into tablet PC like position or orienting towards the direction opposite to the user to show to a second user}

Definition statement
This place covers:
Reversing the orientation done either by rotating along the X or Y axis or by detaching the display and attaching it in the reverse orientation. Illustrative example:
G06F 1/1622

{with enclosures rotating around an axis perpendicular to the plane they define or with ball-joint coupling, e.g. PDA with display enclosure orientation changeable between portrait and landscape by rotation with respect to a coplanar body enclosure}

Definition statement

This place covers:
Illustrative examples of subject matter classified in this group:

Additionally rotation around an axis common to the plane they define but perpendicular to their common side, e.g. reversing the relative orientation along an axis common to both planes but not along their sides (which would be then a folding axis).

References

Limiting references

This place does not cover:

| Reversing the face orientation of the screen of a folding flat display | G06F 1/162 |
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Rotatable portable telephones | H04M 1/0225 |

**G06F 1/1624**

{with sliding enclosures, e.g. sliding keyboard or display}

**Definition statement**

*This place covers:*

Portable computers linked by a mechanism allowing translation of one housing relatively to the other housing.

References

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Slidable portable telephones | H04M 1/0235 |

**G06F 1/1628**

{Carrying enclosures containing additional elements, e.g. case for a laptop and a printer}

**Definition statement**

*This place covers:*

Also bags allowing the transport of other peripherals together with the portable computer and carrying trolleys for transporting portable computers.

References

**Limiting references**

*This place does not cover:*

| Bags per se | A45C 3/00 - A45C 15/00 |
| Stands with or without wheels as supports for apparatus | F16M 11/00 |
**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Holders or carriers for hand articles | A45F 5/00 |

**G06F 1/163**

{Wearable computers, e.g. on a belt}

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Garments adapted to accommodate electronic equipment | A41D 1/002 |
| Fastening articles to garments | A45F 5/02 |

**G06F 1/1632**

{External expansion units, e.g. docking stations}

**Definition statement**

This place covers:

Expansions which are directly attached to portable computers, including supplementary battery packs external to the housing, port replicators and cradles for PDAs.

**References**

**Limiting references**

This place does not cover:

| Standard wired or wireless peripherals such as keyboards, printers or displays which are not mechanically linked to a portable computer | B41J 1/00, G06F 3/02, G06F 1/1601 |

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Mounting in a car | B60R 11/02 |
| Locking against unauthorized removal | E05B 73/0082 |
| Battery charging cradles | H02J 7/0042 |
| PCMCIA cards | H05K 5/0256 |

**Synonyms and Keywords**

In patent documents, the following words/expressions are often used as synonyms:

- "docking station", "cradle" and "port replicator"
G06F 1/1633

{Constructional details or arrangements of portable computers not specific to the type of enclosures covered by groups G06F 1/1615 - G06F 1/1626}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Constructional details or arrangements of portable computers specific to the type of enclosures | G06F 1/1615 - G06F 1/1626 |
| Mounting of specific components of portable telephones | H04M 1/026 |

G06F 1/1635

{Details related to the integration of battery packs and other power supplies such as fuel cells or integrated AC adapter (details of mounting batteries in general H01M 2/1022)}

References

Limiting references

This place does not cover:

| Details of mounting batteries in general | H01M 2/1022 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Computer power supply in general | G06F 1/26 |
| Portable telephones battery compartments | H04M 1/0262 |

G06F 1/1637

{Details related to the display arrangement, including those related to the mounting of the display in the housing (constructional details related to the housing of computer displays in general G06F 1/1601)}

References

Limiting references

This place does not cover:

| Constructional details related to the housing of computer displays in general | G06F 1/1601 |
| Accessories mechanically attached to the display housing portion of portable computers | G06F 1/1603 - G06F 1/1611 |
**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Portable telephones display | H04M 1/0266 |

**G06F 1/1641**

{the display being formed by a plurality of foldable display components (G06F 1/1647 takes precedence)}

**References**

**Limiting references**

This place does not cover:

| Including at least an additional display | G06F 1/1647 |

**Special rules of classification**

Should be used when the displays are used in combination as a virtual single display area where the displayed image is split over the display screens.

**G06F 1/1647**

{including at least an additional display (G06F 1/1692 takes precedence)}

**References**

**Limiting references**

This place does not cover:

| Constructional details or arrangements related to integrated I/O peripheral being a secondary touch screen used as control interface, e.g. virtual buttons or sliders | G06F 1/1692 |


**G06F 1/165**

{the additional display being small, e.g. for presenting status information}

**Definition statement**

*This place covers:*

Typically very small displays disposed on the back of the main display for indicating time, alerts or battery level or small status displays near the hinge above the keyboard. Illustrative examples:

![Illustrative example of a small display](image1)

**G06F 1/1652**

{the display being flexible, e.g. mimicking a sheet of paper, or rollable}

**References**

*Informative references*

*Attention is drawn to the following places, which may be of interest for search:*

| Portable telephones flexible display | H04M 1/0268 |


G06F 1/1656

{Details related to functional adaptations of the enclosure, e.g. to provide protection against EMI, shock, water, or to host detachable peripherals like a mouse or removable expansions units like PCMCIA cards, or to provide access to internal components for maintenance or to removable storage supports like CDs or DVDs, or to mechanically mount accessories (mounting of accessories to a computer display G06F 1/1607; display hoods G06F 1/1603; cooling arrangements for portable computers G06F 1/203)}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Accessories mechanically attached to the display housing portion of portable computers</th>
<th>G06F 1/1603 - G06F 1/1611</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure details of non portable computers</td>
<td>G06F 1/181</td>
</tr>
<tr>
<td>Cooling arrangements for portable computers</td>
<td>G06F 1/203</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Portable telephones with mechanically detachable module(s)</th>
<th>H04M 1/0254</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable telephones with improved resistance to shocks</td>
<td>H04M 1/185</td>
</tr>
</tbody>
</table>

G06F 1/1658

{related to the mounting of internal components, e.g. disc drive or any other functional module}

References

Limiting references

This place does not cover:

| Internal mounting structures of non portable computers | G06F 1/183 |

G06F 1/1662

{Details related to the integrated keyboard}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Details of stand alone keyboards</th>
<th>G06F 3/0202</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructional details of keyboard switches</td>
<td>H01H 13/70</td>
</tr>
<tr>
<td>Portable telephones keypads</td>
<td>H04M 1/23</td>
</tr>
</tbody>
</table>
G06F 1/1673

{Arrangements for projecting a virtual keyboard}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Digitisers</th>
<th>G06F 3/041</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction with virtual keyboards</td>
<td>G06F 3/04886</td>
</tr>
<tr>
<td>displayed on a touch sensitive surface</td>
<td></td>
</tr>
</tbody>
</table>

G06F 1/1675

{Miscellaneous details related to the relative movement between the different enclosures or enclosure parts which could be adopted independently from the movement typologies specified in G06F 1/1615 and subgroups}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Movement typologies</th>
<th>G06F 1/1615</th>
</tr>
</thead>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Relative motion of the body parts to change the operational status of the portable telephone | H04M 1/0241 |

G06F 1/1677

{for detecting open or closed state or particular intermediate positions assumed by movable parts of the enclosure, e.g. detection of display lid position with respect to main body in a laptop, detection of opening of the cover of battery compartment}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Portable telephones open/close detection</th>
<th>H04M 1/0245</th>
</tr>
</thead>
</table>
G06F 1/1681

{Details related solely to hinges (hinge details related to the transmission of signals or power are classified in G06F 1/1683)}

References

Limiting references

This place does not cover:

| Hinge details related to the transmission of signals or power | G06F 1/1683 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Hinges for doors, windows or wings | E05D 1/00 - E05D 15/00 |
| Portable telephones hinge details | H04M 1/0216, H04M 1/0227, H04M 1/0237 |

G06F 1/1683

{for the transmission of signal or power between the different housings, e.g. details of wired or wireless communication, passage of cabling}

Definition statement

This place covers:

Also optical transmission of data or inductive transmission of power between housings.
G06F 1/1686
{the I/O peripheral being an integrated camera}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Camera details of portable telephones | H04M 1/0264 |

G06F 1/1688
{the I/O peripheral being integrated loudspeakers}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Mounting aspects of transmitters in portable telephones | H04M 1/03 |
| Loudspeakers | H04R 1/00 |

G06F 1/169
{the I/O peripheral being an integrated pointing device, e.g. trackball in the palm rest area, mini-joystick integrated between keyboard keys, touch pads or touch stripes (G06F 1/1643 takes precedence; constructional details of pointing devices G06F 3/033; joysticks in general G05G 9/047)}

References
Limiting references
This place does not cover:

| Touchscreens | G06F 1/1643, G06F 1/1692 |
| Constructional details of pointing devices | G06F 3/033 |
| Joysticks in general | G05G 9/047 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Constructional details of pointing devices in portable telephones | H04M 1/233 |
G06F 1/1692
{the I/O peripheral being a secondary touch screen used as control interface, e.g. virtual buttons or sliders}

Definition statement
This place covers:
Secondary touchscreens which are used only as input device (touchpad, virtual input devices), and not for information display.

G06F 1/1694
{the I/O peripheral being a single or a set of motion sensors for pointer control or gesture input obtained by sensing movements of the portable computer}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Gesture input</th>
<th>G06F 3/017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion sensing in space for computer input</td>
<td>G06F 3/0346</td>
</tr>
</tbody>
</table>

G06F 1/1696
{the I/O peripheral being a printing or scanning device}

Definition statement
This place covers:
Scanners for e.g. A4 sheets.

References
Limiting references
This place does not cover:

| Barcode readers | G06K 7/10861, G06K 7/10821 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Scanners</th>
<th>G06K 7/10, H04N 1/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printers</td>
<td>G06K 15/00, B41J 1/00</td>
</tr>
</tbody>
</table>
**G06F 1/1698**

{the I/O peripheral being a sending/receiving arrangement to establish a cordless communication link, e.g. radio or infrared link, integrated cellular phone (details of antennas disposed inside a computer **H01Q 1/2266**)}

**References**

**Limiting references**

This place does not cover:

| Details of antennas disposed inside a computer | H01Q 1/2266 |
| Interaction of portable devices with video on demand or television systems | H04N 21/4126, H04N 21/41407, H04N 5/4403 |

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Aerials | H01Q |
| Cordless telephones | H04M 1/725 |

**G06F 1/18**

Packaging or power distribution {for electrical apparatus in general **H05K, H02J**}  

**Definition statement**

This place covers:

Cases and housing for computers and how computer components are “packed”, i.e. mounted within the housing. It also covers arrangements, e.g. cabling, to distribute the power generated by the power supply unit to the other computer components mounted within the casing.

**References**

**Limiting references**

This place does not cover:

| Cases or housings of portable computers | G06F 1/1613 |
| Cases or housings for electrical apparatuses in general | H05K, H02J |

**G06F 1/181**

{Enclosures (for electric apparatus in general **H05K 5/00**; for portable computers **G06F 1/1613**)}

**Definition statement**

This place covers:

Enclosures for computers, including constructional details of front or bezel.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Enclosures for portable computers</th>
<th>G06F 1/1613</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosures for electrical apparatuses in general</td>
<td>H05K 5/00</td>
</tr>
</tbody>
</table>

G06F 1/182

{with special features, e.g. for use in industrial environments; grounding or shielding against radio frequency interference [RFI] or electromagnetical interference [EMI] (in general H05K 9/00)}

Definition statement

This place covers:
Enclosures for non-standard computers, e.g. industrial computers, computers specifically adapted to special environments.

References

Limiting references

This place does not cover:

| Shielding against electromagnetical interference in general | H05K 9/00 |

G06F 1/183

{Internal mounting support structures, e.g. for printed circuit boards (in general H05K 7/1422), internal connecting means (for buses G06F 13/409)}

Definition statement

This place covers:
Mounting structures for securing and/or interconnecting among them internal components within the enclosure of a computer system.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Internal mounting structures for portable computers</th>
<th>G06F 1/1656</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal connecting means for buses</td>
<td>G06F 13/409</td>
</tr>
<tr>
<td>Mounting structures for printed circuits in general</td>
<td>H05K 7/1422</td>
</tr>
</tbody>
</table>
G06F 1/185

{Mounting of expansion boards (in general H05K 7/1417)}

References

Limiting references

This place does not cover:

| Mounting of expansion boards in general | H05K 7/1417 |

Special rules of classification

Used for the securing of expansion cards completely within the enclosure, and not to the connection to openings in the enclosure.

G06F 1/186

{Securing of expansion boards in correspondence to slots provided at the computer enclosure (in general H05K 7/1402)}

References

Limiting references

This place does not cover:

| Securing of expansion boards in general | H05K 7/1402 |

Special rules of classification

Used for to the connection of expansion boards to openings in the enclosure so that at least a portion, or connector, of the expansion board is accessible from outside the enclosure.

G06F 1/187

{Mounting of fixed and removable disk drives (constructional details of disk drives housings in general G11B 33/00)}

References

Limiting references

This place does not cover:

| Constructional details of disk drives housings in general | G11B 33/00 |

Special rules of classification

Used for both optical drives and hard disk drives.
G06F 1/20
Cooling means

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Modifications to facilitate cooling, ventilating, or heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>H05K 7/20</td>
</tr>
</tbody>
</table>

G06F 1/206
{comprising thermal management}

Special rules of classification
This groups refers also to documents wherein the thermal management is achieved by lowering power consumption in order to reduce heat generation..

Documents also disclosing costrucional details about the managed cooling arrangement should be also classified in G06F 1/20 if describing the cooling of a desktop computer or G06F 1/203 if describing the cooling of a portable computer.

G06F 1/24
Resetting means

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Microprogramme loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F 9/24</td>
</tr>
<tr>
<td>Restoration from data faults</td>
</tr>
<tr>
<td>G06F 11/00</td>
</tr>
</tbody>
</table>

G06F 1/26
Power supply means, e.g. regulation thereof (for memories G11C)

Definition statement
This place covers:
Power supplies for computers including:
• Power regulation;
• Power monitoring including means for acting in the event of power supply fluctuations or interruption;
• Power save.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Power supplies for memories</th>
</tr>
</thead>
<tbody>
<tr>
<td>G11C</td>
</tr>
</tbody>
</table>
Informative references

Attention is drawn to the following places, which may be of interest for search:

| Systems for regulating electric or magnetic variables | G05F |

G06F 1/263

{Arrangements for using multiple switchable power supplies, e.g. battery and AC (G06F 1/30 takes precedence)}

Definition statement

This place covers:
Arrangements with switchable, multiple power supplies (typical example is AC and battery, but may also include multiple batteries, fuel cells or solar panels).

References

Limiting references

This place does not cover:

| Means for acting in the event of power-supply failure or interruption, e.g. power-supply fluctuations | G06F 1/30 |

G06F 1/266

{Arrangements to supply power to external peripherals either directly from the computer or under computer control, e.g. supply of power through the communication port, computer controlled power-strips}

Definition statement

This place covers:
Arrangements to supply power to external peripherals, either directly from the computer or under computer control (typical cases are the supply of power through a USB interface and the power strips).

G06F 1/28

Supervision thereof, e.g. detecting power-supply failure by out of limits supervision

Definition statement

This place covers:
Arrangements to monitor, and only monitoring, power supply parameters (e.g. voltage and/or current).

References

Limiting references

This place does not cover:

| Means for acting in the event of power-supply failure or interruption, e.g. power-supply fluctuations | G06F 1/30, G06F 1/305 |
G06F 1/30
Means for acting in the event of power-supply failure or interruption, e.g. power-supply fluctuations (for resetting only G06F 1/24)

References
Limiting references
This place does not cover:

| For resetting only | G06F 1/24 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Involving the processing of data-words | G06F 11/00 |

G06F 1/32
Means for saving power

Definition statement
This place covers:
Means to save power in computers, including devices, methods and combinations of devices and method features.

G06F 1/3203
Power management, i.e. event-based initiation of power-saving mode

Definition statement
This place covers:
Power saving having a relationship to an event of any type. As opposed to arrangements and/or methods to save power of permanent or continuous nature.

G06F 1/3206
Monitoring of events, devices or parameters that trigger a change in power modality

Definition statement
This place covers:
Power saving triggered by a certain event and/or condition detected by monitoring or supervision of e.g. hardware, communication, processing tasks.
G06F 1/3215
Monitoring of peripheral devices

Special rules of classification
Used when the peripheral monitored does not belong to any of the subgroups: G06F 1/3218, G06F 1/3221 or G06F 1/3225.

G06F 1/3228
Monitoring task completion, e.g. by use of idle timers, stop commands or wait commands

Definition statement
This place covers:
Power saving initiated when a task completion is detected (typical cases are the completion of processing tasks, e.g. programs, applications, routines).

G06F 1/3231
Monitoring the presence, absence or movement of users

Definition statement
This place covers:
Power saving initiated when the user absence is detected, e.g. through camera and/or sensors.

Special rules of classification
Not to be used when the user absence is inferred by inactivity period (subgroups referring to monitoring of peripheral devices to be used in such cases: G06F 1/3215, etc).

G06F 1/3237
by disabling clock generation or distribution

Definition statement
This place covers:
Power saving by stopping clock generation or distribution to a computer or a component.

G06F 1/3243
{Power saving in microcontroller unit}

Definition statement
This place covers:
Power saving taking place in the processing unit of the computer, intended as central processing unit (CPU), microcontroller unit (MCU), microprocessor.
G06F 1/3256

{Power saving in optical drive}

Definition statement
This place covers:
Power saving in optical (or magneto-optical) disk drives, e.g. CD, DVD, Blue-Ray, etc.

G06F 1/3268

{Power saving in hard disk drive}

References

Limiting references
This place does not cover:

| Power saving in storage systems (e.g. not in disk drives within a computer system) | G06F 3/0625 |

G06F 1/3287

by switching off individual functional units in the computer system

Definition statement
This place covers:
Power saving by selectively reducing power consumption of individual components of a computer system. Such reduction can be achieved in different ways, e.g. by lowering the clock frequency or stopping the clock, by lowering the voltage, by stopping the power supply (power gating).

G06F 3/00

Input arrangements for transferring data to be processed into a form capable of being handled by the computer; Output arrangements for transferring data from processing unit to output unit, e.g. interface arrangements (typewriters B41J; conversion of physical variables F15B 5/00, G01; image acquisition G06T 1/00, G06F 9/00; coding, decoding or code conversion in general H03M; transmission of digital information H04L; {in regulating or control systems G05B})

Definition statement
This place covers:
Input arrangements which are not covered in specific subgroups under it in the hierarchy

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Typewriters | B41J |
| Conversion of physical variables | F15B 5/00, G01 |
In regulating or control systems G05B
Image acquisition G06T 1/00, G06F 9/00
Coding, decoding or code conversion in general H03M
Transmission of digital information H04L

G06F 3/002

{Specific input/output arrangements not covered by G06F 3/02 - G06F 3/16, e.g. facsimile, microfilm (facsimile per se H04N 1/00; viewers photographic printing G03B; electrography, magnetography G03G; other optical apparatus G02B 27/00)}

Definition statement

This place covers:
Includes inter alia arrangements in which a barcode reader is used to input data to a computer and in particular drivers for barcode or QR code readers.

Due to the later creation of G06F 3/01 groups, the title should be understood as I/O arrangements not covered by G06F 3/01 - G06F 3/16, instead of G06F 3/02 - G06F 3/16.

Relationships with other classification places

Recognition of data; presentation of data; record carriers; handling record carriers: G06K.

References

Limiting references

This place does not cover:

Detection of the position or the displacement of a tangible user interface as a computer input G06F 3/03
Other optical apparatus G02B 27/00
Viewers photographic printing G03B
Electrography, magnetography G03G
Constructional details of barcode readers G06K 7/00
Reading of RFID record carriers G06K 7/0008
Constructional details of RFID record carriers G06K 19/07749
Use of barcode readers or RFIDs in data processing systems for business applications G06Q
Wireless phone using NFC or a two-way short-range wireless interface H04M 1/7253
Facsimile per se H04N 1/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Specific input/output arrangements G06F 3/02- G06F 3/16
Viewers photographic printing G03B
Electrography, magnetography G03G
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUI</td>
<td>a user interface in which a person interacts with digital information through a physical environment, i.e. by manipulating physical objects (e.g. in the same way as moving pieces of a game on a tablet), often using RFID or NFC.</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUI</td>
<td>Tangible User Interface</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio-Frequency Identification</td>
</tr>
<tr>
<td>NFC</td>
<td>Near Field Communication</td>
</tr>
</tbody>
</table>

G06F 3/005

{Input arrangements through a video camera}

Definition statement

This place covers:

Specific arrangements for input through a video camera, not covered by G06F 3/01 - G06F 3/16, e.g. details of the interface linking the camera to the computer.

This group was originally meant for devices adapting analog video cameras to computer entry.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking user body for computer input</td>
<td>G06F 3/011, G06F 3/017</td>
</tr>
<tr>
<td>Pointing device integrating a camera for tracking its own position with</td>
<td>G06F 3/0304</td>
</tr>
<tr>
<td>respect to an imaged reference surface or the surroundings</td>
<td></td>
</tr>
<tr>
<td>Tracking a projected light spot generated by a light pen or a &quot;laser</td>
<td>G06F 3/0386</td>
</tr>
<tr>
<td>pointer&quot; indicating a position on a display surface</td>
<td></td>
</tr>
<tr>
<td>Digitisers using a camera for tracking the position of objects with respect</td>
<td>G06F 3/042</td>
</tr>
<tr>
<td>to an imaged reference surface</td>
<td></td>
</tr>
<tr>
<td>Recognising movements or behaviour, e.g. recognition of gestures,</td>
<td>G06K 9/00335</td>
</tr>
<tr>
<td>dynamic facial expressions; Lip-reading</td>
<td></td>
</tr>
<tr>
<td>Television cameras</td>
<td>H04N 5/225</td>
</tr>
</tbody>
</table>
G06F 3/007

{Digital input from or digital output to memories of the shift register type, e.g.
magnetic bubble memories, CCD memories (magnetic bubble memories per se
G11C 19/08, CCD memories per se G11C 19/28)}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Digital input from or digital output to record carriers | G06F 3/06 |
| Magnetic bubble memories per se | G11C 19/08 |
| Shift registers, C-C-D memories per se | G11C 19/28 |
| Organisation of a multiplicity of shift registers | G11C 19/287 |

Special rules of classification

Old technology, not used anymore.

G06F 3/01

Input arrangements or combined input and output arrangements for interaction
between user and computer (G06F 3/16 takes precedence)

Definition statement

This place covers:
Input arrangements, or combined input and output arrangements, for interaction between user and computer.

Particularly, said input arrangements include those based on the interaction with the human body, e.g.
• gloves for hand or finger tracking;
• eye or head trackers;
• devices using bioelectric signals, e.g. detecting nervous activity;
• arrangements for providing computer generated force feedback in input devices.

References

Limiting references

This place does not cover:

| Sound input, sound output including multimode user input, i.e. combining audio input (e.g. voice input) with other user input | G06F 3/16 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Interaction techniques based on graphical user interfaces [GUI] | G06F 3/048 |
G06F 3/011

{Arrangements for interaction with the human body, e.g. for user immersion in virtual reality (for handicapped people in general A61F 4/00; robot control B25J; tactile signalling G08B; blind teaching G09B 21/00; for electrophonic musical instruments G10H 1/344; electronic switches characterised by the way in which the control signals are generated H03K 17/94))}

Relationships with other classification places

Diagnosis; surgery; identification: A61B

Recognition of data; presentation of data; record carriers; handling record carriers: G06K

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring of parameters or motion of the human body or parts thereof for</td>
<td>A61B 5/00</td>
</tr>
<tr>
<td>diagnostic purposes</td>
<td></td>
</tr>
<tr>
<td>For handicapped people in general</td>
<td>A61F 4/00</td>
</tr>
<tr>
<td>Games using an electronically generated display and player-operated input</td>
<td>A63F 13/20</td>
</tr>
<tr>
<td>means</td>
<td></td>
</tr>
<tr>
<td>Robot control</td>
<td>B25J</td>
</tr>
<tr>
<td>Stereoscopic optical systems</td>
<td>G02B 27/22</td>
</tr>
<tr>
<td>Acquiring or recognising human faces, facial parts, facial sketches, facial</td>
<td>G06K 9/00221</td>
</tr>
<tr>
<td>expressions</td>
<td></td>
</tr>
<tr>
<td>Recognising human body or animal bodies</td>
<td>G06K 9/00362</td>
</tr>
<tr>
<td>Tactile signalling</td>
<td>G08B</td>
</tr>
<tr>
<td>Blind teaching</td>
<td>G09B 21/00</td>
</tr>
<tr>
<td>Virtual reality arrangements for interacting with music, including those</td>
<td>G10H 1/00</td>
</tr>
<tr>
<td>with tactile feedback</td>
<td></td>
</tr>
<tr>
<td>For electrophonic musical instruments</td>
<td>G10H 1/344</td>
</tr>
<tr>
<td>Electronic switches characterised by the way in which the control signals</td>
<td>H03K 17/94</td>
</tr>
<tr>
<td>are generated</td>
<td></td>
</tr>
</tbody>
</table>

G06F 3/012

{Head tracking input arrangements}

Definition statement

This place covers:

For the scope of this group, Head-tracking is interpreted as covering face detection and tracking.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-tracking for image generation in head-mounted display</td>
<td>G02B 27/0093, G02B 27/01</td>
</tr>
<tr>
<td>Use of head-tracking for image generation</td>
<td>G06T 7/00, G06T 11/00</td>
</tr>
<tr>
<td>3D image generation in augmented reality</td>
<td>G06T 19/006</td>
</tr>
<tr>
<td>Using viewer tracking</td>
<td>H04N 13/366</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMD</td>
<td>Head-Mounted Display</td>
</tr>
</tbody>
</table>

G06F 3/013

{Eye tracking input arrangements (G06F 3/015 takes precedence)}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on nervous system activity detection</td>
<td>G06F 3/015</td>
</tr>
<tr>
<td>Apparatus for testing the eyes and instruments for examining the eyes</td>
<td>A61B 3/00</td>
</tr>
<tr>
<td>Instruments for determining or recording eye movement</td>
<td>A61B 3/113</td>
</tr>
<tr>
<td>Acquiring or recognising eyes</td>
<td>G06K 9/00597</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "eye tracking" and "gaze tracking"

G06F 3/014

{Hand-worn input/output arrangements, e.g. data gloves}

Definition statement

This place covers:
Also covers hand-worn keyboards

Relationships with other classification places

Manipulators; chambers provided with manipulation devices: B25J
References

Limiting references
This place does not cover:

| Finger worn arrangements for converting the position or the displacement of a member into a coded form | G06F 3/03, G06F 2203/0331 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Data glove (sometimes called a "wired glove" or "cyberglove") | an input device for human–computer interaction worn like a glove |

G06F 3/015

{Input arrangements based on nervous system activity detection, e.g. brain waves [EEG] detection, electromyograms [EMG] detection, electrodermal response detection}

References

Limiting references
This place does not cover:

| Detecting bioelectric signals for diagnostic purpose | A61B 5/0006, A61B 5/04 |
| Bioelectrical control, e.g. myoelectric | A61F 2/72 |

G06F 3/016

{Input arrangements with force or tactile feedback as computer generated output to the user}

Definition statement
This place covers:

Dynamic force or tactile feedback arrangements. Also passive feedback arrangements but only if they are dynamically reconfigurable under computer control, e.g. buttons raised from a touchpad surface using electronic muscle or similar.

Relationships with other classification places

- Manipulators; chambers provided with manipulation devices: B25J
- Conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit: B60W
- Systems acting by means of fluids; fluid-pressure actuators, e.g. servo-motors: F15B
- Control or regulating systems in general: G05B
- Mechanical control devices: G05G
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive (and non reconfigurable) feedback arrangements on a touchscreen, e.g. overlays with reliefs for indicating keys of a virtual keyboard</td>
<td>G06F 3/04886</td>
</tr>
<tr>
<td>Hand grip control means for manipulators</td>
<td>B25J 13/02</td>
</tr>
<tr>
<td>Tactile feedback for vehicle driver</td>
<td>B60W 50/16</td>
</tr>
<tr>
<td>Servo-motor systems giving the operating person a &quot;feeling&quot; of the response of the actuated device:</td>
<td>F15B 13/14</td>
</tr>
<tr>
<td>Means for enhancing the operator's awareness of arrival of the controlling member (knob, handle) at a command or datum position; Providing feel, e.g. means for creating a counterforce</td>
<td>G05G 5/03</td>
</tr>
<tr>
<td>Tactile presentation of information , e.g. Braille display</td>
<td>G09B 21/001</td>
</tr>
<tr>
<td>Keyboards characterised by tactile feedback features</td>
<td>H01H 13/85</td>
</tr>
<tr>
<td>Piezoelectric actuators</td>
<td>H01L 41/09</td>
</tr>
</tbody>
</table>

G06F 3/017

{Gesture based interaction, e.g. based on a set of recognized hand gestures (interaction based on gestures traced on a digitiser G06F 3/04883)}

Definition statement

This place covers:

Gesture interaction as a sequence and/ or a combination of user movements captured using various sensing techniques such as (among others) cameras monitoring the user, arrangements for interaction with the human body, input by means of a device moved freely in 3D space or opto-electronic detection arrangements.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestures made on the surface of a digitiser and/or in close proximity to this surface for digitisers capable of touchless position sensing and/or measuring also the distance in the Z direction</td>
<td>G06F 3/04883</td>
</tr>
<tr>
<td>Acquiring or recognising (static) human faces, facial parts, facial sketches, facial expressions</td>
<td>G06K 9/00221</td>
</tr>
<tr>
<td>Recognising movements or behaviour, e.g. recognition of gestures, dynamic facial expressions; Lip-reading</td>
<td>G06K 9/00335</td>
</tr>
<tr>
<td>Lip-reading assisted speech recognition</td>
<td>G10L 15/24</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Arrangements for interaction with the human body:                           | G06F 3/011 |
Detection arrangements using opto-electronic means  G06F 3/0304
Input by means of (pointing) device or object moved freely in 3D space  G06F 3/0346

**Special rules of classification**
The sensing technique as such should be also classified in the relevant class if necessary (non trivial technique).

**G06F 3/018**
{Input/output arrangements for oriental characters}

**Relationships with other classification places**
Handling natural language data: G06F 17/20

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Inputting characters</th>
<th>G06F 3/0233</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Latin character encoding in text processing, e.g. kana-to-kanji conversion</td>
<td>G06F 17/2223</td>
</tr>
<tr>
<td>Processing of non-latin text</td>
<td>G06F 17/2863</td>
</tr>
</tbody>
</table>

**G06F 3/02**
Input arrangements using manually operated switches, e.g. using keyboards or dials (keyboard switches per se H01H 13/70; electronic switches characterised by the way in which the control signals are generated H03K 17/94)

**Definition statement**

This place covers:

Input arrangements using manually operated switches, e.g. using keyboards or dials, insofar as they are stand-alone devices or integrated in a fixed computer system. Includes wired or wireless keyboards which are not mechanically linked to a portable computer.

**Relationships with other classification places**

- Electric switches; relays; selectors; emergency protective device: H01H
- Pulse technique: H03K

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Details related to integrated keyboard of portable computers</th>
<th>G06F 1/1662</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard switches per se</td>
<td>H01H 13/70</td>
</tr>
<tr>
<td>Electronic switches characterised by the way in which the control signals are generated</td>
<td>H03K 17/94</td>
</tr>
</tbody>
</table>
### G06F 3/0202

{Constructional details or processes of manufacture of the input device}

### References

#### Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special layout of keys</td>
<td>G06F 3/0219</td>
</tr>
<tr>
<td>Palm(wrist)-rests not integrated in the keyboard</td>
<td>A47B 21/0371</td>
</tr>
<tr>
<td>Wrist worn wrist rests</td>
<td>A61F 5/0118</td>
</tr>
<tr>
<td>Document holders for typewriters</td>
<td>B41J 29/15</td>
</tr>
<tr>
<td>Input/Output devices for watches</td>
<td>G04G 21/00</td>
</tr>
<tr>
<td>Details of keys/push buttons</td>
<td>H01H 3/12</td>
</tr>
<tr>
<td>Switches having rectilinearly-movable operating part or parts</td>
<td>H01H 13/00</td>
</tr>
<tr>
<td>Constructional details of keyboards having such switches</td>
<td>H01H 13/70</td>
</tr>
<tr>
<td>Electronic switching or gating i.e. not by contact-making or -braking</td>
<td>H03K 17/00</td>
</tr>
<tr>
<td>Proximity switches</td>
<td>H03K 17/945</td>
</tr>
<tr>
<td>Touch switches with electronic switching</td>
<td>H03K 17/96</td>
</tr>
<tr>
<td>Capacitive touch switches</td>
<td>H03K 17/962</td>
</tr>
<tr>
<td>Force resistance transducer</td>
<td>H03K 17/9625</td>
</tr>
<tr>
<td>Optical touch switches</td>
<td>H03K 17/9627</td>
</tr>
<tr>
<td>Piezo-electric touch switches</td>
<td>H03K 17/964</td>
</tr>
<tr>
<td>Resistive touch switches</td>
<td>H03K 17/9645</td>
</tr>
<tr>
<td>Keyboard, i.e. having a plurality of control members, with electronic switching</td>
<td>H03K 17/967</td>
</tr>
<tr>
<td>With optoelectronic devices</td>
<td>H03K 17/969</td>
</tr>
<tr>
<td>With magnetic movable elements</td>
<td>H03K 17/972</td>
</tr>
<tr>
<td>With capacitive movable elements</td>
<td>H03K 17/98</td>
</tr>
</tbody>
</table>

### Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSI</td>
<td>Repetitive Stress Injuries</td>
</tr>
</tbody>
</table>
### G06F 3/0205

**{Lever arrangements for operating keyboard cursor control keys in a joystick-like manner}**

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Integration of a mini joystick in a portable computer</th>
<th>G06F 1/169</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of a mini joystick in a keyboard</td>
<td>G06F 3/0213</td>
</tr>
<tr>
<td>Details of the interface with a computer</td>
<td>G06F 3/038</td>
</tr>
<tr>
<td>Joysticks with a pivotable rigid stick</td>
<td>G05G 9/047</td>
</tr>
</tbody>
</table>

### G06F 3/0208

**{Arrangements for adjusting the tilt angle of a keyboard, e.g. pivoting legs (for keyboards integrated in a laptop computer G06F 1/1667)}**

**References**

**Limiting references**

*This place does not cover:*

| Adjusting the tilt angle of the integrated keyboard in a mobile computer | G06F 1/1667 |

### G06F 3/021

**{Arrangements integrating additional peripherals in a keyboard, e.g. card or barcode reader, optical scanner}**

**References**

**Limiting references**

*This place does not cover:*

| Constructional details of barcode readers              | G06K 7/00  |

### G06F 3/0213

**{Arrangements providing an integrated pointing device in a keyboard, e.g. trackball, mini-joystick (for pointing devices integrated in a laptop computer G06F 1/169; joysticks G05G 9/047; constructional details of pointing devices G06F 3/033)}**

**References**

**Limiting references**

*This place does not cover:*

| Integration of a mini joystick in a portable computer | G06F 1/169 |

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G06F 3/0216

{Arrangements for ergonomically adjusting the disposition of keys of a keyboard (for keyboards integrated in a laptop computer G06F 1/1664)}

References

Limiting references

This place does not cover:

- For keyboards integrated in a laptop computer
- Keyboards characterised by ergonomic functions, e.g. for miniature keyboards

G06F 3/0219

{Special purpose keyboards}

Definition statement

This place covers:

Any keyboard designed or modified to control a specific software application or specific hardware, e.g. by integrating dedicated keys. Key layouts in alternative to the QWERTY standard are also classified in this group.

References

Limiting references

This place does not cover:

- Devices for teaching typing

G06F 3/0221

{Arrangements for reducing keyboard size for transport or storage, e.g. foldable keyboards, keyboards with collapsible keys (G06F 3/0216 takes precedence; for keyboards integrated in a laptop computer G06F 1/1666)}

References

Limiting references

This place does not cover:

- Arrangements for reducing the size of the integrated keyboard in a portable computer
- Arrangements for ergonomically adjusting the disposition of keys of a keyboard
- Keyboards characterised by the casing, e.g. sealed casings or casings reducible in size
G06F 3/0224

{Key guide holders}

References

Limiting references

This place does not cover:

| Document holders for typewriters | B41J 29/15 |

G06F 3/0227

{Cooperation and interconnection of the input arrangement with other functional units of a computer (G06F 3/023 - G06F 3/037 take precedence)}

Definition statement

This place covers:

Input arrangements using manually operated switches, e.g. using keyboards or dials, further comprising cooperation and interconnection of the input arrangement with other functional units of a computer.

References

Limiting references

This place does not cover:

| Keyboards integrating additional peripherals | G06F 3/021 |
| Arrangements for converting discrete items of information into a coded form. Arrangements for converting the position or the displacement of a member into a coded form | G06F 3/023 - G06F 3/037 |
| Arrangements for converting the position or the displacement of a member into a coded form | G06F 3/03 |

G06F 3/023

Arrangements for converting discrete items of information into a coded form, e.g. arrangements for interpreting keyboard generated codes as alphanumeric codes, operand codes or instruction codes {(coding in connection with keyboards or like devices in general H03M 11/00)}

Definition statement

This place covers:

Keyboard interfaces and drivers; peripherals emulating a keyboard (e.g. producing "keystroke input" signals); devices providing additional buttons or foot operated switches and connected between keyboard and PC.

Also comprises KVM switches.
References

Limiting references

This place does not cover:

| Virtual keyboards displayed on a touchscreen | G06F 3/04886 |
| Coding in connection with keyboards, i.e. coding of the position of operated keys | H03M 11/00 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| KVM | a KVM switch allows a user to control one or multiple computer(s) from one or multiple KVM device(s) |

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| KVM | Keyboard, Video, Mouse |

G06F 3/0231

{Cordless keyboards}

Definition statement

This place covers:
Costructional details related to the wireless link, e.g. position of the IR transmitter/receiver as well as protocol details for the wireless trasmission of keyboard codes.

References

Limiting references

This place does not cover:

| Means for saving power, monitoring of peripheral devices | G06F 1/325 |
| Information transfer between I/O devices and CPU, e.g. on bus | G06F 13/38 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Cordless keyboards | wireless keyboards; they are also often called according to the technology used: Infrared keyboard, radio keyboard, wlan keyboard, bluetooth keyboard |

G06F 3/0232

{Manual direct entries, e.g. key to main memory}

Special rules of classification

Old technology, not used anymore.
G06F 3/0233
{Character input methods}

Definition statement

This place covers:
Character input using a reduced number of keys, e.g. with respect to the alphabet, i.e. multivalued keys. Covers character input methods wherein a character is entered by tracing it on a matrix of switches (keys). Covers character input methods where a character is entered as a sequence of strokes on different keys or on a same key.

References

Limiting references

This place does not cover:

Interaction with virtual keyboards displayed on a touchscreen

G06F 3/0234
{using switches operable in different directions}

Definition statement

This place covers:
Keyboards or keypads having keys that can be operated not only vertically but also laterally to actuated separate switches associated to different key codes.

References

Limiting references

This place does not cover:

Character input using (e.g. 2 or 4 or 8) directional cursor keys for selecting characters in cooperation with displayed information

G06F 3/0235
{using chord techniques (G06F 3/0234 takes precedence)}

Definition statement

This place covers:
Chord keyboards even if they are split in two or more parts, i.e. the predominant feature is the fact that chording is required to enter a character.

References

Limiting references

This place does not cover:

Character input using switches operable in different directions
Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Chord                      | only an almost simultaneous depression of several keys |

G06F 3/0236
{using selection techniques to select from displayed items}

References
Limiting references
This place does not cover:

| Selecting from displayed items by using keys for other purposes than character input | G06F 3/0489 |

G06F 3/0237
{using prediction or retrieval techniques}

Definition statement
This place covers:
Character input using retrieval techniques from a database or dictionary based on previously inputted characters, e.g. for predicting and proposing word completion alternatives.

Covers inter alia T9, iTap and similar techniques.

References
Limiting references
This place does not cover:

| Guess-ahead for partial word input (code gives word) in systems handling natural language data by automatic analysis or parsing (e.g. for stenotying): | G06F 17/276 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| T9 (stands for Text on 9 keys) | a predictive text input technology for mobile phones, developed by Tegic Communications |
| iTap                          | a predictive text technology for mobile phones, developed by Motorola |
G06F 3/0238

{Programmable keyboards (key guide holders G06F 3/0224)}

Definition statement

This place covers:
Any keyboard in which the function assigned to all or some of the keys can be reprogrammed, e.g. changing alphabetical keys according to language, programming dedicated function keys.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key guide holders</td>
<td>G06F 3/0224</td>
</tr>
<tr>
<td>Virtual keyboards on a touchscreen</td>
<td>G06F 3/0486</td>
</tr>
<tr>
<td>Scrambling keyboard with display keys in electronically operated locks:</td>
<td>G07C 9/00698</td>
</tr>
<tr>
<td>Scrambling keyboard in electronically banking systems (POS, ATM):</td>
<td>G07F</td>
</tr>
<tr>
<td>Switches with programmable display:</td>
<td>H01H 9/181</td>
</tr>
<tr>
<td>Telephone set with programmable function keys:</td>
<td>H04M 1/2472</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display on the key tops of musical instruments:</td>
<td>G10H</td>
</tr>
<tr>
<td>Display on the key tops in general</td>
<td>H01H 2219/00</td>
</tr>
</tbody>
</table>

G06F 3/027

for insertion of decimal point {(display of decimal point G06F 3/1407; complete desk-top or hand-held calculators G06F 15/02)}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display of decimal point</td>
<td>G06F 3/1407</td>
</tr>
<tr>
<td>Complete desk-top or hand-held calculators</td>
<td>G06F 15/02</td>
</tr>
</tbody>
</table>

Special rules of classification

Old technology, not used anymore.
**G06F 3/03**

Arrangements for converting the position or the displacement of a member into a coded form

**Definition statement**

**This place covers:**

This group is used only for "exotic" input devices corresponding to the wording of the definition and not fitting in any of the subgroups, for example arrangements detecting the position or the displacement of tangible user interfaces comprising RFID tags or bar codes interacting with a surface (such as chessboard-like surface) where the position detection technique is not covered by any of the subgroups of **G06F 3/03**.

Example:

![WO 2005/078562](image)

**References**

**Limiting references**

**This place does not cover:**

<table>
<thead>
<tr>
<th>Interaction with a tangible user interface other than detecting its location or displacement</th>
<th>G06F 3/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic game devices per se</td>
<td>A63K</td>
</tr>
<tr>
<td>Coordinate identification of nuclear particle tracks</td>
<td>G01T 5/02</td>
</tr>
<tr>
<td>Telemetry of coordinates</td>
<td>G08C 21/00</td>
</tr>
</tbody>
</table>

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| A Tangible User Interface (TUI) | a user interface in which a person interacts with digital information through a physical environment, i.e. by manipulating physical objects (e.g. in the same way as moving pieces of a game on a tablet), often using RFID or NFC |

**Synonyms and Keywords**

*In patent documents, the following abbreviations are often used:*

<table>
<thead>
<tr>
<th>TUI</th>
<th>Tangible User Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID</td>
<td>Radio-Frequency IDentification</td>
</tr>
</tbody>
</table>
G06F 3/0304

{Detection arrangements using opto-electronic means (constructional details of pointing devices not related to the detection arrangement using opto-electronic means G06F 3/033 and subgroups; optical digitisers G06F 3/042)}

Definition statement

This place covers:

When there is a doubt whether the subject matter belongs to G06F 3/0304 and below or to G06F 3/042 and below, the rule of thumb is: if the moving part is the sensor then it belongs to G06F 3/0304 and below, if the observed target (e.g. finger) is moving then it belongs to G06F 3/042 and below.

References

Limiting references

This place does not cover:

| Constructional details of pointing devices not related to the detection arrangement using opto-electronic means | G06F 3/033 |
| Systems where the position detection is based on the raster scan of a cathode-ray tube (CRT) with a light pen | G06F 3/037 |
| Digitisers using opto-electronic means | G06F 3/042 |
| Measuring arrangements characterised by the use of optical means | G01B 11/00 |
| Optical encoders | G01D 5/34 |
| Position fixing using optical waves | G01S 5/16, G01S 17/00 |
| Prospecting or detecting by optical means | G01V 8/00 |
| Static switches using electro-optical elements in general | H03K 17/78 |
| Optical switches | H03K 17/941 |
| Optical touch switches | H03K 17/9627 |

G06F 3/0317

{in co-operation with a patterned surface, e.g. absolute position or relative movement detection for an optical mouse or pen positioned with respect to a coded surface}

Definition statement

This place covers:

Tracking relative movement in co-operation with a regularly or irregularly patterned surface, e.g. arrangements for detecting relative movement of an optical mouse with respect to a generic surface optically detected as irregularly patterned (table, desk top, ordinary mouse pad) or with respect to a surface (e.g. mouse pad) encoded with an optically detectable regular pattern.

Arrangements for detecting absolute position of a member with respect to a regularly patterned surface, e.g. pen optically detecting position-indicative tags printed on a paper sheet.
G06F 3/033

Pointing devices displaced or positioned by the user, e.g. mice, trackballs, pens or joysticks; Accessories therefor {((constructional details of joysticks G05G 9/047; arrangement for interfacing a joystick to a computer G06F 3/038)}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Details of optical sensing in input devices</th>
<th>G06F 3/0304</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangement for interfacing a joystick to a computer</td>
<td>G06F 3/038</td>
</tr>
<tr>
<td>Constructional details of joysticks</td>
<td>G05G 9/047</td>
</tr>
</tbody>
</table>

Special rules of classification

For finger worn pointing devices covered by this group and its subgroups add the Indexing Code G06F 2203/0331.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| RSI | Repetitive Stress Injury |

G06F 3/0338

with detection of limited linear or angular displacement of an operating part of the device from a neutral position, e.g. isotonic or isometric joysticks

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Integration of a mini joystick in a portable computer</th>
<th>G06F 1/169</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of a mini joystick in a keyboard</td>
<td>G06F 3/0213</td>
</tr>
<tr>
<td>Sliders, in which the moving part moves in a plane</td>
<td>G06F 3/03548</td>
</tr>
<tr>
<td>Details of the interface with a computer</td>
<td>G06F 3/038</td>
</tr>
<tr>
<td>Joysticks with a pivotable rigid stick</td>
<td>G05G 9/047</td>
</tr>
<tr>
<td>Switches with generally flat operating part depressible at different locations</td>
<td>H01H 25/041</td>
</tr>
</tbody>
</table>
**G06F 3/0346**

with detection of the device orientation or free movement in a 3D space, e.g. 3D mice, 6-DOF [six degrees of freedom] pointers using gyroscopes, accelerometers or tilt-sensors

**Definition statement**

This place covers:

Devices sensing their own position or orientation in a three dimensional space, allowing thereby the user to input up to 6 coordinates (position + orientation) by moving the device. Covers inter alia 3D mice.

**Relationships with other classification places**

Remote control based on movements [G08C].

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>3D input gestures</th>
<th>G06F 3/017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input devices using opto-electronic sensing</td>
<td>G06F 3/0304</td>
</tr>
</tbody>
</table>

---

**G06F 3/03542**

{Light pens for emitting or receiving light}

**Definition statement**

This place covers:

Pens detecting the presence of light on one point (such as a CRT scanning beam).

Light emitting pens positioned in contact or proximity of the pointed position.

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Pens comprising an optical sensor for 1 or 2 dimensional position detection</th>
<th>G06F 3/0304</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light emitting pointers per se used for marking with a light spot the pointed position from a distance</td>
<td>G06F 3/0346</td>
</tr>
</tbody>
</table>
G06F 3/03543
{Mice or pucks (G06F 3/03541 takes precedence)}

References
Limiting references
This place does not cover:

Mouse/trackball convertible-type devices, in which the same ball is used to track the 2-dimensional relative movement

G06F 3/03545
{Pens or stylus}

Definition statement
This place covers:
Pens other than optically sensing pens or light pens (e.g. for use in combination with a digitiser). Constructional details of pens in general irrespectively of the interaction technology.

Relationships with other classification places

References
Limiting references
This place does not cover:

Details of optically sensing pens
Light pens

G06F 3/0317
G06F 3/0342

G06F 3/03547
{Touch pads, in which fingers can move on a surface}

Definition statement
This place covers:
Touch surface for sensing the relative motion of a finger over the surface.

References
Limiting references
This place does not cover:

Digitisers

G06F 3/041
Special rules of classification

Specific Indexing Codes G06F 2203/0338 and G06F 2203/0339 are associated to this group for some constructional details.

**G06F 3/03549**

(Trackballs (G06F 3/03541 takes precedence))

References

*Limiting references*

This place does not cover:

| Mouse/trackball convertible-type devices, in which the same ball is used to track the 2-dimensional relative movement | G06F 3/03541 |

**G06F 3/0362**

with detection of 1D translations or rotations of an operating part of the device, e.g. scroll wheels, sliders, knobs, rollers or belts

References

*Limiting references*

This place does not cover:

| User controls for vehicle, e.g. dashboard knobs | B60K 37/06 |
| Incremental encoders | G01D 5/244, G01D 5/347 |
| Sliding switches | H01H 15/00 |
| Rotary encoding wheels -“thumb-wheel switches” | H01H 19/001 |

**G06F 3/038**

Control and interface arrangements therefor, e.g. drivers or device-embedded control circuitry

References

*Limiting references*

This place does not cover:

| Control circuits or drivers for touchscreens or digitisers | G06F 3/0416 |
| Graphical user interfaces (GUI) in general | G06F 3/048 |
| Pointing device drivers modified to control cursor appearance or behaviour taking into account the presence of displayed objects | G06F 3/04812 |
**G06F 3/0386**

{for light pen}

**Definition statement**

*This place covers:*

Tracking a projected light spot generated by a light pen or a "laser pointer" indicating a position on a display surface, drivers for light pen systems.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Light emitting pointers per se used for marking with a light spot the pointed position from a distance</th>
<th>G06F 3/0346</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light emitting pens positioned in contact or proximity of the pointed position</td>
<td>G06F 3/03542</td>
</tr>
<tr>
<td>Light pen using the raster scan of a CRT</td>
<td>G06F 3/037</td>
</tr>
</tbody>
</table>

**G06F 3/039**

Accessories therefor, e.g. mouse pads

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Furniture aspects</th>
<th>A47B 21/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platforms for supporting wrists as table extension</td>
<td>A47B 21/0371</td>
</tr>
</tbody>
</table>
**G06F 3/0393**

{Accessories for touch pads or touch screens, e.g. mechanical guides added to touch screens for drawing straight lines, hard keys overlaying touch screens or touch pads}

**Definition statement**

*This place covers:*

For example:

![Image of accessories for touch pads or touch screens](image1)

---

**G06F 3/041**

Digitisers, e.g. for touch screens or touch pads, characterised by the transducing means

**Definition statement**

*This place covers:*

Position sensing of movable objects such as fingers or pens in contact with a surface or within a relative small distance to this surface (hovering).

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Touchscreens integrated in a portable computer | G06F 1/1643, G06F 1/1692 |
| Integration of touchpad in a portable computer (laptop, PDA) | G06F 1/169 |
| 3D input gestures | G06F 3/017 |
| Integration of touchpad in a keyboard | G06F 3/0213 |
| True 3D computer input devices with a freely movable member | G06F 3/0346 |
| Pens for interaction between user and computer | G06F 3/03545 |
| Constructional details of touchpads | G06F 3/03547 |
| Accessories for pointing devices | G06F 3/039 |
| Touch interaction within a graphical user interface [GUI] | G06F 3/0488 |
Special rules of classification

In this area, Indexing Codes G06F 2203/04101 - G06F 2203/04114 dealing with details which may be related to different sensing technologies are used in parallel to the classification scheme.

Subgroups G06F 3/0412 and G06F 3/0416 - G06F 3/04186 are not explicit to a specific sensing technology but describe details about the integration within a display or the driving/interface of the digitiser.

For documents belonging to these subgroups, if further relevant details related to the sensing technology are disclosed, the corresponding subgroup of G06F 3/041 that is best related to the sensing technology employed should be doubly allocated as invention information.

If the sensing technology is indicated only with minor details, the sensing technology (if any) should be indicated as additional information.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Surface | either as a physical surface or as a virtual one, such as a virtual interaction plane floating in the air |

G06F 3/0412

{Digitisers structurally integrated in a display}

Definition statement

This place covers:

Structural details and methods of driving a combination of displays with digitisers that share at least one constitutive part of both the touch sensing technology as well as the display technology (e.g. a common electrode for LCD control and a touch electrode (i.e. driving or sensing) for capacitive touch sensing, a common electrode being used as a guard/shield electrode in touch sensing, or a common electrode that is specifically floated during a touch driving/sensing period).
Examples:

Structural details and methods of driving a display and a digitizer in which the digitizer is either wholly or in part within the structural confines that make up the display panel of the display device (e.g., a sensor pixel that is adjacent to the display pixel) or the sensor is arranged to utilize at least one structural component of the display panel (e.g. such as the top substrate of the display pane).
Examples:

FIG. 1

FIG. 13
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Constructional details of LCDs</th>
<th>G02F 1/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving details of LED/OLED</td>
<td>G09G 3/30</td>
</tr>
<tr>
<td>Driving details of LCDs</td>
<td>G09G 3/36</td>
</tr>
<tr>
<td>Construction details of OLED displays</td>
<td>H01L 27/323</td>
</tr>
</tbody>
</table>
Special rules of classification

Documents disclosing both a specific display panel (LCD, OLED etc.) and touch sensing are doubly classified in the relevant areas (for example: G02F for LCD, H01L for OLEDs, and G09G for methods of driving displays), pertaining to the respective types of display panels as well as in G06F 3/0412.

Devices in which a component is shared between touch detection circuitry and display driving circuitry, for example, a shared electrode for touch detection and display driving wherein the details of both the touch detection and the display driving are disclosed should be classified in the relevant areas either G09G (depending upon the type of display device) as well as in G06F 3/0412.

Devices in which construction details of both LCD panel and touch components are disclosed, but touch detection is only nominally disclosed should be classified only in G02F 1/13338 and only classified in G06F 3/0412 as an Additional.

Construction details of OLED display components integrated with touch detection components wherein the disclosure primarily concerns the OLED and minimally recites touch circuitry is classified in H01L 27/323 and only classified in G06F 3/0412 as an Additional.

G06F 3/0414

{using force sensing means to determine a position}

Definition statement

This place covers:

Touch position determined by the analysis of the signals provided by pressure/force sensors.

Relationships with other classification places

Measuring force or stress in general: G01L 1/00.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure sensors for measuring the pressure or force exerted on the touch surface without providing the touch position</td>
<td>G06F 2203/04105</td>
</tr>
<tr>
<td>Tactile force sensors</td>
<td>G01L 5/226</td>
</tr>
<tr>
<td>Force resistance touch switches</td>
<td>H03K 17/9625</td>
</tr>
<tr>
<td>Piezoelectric touch switches</td>
<td>H03K 17/964</td>
</tr>
</tbody>
</table>
G06F 3/04142
{the force sensing means being located peripherally, e.g. disposed at the corners or at the side of a touch sensing plate}

Definition statement
This place covers:
Touch position determined by the analysis of the signals provided by a plurality (reduced number) of discrete pressure/force sensors disposed at several points of (e.g. under) the touch sensing surface, e.g. at the corners or the side of a touch sensing plate.

G06F 3/04144
{using an array of force sensing means (position sensing using the local deformation of sensor cells G06F 3/0447)}

Definition statement
This place covers:
Touch position determined by the analysis of the signals provided by either virtual pressure sensors generated by intersection nodes of a grid of sensing lines interacting with a pressure sensitive medium or an array of discrete pressure/force sensors delivering a variable (not a single Boolean 0/1) signal,
the array extending over the whole area of the touch sensing surface, e.g. a grid of sensors disposed under the touch sensing surface.

References

Limiting references

This place does not cover:

Position sensing using the local deformation of sensor cells

G06F 3/0447

G06F 3/04146

{using pressure sensitive conductive elements delivering a boolean signal and located between crossing sensing lines, e.g. located between X and Y sensing line layers}

Definition statement

This place covers:

Digitisers having a grid of crossing wires brought into virtual contact when pressure is exerted on the interaction surface, the virtual contact is established through a pressure sensitive layer disposed between the wire layers and made of a material that resistance diminishes under an applied pressure
used to provide a "binary" output. The touch position is determined only by the contacting wires (scanning line and column) and not by the analog value of the sensed signal.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Tactile force sensors</th>
<th>G01L 5/226</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force resistance touch switches</td>
<td>H03K 17/9625</td>
</tr>
<tr>
<td>Piezoelectric touch switches</td>
<td>H03K 17/964</td>
</tr>
</tbody>
</table>

G06F 3/0416

{Control or interface arrangements specially adapted for digitisers}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Touch interaction with a GUI | G06F 3/0488 |

Special rules of classification

Documents disclosing any additional means of providing or processing touch signals outside of the traditional ways how individual methods of touch sensing technology work should be classified in their respective touch sensing technology subgroups as well as in G06F 3/0416.
G06F 3/04162

{for exchanging data with external devices, e.g. smart pens, via the digitiser sensing hardware}

Definition statement

This place covers:

Digitiser control allowing exchange of data with external devices via the digitiser sensing hardware (touch sensing electrodes, touch sensing coils, etc...), including exchange of information with smart pens as long as it concerns data transmission via the touch detection hardware.

Not for transmission of data between devices using only transmission paths other than the touch sensing hardware (e.g. wired or wireless network).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>CPC/TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote control transmission over wireless link</td>
<td>G08C 17/00</td>
</tr>
<tr>
<td>Near-field transmission systems</td>
<td>H04B 5/00</td>
</tr>
<tr>
<td>Data switching networks</td>
<td>H04L 12/00</td>
</tr>
<tr>
<td>Mobile phones interface using two way short range wireless interface</td>
<td>H04M 1/7253</td>
</tr>
</tbody>
</table>
**G06F 3/04164**

{Connections between sensors and controllers, e.g. routing lines between electrodes and connection pads}

**Definition statement**

This place covers:

Routing between sensing electrodes and controller or connector, details on wiring and connectors.
G06F 3/04166

{Details of scanning methods, e.g. sampling time, grouping of sub areas or
time sharing with display driving (Synchronisation with the driving of the
display or the backlighting unit to avoid interferences generated internally
G06F 3/04184)}

Definition statement

This place covers:
For example grouping electrodes for changing the detection speed, resolution or sensitivity (including
proximity distance), detection of multiple touches, detection of both pen and finger or, combination of
multiple touch technologies.

References

Limiting references

This place does not cover:

Synchronisation with the driving of the display or the backlighting unit to
avoid interferences generated internally

G06F 3/04184
**G06F 3/04184**

{Synchronisation with the driving of the display or the backlighting unit to avoid interferences generated internally}

**Definition statement**

*This place covers:*

Synchronisation of the touch detection signals with the display (or backlight) driving signals whenever the digitiser is integrated in the display or not.

**G06F 3/04186**

{Touch location disambiguation}

**Definition statement**

*This place covers:*

Correcting or resolving an ambiguous detected touch, resulting from either

- an ambiguous touch location measured by the digitiser (e.g. correcting a detected large single touch into more than one smaller and adjacent touches, a partial touch at an edge of a digitiser into a full touch, a detected touch with an unwanted detected event like hover/palm rejection, cracks, water droplets, impurities, ghost touches, or gravity center due to tilt/angle of the input device) or
- an ambiguous interaction with a GUI on a touch screen, wherein the touch location as measured by the digitiser is unambiguous (e.g. correcting a detected touch to a user intended touch position)

**Special rules of classification**

Documents disclosing disambiguation of an interaction with a GUI on a touch screen, wherein the touch location as measured by the digitiser is unambiguous, should be doubly classified in **G06F 3/0488** and below.

**G06F 3/042**

by opto-electronic means

**Relationships with other classification places**

Optical scanners: [G06K 7/10544](#).
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Pens detecting optically their absolute position with respect to a coded surface | G06F 3/0317 |
| Systems where the position detection is based on the screen scanning with a light pen | G06F 3/0386, G06F 3/037 |
| Measuring arrangements characterised by the use of optical means | G01B 11/00 |
| Optical encoders | G01D 5/34 |
| Position fixing using optical waves | G01S 5/16, G01S 17/00 |
| Prospecting or detecting by optical means | G01V 8/00 |
| Static switches using electro-optical elements in general | H03K 17/78 |
| Optical switches | H03K 17/941 |
| Optical touch switches | H03K 17/9627 |

Special rules of classification

When there is a doubt whether the subject matter belongs to G06F 3/0304 and below or to G06F 3/042 and below, the rule of thumb is: if the moving part is the sensor then it belongs to G06F 3/0304 and below, if the observed target (e.g. finger) is moving then it belongs to G06F 3/042 and below. In any case, the subclasses G06F 3/042 and below are used only in the context of interaction with a surface as defined in G06F 3/041 or in close proximity of this surface; they are not used in the context of a true 3D interactive environment.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| FTIR | Frustrated Total Internal Reflection |

G06F 3/0421

{by interrupting or reflecting a light beam, e.g. optical touch-screen}

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Beam | a narrow beam emitted in a given direction, not as a bright band of light or as an omnidirectional lightening; in the context of beams propagating from one side towards receivers on the opposite side in a grid like arrangement, the beam may have a triangular (or conical) shape with a slightly broader opening angle in order to be sensed by several receivers on the opposite side but not covering the whole array of receivers. |
G06F 3/0423
{using sweeping light beams, e.g. using rotating or vibrating mirror}

References
Limiting references
This place does not cover:

Details of moving scanning beam in optical scanners

G06K 7/10603

G06F 3/043
using propagating acoustic waves

Definition statement
This place covers:
Also documents where the acoustic wave is produced by knocking or rubbing the movable member (finger or pen) on the touch surface without any other vibration generator.

References
Limiting references
This place does not cover:

Infra/ultrasonic mechanical vibration generators

B06B 1/00

Manufacture of resonators or networks using SAW

H03H 3/08

Synonyms and Keywords
In patent documents, the following abbreviations are often used:

| SAW                         | Surface Acoustic Waves |

G06F 3/0433
{in which the acoustic waves are either generated by a movable member and propagated within a surface layer or propagated within a surface layer and captured by a movable member}

Definition statement
This place covers:
Position detection using pens able either to emit acoustic waves using a dedicated wave generator (e.g. piezo-electric or mechanical vibrators, ultrasound generators or sparks) or to sense the propagating waves arriving through the surface.

References
Limiting references
This place does not cover:

Documents where the movable member (finger or pen) generates the waves but has no acoustic source

G06F 3/043
G06F 3/0436
{in which generating transducers and detecting transducers are attached to a single acoustic waves transmission substrate}

Definition statement
This place covers:
Passive movable member (finger or pen) disturbing the propagating waves within the substrate.

G06F 3/044
by capacitive means

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Means for converting the output of a sensing member to another variable by varying capacitance</th>
<th>G01D 5/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitive proximity switches</td>
<td>H03K 17/955</td>
</tr>
<tr>
<td>Capacitive touch switches</td>
<td>H03K 17/962</td>
</tr>
</tbody>
</table>

G06F 3/0441
{using active external devices, e.g. active pens, for receiving changes in electrical potential transmitted by the digitiser, e.g. tablet driving signals}

Definition statement
This place covers:
Digitisers using the capacitive coupling between the edge of a pointing pen or a similar sensing device and touch sensing conductors (electrodes) of the position sensing surface wherein the pen detects
changes in electric potential of the conductors generated by the tablet (e.g. tablet driving signals); corresponding to JP FI: G06F3/044&A.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Transmission of data between devices using the touch sensing hardware as transmission path | G06F 3/04162 |
**G06F 3/0442**

{using active external devices, e.g. active pens, for transmitting changes in electrical potential to be received by the digitiser}

**Definition statement**

*This place covers:*

Digitisers using the capacitive coupling between the edge of a pointing pen or a similar input device and touch sensing conductors (electrodes) of the position sensing surface wherein active pens generate changes in electric potential of tablets, corresponding to JP FI: G06F3/044&B.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

| Transmission of data between devices using the touch sensing hardware as transmission path | G06F 3/04162 |
**G06F 3/0443**

{using a single layer of sensing electrodes}

**Definition statement**

*This place covers:*

Digitisers using a single layer of sensing electrodes, i.e. sense and/or drive electrodes. The electrodes may be interconnected by bridges at crossings. The connecting bridge may be in another layer but all the sensing electrodes are in the same one.

**G06F 3/0444**

{using a single conductive element covering the whole sensing surface, e.g. by sensing the electrical current flowing at the corners}

**Definition statement**

*This place covers:*

Digitisers using a single layer of sensing electrode which is made of a single piece of conducting material extending on the detection area and covered by a dielectric material.
**G06F 3/0445**

{using two or more layers of sensing electrodes, e.g. using two layers of electrodes separated by a dielectric layer}

**Definition statement**

This place covers:

Digitisers using at least two layers of sensing electrodes, i.e. sense and/or drive electrodes, separated either by a solid dielectric layer or by a gap which could be filled by a dielectric material.

---

**G06F 3/0446**

{using a grid-like structure of electrodes in at least two directions, e.g. using row and column electrodes}

**Definition statement**

This place covers:

Digitisers comprising a plurality of sets of parallel sensing and/or driving electrodes extending in at least two crossing directions; each “row” or “column” electrode may be either a single piece electrode or a plurality of interconnected electrodes (e.g. via bridges over the electrodes in the crossing direction) making a virtual electrode extending along the given direction.
**G06F 3/0447**

*{Position sensing using the local deformation of sensor cells}*

**Definition statement**

*This place covers:*

Digitisers comprising an array of cells, e.g. made by the crossing of "row" and "column" electrodes, which are deformed under the pressure of a touching object, inducing a change in their capacitance.

**G06F 3/0448**

*{Details of the electrode shape, e.g. for enhancing the detection of touches, for generating specific electric field shapes, for enhancing display quality}*

**Definition statement**

*This place covers:*

The electrodes have shapes optimised to obtain a specific effect, e.g. increasing fringe field, better resolution or avoiding moiré effect.
If the electrode design or pattern exhibits an irregular or non-conventional shape without mentioning any specific effect then this symbol should be allocated as additional information.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Touch switches | H03K 2017/9602 |

G06F 3/045

using resistive elements, e.g. single continuous surface or two parallel surfaces put in contact

References

Limiting references

This place does not cover:

| Resistive potentiometers | G01D 5/165 |
| Resistive touch switches | H03K 17/9645 |

G06F 3/046

by electromagnetic means

References

Limiting references

This place does not cover:

| Means for converting the output of a sensing member to another variable by varying inductance | G01D 5/20 |
| Electromagnetic proximity switch | H03K 17/95 |
G06F 3/047

using sets of wires, e.g. crossed wires

Definition statement
This place covers:
Digitisers having a grid of crossing wires brought into contact when pressure is exerted on the interaction surface. The contact may be a direct contact or through a pressure sensitive switch making a connection between the wires. It includes arrays of switches integrated in a display where a galvanic contact is established between rows and columns when the user presses the display surface.

Special rules of classification
When wires or switches are integrated in a display, G06F 3/0412 should also be used.

G06F 3/048

Interaction techniques based on graphical user interfaces [GUI]

Definition statement
This place covers:
Interaction techniques for GUIs per se, or their application to a computer (system) in general.

Relationships with other classification places
Control or regulating in general: G05B.
Display control circuits: G09G.
Pictorial communication, e.g. television: H04N.

Application of (standard features of) GUIs to a particular technical field, see the corresponding field.

References

Limiting references
This place does not cover:

| Hardware interface between computer and display | G06F 3/14 |
| User interface programs, e.g. command shells, help systems, UIMS | G06F 9/451 |
| Input/output arrangements of navigation systems | G01C 21/36 |
| Program-control in industrial systems | G05B 19/00 |
| Drawing of charts or graphs | G06T 11/206 |
| Editing figures and text | G06T 11/60 |
| Control arrangements or circuits for visual displays | G09G 5/00 |
| E.g. for display of multiple viewports | G09G 5/14 |
| Interaction with a remote controller on a TV display | H04N 5/44582, H04N 5/4403 |
| End user interface for interactive television or video on demand | H04N 21/47 |
Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| GUI               | Graphical User Interface |

G06F 3/0481

based on specific properties of the displayed interaction object or a metaphor-based environment, e.g. interaction with desktop elements like windows or icons, or assisted by a cursor's changing behaviour or appearance

Special rules of classification

In the G06F 3/048 group and its subgroups, multi-aspect classification is applied. If an interaction technique is characterized by the fact that it is designed around a metaphor or interaction object, then it should be classified in G06F 3/0481 or in the related subgroups.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Cursor (also called (mouse) pointer) | an indicator used to show the position on a computer display that will respond to input from a text input or pointing device |

G06F 3/04812

{interaction techniques based on cursor appearance or behaviour being affected by the presence of displayed objects, e.g. visual feedback during interaction with elements of a graphical user interface through change in cursor appearance, constraint movement or attraction/repulsion with respect to a displayed object (interaction techniques based on cursor behaviour involving tactile or force feedback G06F 3/016)}

References

Limiting references

This place does not cover:

| Interaction techniques based on cursor behaviour involving tactile or force feedback G06F 3/016 |
| Interaction techniques for the selection of a displayed object G06F 3/04842 |
G06F 3/04815

{Interaction with three-dimensional environments, e.g. control of viewpoint to navigate in the environment}

References

Limiting references

This place does not cover:

| Navigational instruments, e.g. visual route guidance using 3D or perspective road maps (including 3D objects and buildings) | G01C 21/3635, G01C 21/3638 |
| Navigation within 3D models or images (Walk- or flight-through a virtual museum, a virtual building, a virtual landscape etc.) | G06T 19/003 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Video games | A63F 13/00 |
| 3D image rendering in general | G06T 15/00 |
| Perspective computation in 3D image rendering | G06T 15/20 |

G06F 3/04817

{using icons (graphical programming languages using iconic symbols G06F 8/34)}

Definition statement

This place covers:
Documents describing icons having a specific (or unconventional) design or specific properties.

References

Limiting references

This place does not cover:

| Graphical programming languages using iconic symbols | G06F 8/34 |

G06F 3/0482

interaction with lists of selectable items, e.g. menus

References

Limiting references

This place does not cover:

| Operating a cordless telephone by selecting telephonic functions from a plurality of displayed items, e.g. menus, icons | H04M 1/72583 |
| Menu-type displays in TV receivers | H04N 5/44543 |
G06F 3/0483

interaction with page-structured environments, e.g. book metaphor

Definition statement

This place covers:

Also documents which relate to tabs.

Interaction techniques of e-books when they are heavily book-inspired.

References

Limiting references

This place does not cover:

| Electronic books, also known as e-books | G06F 15/02, G06F 15/0283 |

G06F 3/0484

for the control of specific functions or operations, e.g. selecting or manipulating an object or an image, setting a parameter value or selecting a range

Special rules of classification

In the G06F 3/048 group and its subgroups, multi-aspect classification is applied. If an interaction technique is characterized by the fact that it is designed to control a specific function or operation, then it should be classified in G06F 3/0484 or in the related subgroups

G06F 3/04842

{Selection of a displayed object (G06F 3/0482 takes precedence)}

Definition statement

This place covers:

GUI interaction techniques specifically designed for selecting a displayed object, e.g. window, icon

Special rules of classification

This class is actually for selection by a pointing device (in the sense of G06F 3/03 and subgroups) such as mouse, a joystick, a digitiser, etc...

There are some older documents relating to selection by keyboard classified here. However, all new documents related to the latter are now classified in G06F 3/0489.

Every time a set of displayed objects can be considered as structured as a “list of selectable items”, the interaction technique for selecting an item should be classified in G06F 3/0482.
G06F 3/04845
{for image manipulation, e.g. dragging, rotation}

Definition statement
This place covers:
Covers image manipulation, e.g. dragging or rotation of the whole image, resizing of objects, changing their colour etc.

References
Limiting references
This place does not cover:

| Image data processing or generation, in general | G06T          |
| Editing figures and text; combining figures or text | G06T 11/60 |

G06F 3/0485
Scrolling or panning

Definition statement
This place covers:
Also documents dealing with panning control.

References
Limiting references
This place does not cover:

| Interaction with scrollbars | G06F 3/04855 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Scrolling | "dragging" in some applications, i.e. depicting a user gesture which is not causing a motion of a previously selected object, but rather a motion of a reference within a given context. Such scrolling interactions are covered by this group |

G06F 3/0486
Drag-and-drop

Definition statement
This place covers:
Drag and drop operations comprise moving by the user a previously selected object, and finally releasing said object.
References

Limiting references
This place does not cover:

| Interaction techniques to control scrolling | G06F 3/0485 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Dragging | "scrolling", i.e. depicting a user gesture which is not causing a motion of a previously selected object, but rather a motion of a reference within a given context. Such scrolling interactions are not covered by this group |

G06F 3/0487

using specific features provided by the input device, e.g. functions controlled by the rotation of a mouse with dual sensing arrangements, or of the nature of the input device, e.g. tap gestures based on pressure sensed by a digitiser

Special rules of classification

In the G06F 3/048 group and its subgroups, multi-aspect classification is applied. If an interaction technique is characterized by the fact that it is designed to take into account specific properties of the input device, then it should be classified in G06F 3/0487 or in the related subgroups

G06F 3/0488

using a touch-screen or digitiser, e.g. input of commands through traced gestures

Relationships with other classification places

Details of input/output arrangements of navigation systems including use of a touch screen and gestures: G01C 21/3664.

References

Limiting references
This place does not cover:

| Constructing details of digitisers | G06F 3/041 |

G06F 3/04883

{for entering handwritten data, e.g. gestures, text}

References

Limiting references
This place does not cover:

| 3D input gestures | G06F 3/017 |
### Signature recognition
- CPC - G06F  - 2019.05

### G06F 3/04886

{by partitioning the screen or tablet into independently controllable areas, e.g. virtual keyboards, menus (G06F 3/04883 takes precedence)}

#### Definition statement

This place covers:

Covers virtual keyboards displayed on a touchscreen or as a template on a tablet.

#### References

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangements for projecting a virtual keyboard in a portable computers</td>
<td>G06F 1/1673</td>
</tr>
<tr>
<td>Programmable (hardware) keyboards</td>
<td>G06F 3/0238</td>
</tr>
<tr>
<td>Entering handwritten data, e.g. gestures, text</td>
<td>G06F 3/04883</td>
</tr>
</tbody>
</table>

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character input methods like chording, prediction or disambiguation used on a keyboard</td>
<td>G06F 3/0233</td>
</tr>
<tr>
<td>Guess-ahead for partial word input (code gives word) in systems handling natural language data by automatic analysis or parsing (e.g. for stenotyping)</td>
<td>G06F 17/276</td>
</tr>
</tbody>
</table>

### G06F 3/0489

using dedicated keyboard keys or combinations thereof

#### Relationships with other classification places

Coin-freed or like apparatus: G07F.

Arrangements or circuits for control of visual displays: G09G.

#### References

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selecting from displayed items by using keys for character input</td>
<td>G06F 3/0236</td>
</tr>
<tr>
<td>Automatic teller machines (ATM)</td>
<td>G07F 19/20</td>
</tr>
<tr>
<td>Adjusting display parameters</td>
<td>G09G 5/00</td>
</tr>
</tbody>
</table>
G06F 3/05
Digital input using the sampling of an analogue quantity at regular intervals of time {, input from a/d converter or output to d/a converter}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Sample-and-hold arrangements</th>
<th>G11C 27/02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling per se</td>
<td>H03K 17/00</td>
</tr>
</tbody>
</table>

G06F 3/06
Digital input from or digital output to record carriers, {e.g. RAID, emulated record carriers, networked record carriers (recording or reproducing devices per se G11B; error detection, error correction, monitoring per se regarding storage systems G06F 11/00; accessing or addressing within memory systems or architectures G06F 12/00; information retrieval G06F 16/00)}

Definition statement
This place covers:
This head-group of the G06F 3/06 range mostly contains very old storage technologies like magnetic drums, punched tapes, storage on a wire etc.

Special rules of classification
Normally, no new documents should be added to this group. New documents should be classified in the branches under G06F 3/0601 (see the section Special rules of classification under G06F 3/0601 for further indication on classification practice).

G06F 3/0601
{Dedicated interfaces to storage systems}

Definition statement
This place covers:
Physical and/or logical interfaces between a host or a plurality of hosts and a storage device or a plurality of storage devices or storage system related to data/command path and data placement techniques.

Storage devices include devices with rotating magnetic and optical storage media as well as solid state devices, or non-volatile electronic storage elements.

Also covered are interfaces to an emulated rotating storage device in (flash) memory.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Error detection, error correction, monitoring per se | G06F 11/00 |

78
### Glossary of terms

**In this place, the following terms or expressions are used with the meaning indicated:**

Storage system: an integrated collection of (a.) storage controllers and/or host bus adapters, (b.) storage devices such as disks, CD-ROMs, tapes, media loaders and robots, and (c.) any required control software, that provides storage services to one or more computers.

**Synonyms and Keywords**

host: computer, PC, PDA, smartphone, (micro)processor, CPU, terminal, client
G06F 3/0602
{specifically adapted to achieve a particular effect}

Definition statement
This place covers:
This group is the hierarchical head group for the range G06F 3/0604 - G06F 3/0626 related to particular storage effects and is not used for classification.

G06F 3/0604
{Improving or facilitating administration, e.g. storage management}

Definition statement
This place covers:
All general aspects of storage administration which do not fit in the subgroups G06F 3/0605 and G06F 3/0607

G06F 3/0605
{by facilitating the interaction with a user or administrator}

Definition statement
This place covers:
Facilitating administration like automating recurrent tasks, selecting and presenting management information to the system user or administrator.

G06F 3/0607
{by facilitating the process of upgrading existing storage systems, e.g. for improving compatibility between host and storage device}

Definition statement
This place covers:
Facilitating administration in relation to modification of existing systems, improving compatibility and scalability.

G06F 3/0608
{Saving storage space on storage systems}

Definition statement
This place covers:
Effects leading to the reduction of the volume of data stored and the storage space requirements e.g. storage efficiency: the ratio of storage system's effective capacity to its raw capacity.

Relationships with other classification places
This group is often combined with the technique G06F 3/0641: data deduplication
G06F 3/061
{Improving I/O performance}

Definition statement
This place covers:
All aspects of improving the I/O performance of a storage system that do not fit in the subgroups G06F 3/0611 - G06F 3/0613.

G06F 3/0611
{in relation to response time}

Definition statement
This place covers:
Reducing I/O operation latency time: the time between the making of an I/O request and the completion of the request's execution.

G06F 3/0613
{in relation to throughput}

Definition statement
This place covers:
Increasing I/O operation throughput: the number of I/O requests satisfied in a given time e.g. expressed in I/O requests/second (IOPS)

G06F 3/0614
{Improving the reliability of storage systems}

Definition statement
This place covers:
All reliability aspects which do not fit in the subgroups G06F 3/0616 - G06F 3/0619. Only reliability effects with a technique specific for G06F 3/06 should be classified in this subgroup range.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Error detection or correction by redundancy in operation</th>
<th>G06F 11/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy in hardware using active fault-masking</td>
<td>G06F 11/20</td>
</tr>
</tbody>
</table>

G06F 3/0616
{in relation to life time, e.g. increasing Mean Time Between Failures [MTBF]}

Definition statement
This place covers:
Increasing the life expectancy measured in e.g. Mean Time Between Failures (MTBF)
**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>User address space allocation in block erasable memory</td>
<td>G06F 12/0246</td>
</tr>
<tr>
<td>Auxiliary circuits for EPROMs</td>
<td>G11C 16/06</td>
</tr>
</tbody>
</table>

**Special rules of classification**

The subject covered by this group is often described in relation to non-volatile semiconductor memory (arrays), which are, as peculiar storage infrastructure, also classified in G06F 3/0679 or G06F 3/0688.

**G06F 3/0617**

{in relation to availability}

**Definition statement**

This place covers:

Increasing availability: the amount of time the system is available during those time periods it is expected to be available, measured in e.g. hours of downtime in a year.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy in operation</td>
<td>G06F 11/14</td>
</tr>
<tr>
<td>Redundancy in hardware using active fault-masking</td>
<td>G06F 11/20</td>
</tr>
</tbody>
</table>

**G06F 3/0619**

{in relation to data integrity, e.g. data losses, bit errors}

**Definition statement**

This place covers:

Avoiding data to be altered or lost in operation or by accident.

**References**

*Limiting references*

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding special bits or symbols to the coded information in memories</td>
<td>G06F 11/1008</td>
</tr>
<tr>
<td>Backing up (Point in time copy), restoring or mirroring files or drives</td>
<td>G06F 11/1446</td>
</tr>
<tr>
<td>Redundancy in hardware by mirroring</td>
<td>G06F 11/2056</td>
</tr>
<tr>
<td>Error detection or correction in digital recording or reproducing</td>
<td>G11B 20/18</td>
</tr>
</tbody>
</table>
G06F 3/062
{Securing storage systems}

Definition statement
This place covers:
All security aspects which do not fit in the subgroups G06F 3/0622 - G06F 3/0625.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting data against unauthorised access or modification</td>
<td>G06F21/00N9</td>
</tr>
<tr>
<td>Protecting computer components used for data storage</td>
<td>G06F 21/78</td>
</tr>
<tr>
<td>Arrangements for network security</td>
<td>H04L 29/0651</td>
</tr>
</tbody>
</table>

G06F 3/0622
{in relation to access}

Definition statement
This place covers:
Securing storage systems by preventing unauthorised access to the storage system, e.g. with a password.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting data against unauthorised access or modification</td>
<td>G06F 21/60</td>
</tr>
<tr>
<td>Protecting computer components used for data storage</td>
<td>G06F 21/78</td>
</tr>
<tr>
<td>Arrangements for network security</td>
<td>H04L 29/0651</td>
</tr>
</tbody>
</table>

G06F 3/0623
{in relation to content}

Definition statement
This place covers:
Securing storage systems by protecting the data content, e.g. by scrambling the content.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting data against unauthorised access or modification</td>
<td>G06F 21/60</td>
</tr>
<tr>
<td>Protecting computer components used for data storage</td>
<td>G06F 21/78</td>
</tr>
</tbody>
</table>
G06F 3/0625

{Power saving in storage systems}

Definition statement

This place covers:
Reducing the power consumption of a storage system: power efficiency

Power saving in storage systems with a plurality of storage devices external to the computer should be classified here.

References

Limiting references

This place does not cover:

Power saving in a single storage device inside a computer

Informative references

Attention is drawn to the following places, which may be of interest for search:

Power management of disk drive devices: G06F1/32P6H
Driving, starting, stopping record carriers: G11B 19/00

Special rules of classification

This group is usually combined with the technique G06F 3/0634 (configuration or reconfiguration of storage systems by changing the state or mode of one or more devices) in order to characterise the technique for the "invention information".

This group is usually combined with the infrastructure G06F 3/0689 (disk arrays) or G06F 3/067 (distributed storage)

G06F 3/0626

{Reducing size or complexity of storage systems}

Definition statement

This place covers:
Reducing the physical size, simplifying the physical integration of storage systems

Relationships with other classification places

This group is often combined with G06F 3/0658 (controller construction) in order to characterise the technique for the "invention information", e.g. System On Chip (SOC) controller
**G06F 3/0628**

{making use of a particular technique}

**Definition statement**

*This place covers:*

This group is the hierarchical head group for the range [G06F 3/0629 - G06F 3/0667] related to particular storage techniques and is not used for classification.

**G06F 3/0629**

{Configuration or reconfiguration of storage systems}

**Definition statement**

*This place covers:*

All configuration or reconfiguration aspects which do not fit in the subgroups.

The general management of storage system features and behaviours through the control of changes made to hardware, software, firmware and related resources throughout the life cycle of the storage system.

**G06F 3/0631**

{by allocating resources to storage systems}

**Definition statement**

*This place covers:*

Allocating physical and/or logical storage resources, including storage elements, storage devices, appliances, virtual devices, disk volume and file resources.

Mapping aspects: conversion between two address spaces, such as the conversion between physical disk block addresses and logical disk block addresses of the virtual disks presented to operating environments by control software i.e. by using a mapping table which contains the correspondence between the two address spaces being mapped to each other.

Partitioning of storage system i.e. the creation of partitions.

**References**

**Limiting references**

*This place does not cover:*

- Management of already existing partitions
- Allocation of resources in multiprogramming arrangements

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

- Addressing or allocation
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Partitioning: presentation of the usable storage capacity of a disk or array to an operating environment in the form of several virtual disks whose aggregate capacity approximates that of the underlying physical or virtual disk.

Partitioning is common in MS-DOS, Windows, and UNIX environments.

Partitioning is useful with hosts that cannot support the full capacity of a large disk or array as one device. It can also be useful administratively, for example, to create hard subdivisions of a large virtual disk.

G06F 3/0632

{by initialisation or re-initialisation of storage systems}

Definition statement

This place covers:

1. The startup and initial configuration of a storage device, system, piece of software or network.

2. The process of installing or removing hardware or software components required for a system or subsystem to function.

3. Assignment of the operating parameters of a system, subsystem or device, such as designating a disk array's member disks or extents and parameters such as stripe depth, RAID model, cache allowance, etc.

4. The collection of a system's hardware and software components and operating parameters.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Program loading or initiating

G06F 9/445

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Discovery of storage devices Array configuration

1. Assignment of the disks and operating parameters for a disk array by setting parameters such as stripe depth, RAID model, cache allowance, spare disk assignments, etc.

2. The arrangement of disks and operating parameters that results from such an assignment.

G06F 3/0634

{by changing the state or mode of one or more devices}

Definition statement

This place covers:

Changing the operating state or mode or parameters of one or more storage devices e.g. changing the rotational speed (measured in RPM) or powering on/off or spinning up/down one or more storage devices.
Special rules of classification
This group is often assigned when there is a power saving effect mentioned see G06F 3/0625

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:
Massive Array of Idle Disks (MAID): a storage system comprising an array of disk drives that are powered down individually or in groups when not required. MAID storage systems reduce the power consumed by a storage array, at the cost of increased Mean Time To Data.

Synonyms and Keywords
MAID

G06F 3/0635
(by changing the path, e.g. traffic rerouting, path reconfiguration)

Definition statement
This place covers:
Changing the configuration of a storage system by changing the interconnections in between storage system components or changing the routes over which the data flows from the host to the storage device and vice versa e.g. storage switches, storage ports, routing aspects in storage systems.

Relationships with other classification places
This group is usually combined with G06F 3/0607: improving administration by facilitating the process of upgrading existing storage systems.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Arrangements and networking functions for distributed storage in a network | H04L 29/08549 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:
Access path: the combination of adapters, addresses and routes through a switching fabric used by a computer to communicate with a storage device.

G06F 3/0637
(Permissions)

Definition statement
This place covers:
Techniques related to the right of a user or host or group of users or group of hosts to access specific parts of a storage system, e.g. zoning, locking, shared access
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Protecting computer components used for data storage:</th>
<th>G06F21/00N1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access control in arrangements for network security e.g. Access Control Lists (ACL):</td>
<td>H04L 29/06823 (H04L29/63)</td>
</tr>
</tbody>
</table>

Special rules of classification

This group is usually combined with the effect G06F 3/0622: securing storage system in relation to access

G06F 3/0638

{Organizing or formatting or addressing of data}

Definition statement

This place covers:

All general aspects of data organizing or formatting or addressing that does not fit in the subgroups e.g. compression of data in general in a storage interface.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Conversion of data formats</th>
<th>G06F 3/0661</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image compression</td>
<td>G06T 9/00</td>
</tr>
<tr>
<td>Audio compression</td>
<td>G10L 19/00</td>
</tr>
<tr>
<td>Time compression or expansion in a recording device</td>
<td>G11B 20/00007</td>
</tr>
<tr>
<td>Compression per se</td>
<td>H03M 7/30</td>
</tr>
<tr>
<td>Data compression in computer networks</td>
<td>H04L 29/0604</td>
</tr>
<tr>
<td>Video compression</td>
<td>H04N 19/00</td>
</tr>
</tbody>
</table>

G06F 3/064

{Management of blocks}

Definition statement

This place covers:

Techniques related to the management of blocks in storage systems

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Block: the unit in which data is stored and retrieved on disk and tape devices; the atomic unit of data recognition (through a preamble and block header) and protection (through a CRC or ECC).
Block addressing: an algorithm for uniquely identifying blocks of data stored on disk or tape media by number, and then translating these numbers into physical locations on the media.

G06F 3/0641

{De-duplication techniques}

Definition statement

This place covers:
Techniques related to data deduplication: the replacement of multiple copies of data - at variable levels of granularity - with references to a shared copy in order to save storage space and/or bandwidth.

References

Limiting references

This place does not cover:

| Using de-duplication of the data stored as backup | G06F 11/1453 |
| File systems; File servers | G06F 16/10 |
| Compression per se | H03M 7/30 |

Special rules of classification

This group is usually combined with G06F 3/0608: saving storage space

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:
Data deduplication: the replacement of multiple copies of data—at variable levels of granularity—with references to a shared copy in order to save storage space and/or bandwidth.

G06F 3/0643

{Management of files}

Definition statement

This place covers:
Techniques related to the management of files in storage systems, e.g. low level file system aspects like File Allocation Tables (FAT)

References

Limiting references

This place does not cover:

| User address space allocation | G06F 12/0223 |
| File systems; file servers per se | G06F 16/10 |
| Processing unordered random access data using directory or table look-up | G06F17/30P1D |
| Table of contents on record carriers (VTOC) | G11B 27/327 |
G06F 3/0644
{Management of space entities, e.g. partitions, extents, pools}

Definition statement
This place covers:
Techniques related to the management of space entities in storage systems, e.g. management of partitions, extents, pools

References
Limiting references
This place does not cover:

| Creation of space entities (allocating resources to storage systems) | G06F 3/0631 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| User address space allocation | G06F 12/0223 |
| File systems; File servers | G06F 16/10 |
| Table of contents on record carriers (VTOC) | G11B 27/327 |
| Arrangements and networking functions for distributed storage of data in a network | H04L 67/1097 |

G06F 3/0646
{Horizontal data movement in storage systems, i.e. moving data in between storage devices or systems}

Definition statement
This place covers:
All general aspects of horizontal moving of data between storage devices or systems which do not fit in the sub-groups.

G06F 3/0647
{Migration mechanisms}

Definition statement
This place covers:
Movement of data or information between information systems, formats, or media. Migration is performed for reasons such as possible decay of storage media, obsolete hardware or software (including obsolete data formats), changing performance requirements (see tiered storage), the need for cost efficiencies etc.
References

Limiting references

This place does not cover:

- Automatically moving less frequently accessed objects to lower levels in the hierarchy (Lifecycle management) [G06F 3/0649]

Special rules of classification

HSM and Tiered storage aspect are usually combined with G06F3/06A6I4H (hierarchical storage) in order to characterise the infrastructure.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Tiered storage: storage that is physically partitioned into multiple distinct classes based on price, performance or other attributes. Data may be dynamically moved among classes in a tiered storage implementation based on access activity or other considerations.

Hierarchical Storage Management (HSM): The automated migration of data objects among storage devices, usually based on inactivity. Hierarchical storage management is based on the concept of a cost-performance storage hierarchy. By accepting lower access performance (higher access times), one can store objects less expensively.

G06F 3/0649

{Lifecycle management}

Definition statement

This place covers:

Data Lifecycle Management (DLM) the policies, processes, practices, services and tools used to align the business value of data with the most appropriate and cost-effective storage infrastructure from the time data is created through its final disposition. Data is aligned with business requirements through management policies and service levels associated with performance, availability, recoverability, cost, etc. DLM is a subset of Information Lifecycle Management (ILM).

By automatically moving less frequently accessed objects to lower levels in the hierarchy, higher cost storage is freed for more active objects, and a better overall cost to performance ratio is achieved.

References

Limiting references

This place does not cover:

- Details of archiving in file system administration [G06F 16/113]
- Details of hierarchical storage management (HSM) systems [G06F 16/185]

Informative references

Attention is drawn to the following places, which may be of interest for search:

- File systems; File servers [G06F 16/10]
Synonyms and Keywords
Retention policy, retention time

G06F 3/065
{Replication mechanisms}

Definition statement
This place covers:
Replication is the technique of sharing information so as to ensure consistency between redundant resources, such as software or hardware components, to improve reliability, fault-tolerance, or accessibility.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:
Redundancy in hardware by mirroring: G06F 11/2056 Backing up (Point in time copy), restoring or mirroring files or drives: G06F 11/1402

| Backing up (Point in time copy), restoring or mirroring files or drives | G06F 11/1402 |
| Redundancy in hardware by mirroring | G06F 11/2056 |

Special rules of classification
This group is usually combined with G06F 3/0614 (improving the reliability of storage systems) and subrange in order to characterise the effect achieved by the replication mechanism.

Synonyms and Keywords
Remote copy, mirroring, snapshot

G06F 3/0652
{Erasing, e.g. deleting, data cleaning, moving of data to a wastebasket}

Definition statement
This place covers:
Erasing of data in a storage systems including secure erasure.

References
Limiting references
This place does not cover:
Secure erasure including encryption techniques G06F 21/78

Informative references
Attention is drawn to the following places, which may be of interest for search:
File systems; File servers G06F 16/10
Delete operations in file systems G06F 16/162
Cleaning, erase control related to flash memory management
G06F 2212/7205

Clearing memory, e.g. to prevent the data from being stolen
G06F 2221/2143

Special rules of classification
This group is often combined with G06F 3/0623 (securing storage systems in relation to content) in order to characterise the effect achieved by the invention

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

Data shredding: the technique of deleting data that is intended to make the data unrecoverable. One such process consists of repeated overwrites of data on disk. Data shredding is not generally held to make data completely unrecoverable in the face of modern forensic techniques—that requires shredding of the disks themselves

G06F 3/0653

{Monitoring storage devices or systems}

Definition statement
This place covers:
Monitoring aspects related to storage interfaces: extra functionality for observing properties of a running storage device or storage system in its normal operating conditions without inputting test data.

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Thermal management in cooling means</th>
<th>G06F 1/206</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power management</td>
<td>G06F 1/3203</td>
</tr>
<tr>
<td>Monitoring for error detection</td>
<td>G06F 11/0751</td>
</tr>
<tr>
<td>Verification or detection of system hardware configuration:</td>
<td>G06F 11/2002</td>
</tr>
<tr>
<td>Monitoring per se of computing systems</td>
<td>G06F 11/34</td>
</tr>
<tr>
<td>Intrusion detection</td>
<td>G06F 21/566</td>
</tr>
<tr>
<td>Monitoring of control systems</td>
<td>G05B 23/02</td>
</tr>
<tr>
<td>Monitoring, i.e. supervising the progress of recording or reproducing</td>
<td>G11B 27/36</td>
</tr>
<tr>
<td>Monitoring network traffic for security</td>
<td>H04L 29/06884</td>
</tr>
<tr>
<td>Network monitoring</td>
<td>H04L 43/00</td>
</tr>
<tr>
<td>Monitoring testing in wireless networks</td>
<td>H04W 24/00</td>
</tr>
</tbody>
</table>
G06F 3/0655

{Vertical data movement, i.e. input-output transfer; data movement between one or more hosts and one or more storage devices}

**Definition statement**

*This place covers:*

All general aspects of vertical moving of data between one or more host and one or more storage devices or systems which do not fit in the sub-groups G06F 3/0656 - G06F 3/0661, i.e general I/O transfer

G06F 3/0656

{Data buffering arrangements}

**Definition statement**

*This place covers:*

Arrangements using one or more buffers whereby a buffer is a memory device or programming construct, used to hold data momentarily as it moves along an I/O path or between software components.

Typically, a solid state memory device is used as a buffer. However, any storage device with faster access properties in relation to the storage device it is buffering can be used, e.g. a disk drive can act as a buffer for a tape device.

**References**

**Limiting references**

*This place does not cover:*

| Changing the speed of data flow, e.g. FIFO buffers per se | G06F 5/06 |
| Partitioned buffers | G06F 5/065 |
| Caches for peripheral storage systems, e.g. disk caches | G06F 12/0866 |
| Detection or prevention of read or write errors by using a data buffer | G11B 19/044 |

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

**Buffer:** A region of a physical memory storage used to temporarily hold data while it is being moved from one place to another. It often adjusts timing by implementing a queue algorithm in memory, simultaneously writing data into the queue at one rate and reading it at another rate.

**Synonyms and Keywords**

*In patent documents, the following words/expressions are often used as synonyms:*

• "FIFO" and "queue"
G06F 3/0658

(Controller construction arrangements)

Definition statement

This place covers:
Constructional details of the storage interface not elsewhere provided for.
Physical connecting arrangements not elsewhere provided for.
Hardware arrangements of storage interface components like processors, bridges, offload engines, state machines

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Disposition of constructional parts in recording /reproducing devices</th>
<th>G11B 33/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical connectors</td>
<td>H01R 13/00</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Information transfer on a bus, bus structures</th>
<th>G06F 13/40</th>
</tr>
</thead>
</table>

G06F 3/0659

(Command handling arrangements, e.g. command buffers, queues, command scheduling)

Definition statement

This place covers:
Techniques related to command decoding and execution and command transformation and routing including command buffering, command queuing, command scheduling

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Data buffering</th>
<th>G06F 3/0656</th>
</tr>
</thead>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:
I/O scheduling: term used to describe the method computer operating systems decide the order in which block I/O operations will be submitted to storage volumes.

Synonyms and Keywords

I/O scheduling, disk scheduling
G06F 3/0661

{Format or protocol conversion arrangements}

Definition statement

This place covers:

Techniques related to the conversion of recording formats, e.g. conversion from Count Key Data (CKD) format from a mainframe to Fixed Block Architecture (FBA) format of an open systems computer.

Techniques related to the conversion of storage protocols; bridging hardware e.g. conversion from Small Computer System Interface (SCSI) protocol to an Advanced Technology Attachment (ATA) protocol.

Reference document: US2010251009

References

Limiting references

This place does not cover:

| Information transfer using universal interface adapter:                      | G06F 13/382 |
| Coupling between buses in general using bus bridges                           | G06F 13/4027 |

G06F 3/0662

{Virtualisation aspects}

Definition statement

This place covers:

All virtualisation aspects which do not fit in the subgroups.

Storage virtualisation refers to:

1. The act of abstracting, hiding, or isolating the internal functions of a storage (sub)system or service from applications, host computers, or general network resources, for the purpose of enabling application and network-independent management of storage or data.

2. The application of virtualization to storage services or devices for the purpose of aggregating functions or devices, hiding complexity, or adding new capabilities to lower level storage resources.

G06F 3/0664

{at device level, e.g. emulation of a storage device or system}

Definition statement

This place covers:

A device presented to an operating environment by control software or by a volume manager. From an application standpoint, a virtual device is equivalent to a physical one. In some implementations, virtual devices may differ from physical ones at the operating system level, e.g., booting from a host based disk array may not be possible.

Storage device emulation, e.g. disk emulation
Storage (sub)system emulation, e.g. Virtual Tape System

Also: port virtualisation on a storage network switch, storage interface virtualisation.

References

Limiting references

This place does not cover:

Program control for peripheral devices where the program performs an input/output emulation function

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Virtual disk: a set of disk blocks presented to an operating environment as a range of consecutively numbered logical blocks with disk-like storage and I/O semantics.

Virtual tape: a virtual device with the characteristics of a tape.

G06F 3/0665

{at area level, e.g. provisioning of virtual or logical volumes}

Definition statement

This place covers:

Storage area virtualisation: the act of applying virtualisation to one or more area based (storage) services for the purpose of providing a new aggregated, higher level—e.g., richer, simpler, more secure—storage area service to clients.

Thin provisioning Dynamic allocation of logical volumes.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Thin provisioning (also: dynamic provisioning): a technology that allocates the physical capacity of a volume or file system as applications write data, rather than preallocating all the physical capacity at the time of provisioning.

G06F 3/0667

{at data level, e.g. file, record or object virtualisation}

Definition statement

This place covers:

Object virtualization:

1. the use of virtualisation to present several underlying objects as one single composite object.

2. the use of virtualisation to present an integrated object interface when object data and metadata are managed separately in the storage system
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| File systems; File servers: | G06F 16/10 |

File systems; File servers: G06F 16/10

G06F 3/0668

{adopting a particular infrastructure}

Definition statement

This place covers:
This group is not used for classification.

Special rules of classification

In this subrange, the physical storage infrastructure should be classified and not the virtualised infrastructure if present. If the virtualised storage infrastructure is important, this should be classified in G06F 3/0664.

G06F 3/067

{Distributed or networked storage systems, e.g. storage area networks [SAN], network attached storage [NAS]}

Definition statement

This place covers:
Architecture comprising multiple storage systems interconnected by a network allowing access from multiple hosts with emphasis on storage related aspects.

References

Limiting references

This place does not cover:

| Distributed file systems implemented using NAS architecture | G06F 16/1824 |
| Network related aspects of SANs, NASes | H04L 29/08549, H04L 67/1097 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Depicted below, an exemplary connection of storage device to a host through a network.
**G06F 3/0671**

**{In-line storage system}**

**Definition statement**

*This place covers:*

Architecture with a direct host to storage system connection attachment.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

Depicted below, an exemplary connection of storage device(s) to a host through a direct connection.

![Diagram of in-line storage system]

**G06F 3/0673**

**{Single storage device}**

**Definition statement**

*This place covers:*

The storage system comprising a single controller controlling one or more storage media, e.g. disks.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

Depicted below, an exemplary architecture for a single storage device.

![Diagram of single storage device]

**G06F 3/0674**

**{Disk device}**

**Definition statement**

*This place covers:*

The storage device being a spinning disk drive: a non-volatile, randomly addressable, data storage device.
G06F 3/0676
{Magnetic disk device}

**Definition statement**

*This place covers:*
The storage device being a magnetic disk drive e.g. HDD, DASD.

G06F 3/0677
{Optical disk device, e.g. CD-ROM, DVD}

**Definition statement**

*This place covers:*
An optical disk drive e.g. CDROM, DVD, WORM optical disk.

G06F 3/0679
{Non-volatile semiconductor memory device, e.g. flash memory, one time programmable memory [OTP]}

**Definition statement**

*This place covers:*
A semiconductor storage device e.g. SSD (solid state drive), flash memory, one time programmable memory (OTP).

---

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Low level flash management such as logical to physical address mapping, erase management and wear levelling: | G06F 12/0246 |
| Auxiliary circuits for EPROMs: | G11C 16/06 |
**G06F 3/068**

{Hybrid storage device}

**Definition statement**

*This place covers:*

Storage device comprising a controller and multiple storage medium types e.g. magnetic and semiconductor mediums sharing the same controller.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

![Diagram](image)

**G06F 3/0682**

{Tape device}

**Definition statement**

*This place covers:*

Being a tape device.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Digital recording/reproducing, formatting on tapes | G11B 20/1201 |

**G06F 3/0683**

{Plurality of storage devices}

**Definition statement**

*This place covers:*

The storage system comprising multiple controllers and a plurality of storage devices.
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

G06F 3/0685

{Hybrid storage combining heterogeneous device types, e.g. hierarchical storage, hybrid arrays}

Definition statement

This place covers:
The storage system comprising multiple controllers and multiple storage medium types e.g. SSD, HDD and tapes combined; FC-HDD, SATA-HDD, SCSI-HDD combined

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| User address space allocation in block erasable memory | G06F 12/0246 |
| Auxillary circuits for EPROMs | G11C 16/06 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:
**G06F 3/0686**

**{Libraries, e.g. tape libraries, jukebox}**

**Definition statement**

*This place covers:*

A storage system providing automatic access to multiple media cartridges typically via an automatic loading robot e.g. tape library, media changer, juke box.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Control of automated cassette changing arrangements</th>
<th>G11B 15/689</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control systems for magazines of disc records</td>
<td>G11B 17/22</td>
</tr>
</tbody>
</table>

---

**G06F 3/0688**

**{Non-volatile semiconductor memory arrays}**

**Definition statement**

*This place covers:*

A storage system comprising multiple controllers and multiple semiconductor storage devices.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

---

**G06F 3/0689**

**{Disk arrays, e.g. RAID, JBOD}**

**Definition statement**

*This place covers:*

A storage system comprising multiple controllers and multiple spinning disk drives e.g. RAID, JBOD.
References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error Correction Coding (ECC) for RAID</td>
<td>G06F 11/1076</td>
</tr>
</tbody>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

RAID: Redundant Array of Independent Disks (originally: of Inexpensive disks)

JBOD: Just a Bunch Of Drives

G06F 3/08

from or to individual record carriers, e.g. punched card {, memory card, integrated circuit [IC] card, smart card (record carriers for use with machines and with at least a part designed to carry digital markings G06K 19/00; coded identity card or credit card with a coded signal G07F 7/10)}

Definition statement

This place covers:

Interfaces between a host or a plurality of hosts and a memory card reader or a plurality of memory card readers in relation to the data/command path and data placement techniques.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information transfer using universal interface adapter</td>
<td>G06F 13/382</td>
</tr>
<tr>
<td>Methods or arrangements for sensing record carriers</td>
<td>G06K 7/00</td>
</tr>
<tr>
<td>Record carriers with integrated circuit chips</td>
<td>G06K 19/07</td>
</tr>
<tr>
<td>Active credit-cards provided with means to personalise their use</td>
<td>G07F 7/1008</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>memory card, integrated circuit (IC) card, smart card, record carriers</td>
<td>G06K 19/00</td>
</tr>
<tr>
<td>for use with machines and with at least a part designed to carry digital</td>
<td></td>
</tr>
<tr>
<td>markings</td>
<td></td>
</tr>
<tr>
<td>coded identity card or credit card with a coded signal</td>
<td>G07F 7/10</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

Memory card, Integrated Circuit (IC) card, Smart card, Intelligent card, Active card
G06F 3/09
Digital output to typewriters

Definition statement
This place covers:
Old technology related to interfaces with typewriters.

Special rules of classification
Not used for classification of new documents.

G06F 3/12
Digital output to print unit {, e.g. line printer, chain printer}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Digital output to typewriter | G06F 3/09 |
| Arrangements for producing a permanent visual presentation of the output data using printers | G06K 15/02 |

G06F 3/1201
{Dedicated interfaces to print systems}

Definition statement
This place covers:
Interfaces between a host or a plurality of hosts and a printer device or a plurality of printer devices. Techniques for preparing the print job, sending it to a printer and printing it.

References
Limiting references
This place does not cover:

| Digital output to typewriter | G06F 3/09 |
| Controlling a printer in view of its graphical performance | B41J 29/393 |
| Printing of alphanumeric characters | G06K 15/02 |
| Special arrangements for scanning and reproduction of pictures, e.g. photographs, facsimile | H04N 1/00 |

Special rules of classification
This group contains older documents (published before the year 2000) from which the majority are not reorganised in the G06F 3/1201 and its subgroups. No new/recent documents should be classified in G06F 3/1201.

Each new document should receive regarding "invention information":
• at least one class in the sub-groups of G06F 3/1202 for the technical effect achieved;
• at least one class in the sub-groups of G06F 3/1223 for the technique used and
• optionally one class in the sub-groups of G06F 3/1278 for the infrastructure involved.

Class in G06F 3/1278 is added only if the infrastructure plays a major role in the "invention information".

The classification of "additional information" is optional.

Indexing Code symbols in the sub-groups of G06F 3/1202 and/or G06F 3/1223 and/or G06F 3/1278 and/or G06F 2206/15 should be used for classifying "additional information".

The older documents should be retrieved using Indexing Codes:
• G06F 3/1293 Printer information exchange with computer;
• G06F 3/1294 Status or feedback related to information exchange;
• G06F 3/1295 Buffering means;
• G06F 3/1296 Printer job scheduling or printer resource handling;
• G06F 3/1297 Printer code translation, conversion, emulation, compression; Configuration of printer parameters;
• G06F 3/1298 Printer language recognition, e.g. program control language, page description language.

The "additional information" can be found by combining the above Indexing Code(s) with the Indexing Code G06F 3/1201.

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:
• "image forming device/apparatus", "image processing device/apparatus", "image printing device/apparatus", "image output device/apparatus", "image control device/apparatus" and "information processing device/apparatus" and "MFP Multi-Function Printer"

G06F 3/1202

{specifically adapted to achieve a particular effect}

Special rules of classification

This group is not used for classifying documents in it, but to introduce one of the three classification criteria mentioned in the "Special rules for classification" section of G06F 3/1201.

G06F 3/1203

{Improving or facilitating administration, e.g. print management}

Definition statement

This place covers:
All general aspects of printing management which do not fit in the sub-groups.
G06F 3/1204
{resulting in reduced user or operator actions, e.g. presetting, automatic actions, using hardware token storing data}

Definition statement
This place covers:
Preventing the user or operator from / avoiding the need for doing complicated and burdensome actions related to the printing of a document.

G06F 3/1205
{resulting in increased flexibility in print job configuration, e.g. job settings, print requirements, job tickets}

Definition statement
This place covers:
Assisting or helping the user during print job configuration, e.g. increasing granularity in job configuration, achieving more customised settings, proposing suitable settings, preventing selection of incompatible or undesirable print options.

Special rules of classification
This group is usually combined with G06F 3/1253 and its sub-groups in order to characterise the technique for the "invention information".

G06F 3/1206
{resulting in increased flexibility in input data format or job format or job type}

Definition statement
This place covers:
Assisting or helping the user to send a print job regardless of the format or type of data that should be printed. Facilitating usage of old print systems with new print systems, more specifically when compatibility between old data formats and new data formats should be achieved.

G06F 3/1207
{resulting in the user being informed about print result after a job submission}

Definition statement
This place covers:
All aspects that make the user aware of what happened with the print job after it being sent.

Special rules of classification
This group is usually combined with G06F 3/1259 and its sub-groups in order to characterise the technique for the "invention information".
G06F 3/1208

{resulting in improved quality of the output result, e.g. print layout, colours, workflows, print preview}

Definition statement
This place covers:
Assisting the user to increase the quality of print output (e.g. matching print output to what was intended by the user, increasing the appeal of the print output), e.g. by using preview screens, test printing. Actions or processing directed to higher fidelity.

Special rules of classification
This group is usually combined with G06F 3/1253 and its sub-groups in order to characterise the technique for the "invention information".

G06F 3/1209

{resulting in adapted or bridged legacy communication protocols, e.g. emulation, protocol extension}

Definition statement
This place covers:
Facilitating usage of old print systems with new print systems, more specifically when compatibility between protocols should be achieved. Modifying/enhancing legacy communication protocols to extend their use into (additional) printing environments or print-related functionality (e.g. modifying Bluetooth to adapt to printing --> Basic Printing Profile (BPP)).

G06F 3/121

{Facilitating exception or error detection and recovery, e.g. fault, media or consumables depleted}

Definition statement
This place covers:
Assisting or helping the user to predict or deal with faults, e.g. device faults, lack of consumables, communication errors. Recovering from faults.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Error or fault reporting or storing | G06F 11/0766 |

G06F 3/1211

{Improving printing performance}

Definition statement
This place covers:
All aspects of making the job to be printed faster that do not fit in the sub-groups.
G06F 3/1212
{achieving reduced delay between job submission and print start}

Definition statement
This place covers:
Decreasing the time between sending a print job (e.g. pressing "print" button) and actual start of the same job at the print device.

G06F 3/1213
{at an intermediate node or at the final node}

Definition statement
This place covers:
Achieving decreasing the time at the node where the job is either temporarily stored (e.g. computer, server, printer) or actually printed (the printer).

G06F 3/1214
{at the submitting node}

Definition statement
This place covers:
Achieving decreasing the time at the node where the job is initiated from (e.g. computer, server, printer).

G06F 3/1215
{achieving increased printing speed, i.e. reducing the time between printing start and printing end}

Definition statement
This place covers:
Decreasing the time actually spent to print the job, once printing has commenced, at the print device.

References
Limiting references
This place does not cover:
Reducing the time between arriving of the job at the printer till actual print process starts.

G06F 3/1217
{achieving reduced idle time at the output device or increased asset utilization}

Definition statement
This place covers:
Decreasing the time during which the printer is doing nothing.
G06F 3/1218

{Reducing or saving of used resources, e.g. avoiding waste of consumables or improving usage of hardware resources}

Definition statement
This place covers:
Saving resources of the printer used for printing a job.

G06F 3/1219

{with regard to consumables, e.g. ink, toner, paper}

Definition statement
This place covers:
Preventing waste of used consumables (see for example US2011051164).

G06F 3/122

{with regard to computing resources, e.g. memory, CPU}

Definition statement
This place covers:
Optimal usage of system's hardware resources.

References
Limiting references
This place does not cover:
Reducing the number of required printer devices

G06F 3/1221

{with regard to power consumption}

Definition statement
This place covers:
Power saving; reducing energy consumption.

Special rules of classification
This group is usually combined with G06F 3/1229 and its sub-groups in order to characterise the technique for the "invention information".
G06F 3/1222
{Increasing security of the print job}

Definition statement
This place covers:
Adding secure aspects to a print job. Preventing unauthorised printing of a job, limiting the printing based on user credentials.

Special rules of classification
This group is usually combined with G06F 3/1238, G06F 3/1239 or G06F 3/1234 in order to characterise the technique for the "invention information".

G06F 3/1223
{specifically adapted to use a particular technique}

Special rules of classification
This group is not used for classifying documents in it, but to introduce one of the three classification criteria mentioned in the "Special rules for classification" section of G06F 3/1201.

G06F 3/1224
{Client or server resources management}

Definition statement
This place covers:
All aspects that deal with the software or hardware resources of the client or server which do not fit in the sub-groups (see e.g. US2011013223, US2009007151).

G06F 3/1225
{Software update, e.g. print driver, modules, plug-ins, fonts}

Definition statement
This place covers:
Updating or installing printer drivers on the client or server. Adding additional functionality to existing printer drivers (e.g. installing plug-ins, downloading printer definition files). Support for newly installed printers by replacing/updating existing drivers.

G06F 3/1226
{Discovery of devices having required properties}

Definition statement
This place covers:
The client or the server sends requests to find suitable printers for printing based on certain requirements, e.g. colour, double side printing, finishing options, status, location, supported encryption, etc.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device discovery specifically adapted for a queued job and aiming at e.g.</td>
<td>G06F 3/126</td>
</tr>
<tr>
<td>load balancing or optimised printing</td>
<td></td>
</tr>
<tr>
<td>Printer device status.</td>
<td>H04L 29/08</td>
</tr>
<tr>
<td>Network management in general</td>
<td>H04L 41/00</td>
</tr>
</tbody>
</table>

G06F 3/1227

(Printer definition files)

Definition statement

This place covers:

Printer properties and commands to invoke/execute the printing properties are described in a separate file and can be used by an application program to convert a print job according to certain printer properties without a printer driver. The file can be used by the printer driver as well, e.g. for supporting different printers (see e.g. "Service Item File" in US6897974).

References

Limiting references

This place does not cover:

- Driverless printing  
  G06F 3/1228

G06F 3/1228

(Printing driverless or using generic drivers)

Definition statement

This place covers:

Specific printer drivers are not used but also printer definition files are not used. Usually a thin client with limited resources is involved. Generic drivers normally are designed to support plurality of different types/models of printers and/or different operating systems.

G06F 3/1229

(Printer resources management or printer maintenance, e.g. device status, power levels)

Definition statement

This place covers:

Device status when checked only in relation to printing of a job - power-level (e.g. on, off, power saving mode), operating or not, reasons for the malfunctions. Logging of device status. All aspects for managing the device which do not fit in the sub-groups.
References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print job status.</td>
<td>G06F 3/1259</td>
</tr>
<tr>
<td>Device discovery in general</td>
<td>H04L 29/08</td>
</tr>
<tr>
<td>Network management in general</td>
<td>H04L 41/00</td>
</tr>
</tbody>
</table>

G06F 3/123

{Software or firmware update, e.g. device firmware management}

Definition statement
This place covers:
Downloading or updating of printer’s firmware. Installing new software for supporting newly added hardware or additional functions (e.g. image processing functions, resident fonts, support for new data formats).

G06F 3/1231

{Device related settings, e.g. IP address, Name, Identification}

Definition statement
This place covers:
Update or initialisation of the printer specific properties - IP address, Device name (see e.g. EP1372059, US2005151988).

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer device capabilities</td>
<td>G06F 3/1232</td>
</tr>
</tbody>
</table>

G06F 3/1232

{Transmitting printer device capabilities, e.g. upon request or periodically}

Definition statement
This place covers:
Transmitting to the requestor printing device capabilities, e.g. double side printing, finishing options, dpi, colour or b/w, ppm (see e.g. EP1435565, EP1178393).

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer device properties/settings, not related to printing capabilities, i.e. IP address. This aspect is covered in</td>
<td>G06F 3/1231</td>
</tr>
</tbody>
</table>
**G06F 3/1234**

{Errors handling and recovery, e.g. reprinting (G06F 3/1261 takes precedence)}

**Definition statement**

*This place covers:*

How to handle received jobs or the job currently being printed in case of error, e.g. reprint only the portion that was not printed, reprint the full job, delete the job and ask the host to send it again.

**References**

**Limiting references**

*This place does not cover:*

| Alternate printer taking over the job from the failed device. | G06F 3/1261. |
| Device malfunctions which do not involve sending a print job. | G06F 11/0766. |

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Error or fault reporting or storing | G06F 11/0766 |

**G06F 3/1235**

{caused by end of consumables, e.g. paper, ink, toner}

**Definition statement**

*This place covers:*

Specific aspects for recovering from errors caused by end of consumables - paper, ink, toner.

**G06F 3/1236**

{Connection management}

**Definition statement**

*This place covers:*

All aspects relating to connection between devices - client<->printer, server<->printer, printer<->printer. (see e.g. US2011019231 or US2011019231).

**G06F 3/1237**

{Print job management}

**Definition statement**

*This place covers:*

General aspects of job management that do no fit in the sub-groups.
G06F 3/1237 (continued)

References

Limiting references

This place does not cover:

| Print device management | G06F 3/1229 |

G06F 3/1238

{Secure printing, e.g. user identification, user rights for device usage, unallowed content, blanking portions or fields of a page, releasing held jobs}

Definition statement

This place covers:

Based on user/content credentials allowing/disabling usage of the printer as a whole.

References

Limiting references

This place does not cover:

| Virus detection and handling. | G06F 21/56 |

G06F 3/1239

{Restricting the usage of resources, e.g. usage or user levels, credit limit, consumables, special fonts}

Definition statement

This place covers:

Limiting the use of printing as such (e.g. credit limit) or limiting the use of printers (e.g. time the printer can be used, e.g. only 1 hour a day, only after 17:00). Restricting configuration options, e.g. to plain paper, to black ink only, double-sided or n-up printing, lower resolution, limited image effects.

Special rules of classification

This group is usually combined with G06F 3/1219 or G06F 3/122 in order to characterise the effect achieved by the "invention information".

G06F 3/124

{Parallel printing or parallel ripping}

Definition statement

This place covers:

Printing or ripping several portions of a job at the same time.

Special rules of classification

This group is usually combined with G06F 3/1215 in order to characterise the effect achieved by the "invention information".
G06F 3/1241
{Dividing a job according to job requirements, e.g. black/white and colour pages, covers and body of books, tabs}

Definition statement
This place covers:
Print job is divided and different parts are sent to different devices having different properties.

References
Limiting references
This place does not cover:

| Dividing for parallel printing | G06F 3/124 |

G06F 3/1242
{Image or content composition onto a page}

Definition statement
This place covers:
Composing or overlaying content from different sources, e.g. different documents, onto a page.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| 2D [Two Dimensional] image generation | G06T 11/60 |
| Image acquisition | G06K 9/20 |

G06F 3/1243
{Variable data printing, e.g. document forms, templates, labels, coupons, advertisements, logos, watermarks, transactional printing, fixed content versioning}

Definition statement
This place covers:
Print data for a page is generated by combining two sets of content (such as text, graphics and images), one set being constant from page to page (fixed content) and the other set being different (variable content) for every page. The combining of fixed and variable data may take place at any step in a print workflow.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Document retrieval systems | G06F 16/93 |
G06F 3/1243 (continued)

[Edited, e.g. insert/delete]

G06F 3/1244

{Job translation or job parsing, e.g. page banding}

Definition statement

This place covers:

All aspects of transforming the print job in order to be printed which do not fit in the sub-groups, e.g. parsing in order to eliminate repetitive data, colour transformation, font transformation.

G06F 3/1245

{by conversion to intermediate or common format}

Definition statement

This place covers:

Conversion or translation of the initial document or print job to a format which is not yet ready to be handled by a target printer but is useful for certain manipulation, e.g. faster to transmit, more efficient to store, easy to secure. Conversion or translation to a format which, although it could be suitable to certain printers, may not be suitable for the target printer (e.g. converting to a print format before target printer is known).

G06F 3/1246

{by handling markup languages, e.g. XSL, XML, HTML}

Definition statement

This place covers:

Parsing of print jobs written in one of the mark-up languages.

G06F 3/1247

{by conversion to printer ready format}

Definition statement

This place covers:

Conversion or translation of the initial print job (or the job in an intermediate format) to a format which is ready to be handled by the target printer.

G06F 3/1248

{by printer language recognition, e.g. PDL, PCL, PDF}

Definition statement

This place covers:

Parsing of the job in order to find a certain mark (or keyword) that identify the language of the job.
G06F 3/125
{Page layout or assigning input pages onto output media, e.g. imposition}

Definition statement
This place covers:
Arrangement of the product's pages (e.g. document pages) on the output medium (e.g. paper sheets or media roll).

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Pagination | G06F 17/217 |

G06F 3/1251
{for continuous media, e.g. web media, rolls}

Definition statement
This place covers:
Specifically adapted to when media to be fed by the printer is of long length, e.g. web media, rolls.

G06F 3/1252
{for sheet based media}

Definition statement
This place covers:
Specifically adapted to when media to be fed by the printer is of short length, e.g. sheets (regardless of whether said media is to be folded or cut after printing. See e.g.US2010039670).

G06F 3/1253
{Configuration of print job parameters, e.g. using UI at the client}

Definition statement
This place covers:
All aspects of configuring how the job should be printed which do not fit in the sub-groups.

G06F 3/1254
{Automatic configuration, e.g. by driver}

Definition statement
This place covers:
Automatic allocation of (some) print settings by software, e.g. print driver, (on the client or server) when a print job is to be printed.
Special rules of classification

Double classification possible if G06F 3/1239 also apply.

G06F 3/1255

{Settings incompatibility, e.g. constraints, user requirements vs. device capabilities}

Definition statement

This place covers:

Limiting the possibilities given to the user at the time of configuring print job, e.g. in b/w printer hide the option for colour printing, hide the option for double side printing if the printer does not support it or if "transparencies" is selected as media (see e.g. WO2010016234).

Comparing how the job should be printed and what the printer can offer when the job is sent from the client. Automatic adjusting of some of job's settings in order to fit the printer's settings or asking the user to solve the conflict settings manually (see e.g. EP1986410).

Special rules of classification

This group is usually combined with G06F 3/1204 or G06F 3/1208 in order to characterise the effect achieved by the "invention information".

G06F 3/1256

{User feedback, e.g. print preview, test print, proofing, pre-flight checks}

Definition statement

This place covers:

Techniques for checking how the job will look like when printed either by using a preview on a display, by checks performed by software (pre-flight, pre-press) or by real print of part of the job.

Special rules of classification

This group is usually combined with G06F 3/1208 in order to characterise the effect achieved by the "invention information"

G06F 3/1257

{by using pre-stored settings, e.g. job templates, presets, print styles}

Definition statement

This place covers:

Previously defined settings are stored (e.g. as a template) and, when configuring a new print job, the stored settings are used instead of selecting a value for each print option.

References

Limiting references

This place does not cover:

| Document templates, i.e. fixed content.. | G06F 3/1242 |
Special rules of classification
This group is usually combined with G06F 3/1204 in order to characterise the effect achieved by the "invention information".

G06F 3/1258
{by updating job settings at the printer}

Definition statement
This place covers:
Changing/updating of settings of a received or currently being created print job using UI of the printer.

G06F 3/1259
{Print job monitoring, e.g. job status}

Definition statement
This place covers:
Supervising of a print job after being sent for printing, e.g. printed, failed, queued. Job status can be requested (by the sending node) or received automatically after job sending.

References
Limiting references
This place does not cover:

| Printer device status | G06F 3/1229. |

Special rules of classification
This group is usually combined with G06F 3/1207 in order to characterise the effect achieved by the "invention information".

G06F 3/126
{Job scheduling, e.g. queuing, determine appropriate device}

Definition statement
This place covers:
Techniques relating to where and/or when the job should be printed which do not fit in the sub-groups. Queuing the jobs before printing, e.g. waiting a long job to finish. Finding a printer based on the job requirements.

References
Limiting references
This place does not cover:

| Determining appropriate device aiming at providing the user with more print destinations or at installing required software for discovered devices | G06F 3/1226. |
G06F 3/1261
{by using alternate printing}

Definition statement
This place covers:
Determining different (alternative) device for printing a job if the designated device can not print the job, e.g. due to failure, lacking of resources or excessive delay expected (see e.g. US7027169).

References

Limiting references
This place does not cover:
The same job printed by the same print device after recovered from a failure (i.e. reprinted)  

G06F 3/1262
{by grouping or ganging jobs}

Definition statement
This place covers:
Combining several print jobs in one job (group job), printing print jobs in batches (e.g. jobs requiring same media or same post-processing, jobs submitted by the same user or intended for the same recipient) (see e.g.WO2008039689).

G06F 3/1263
{based on job priority, e.g. re-arranging the order of jobs, e.g. the printing sequence}

Definition statement
This place covers:
Changing the order of print jobs according certain priorities - either user-defined or automatically determined.

G06F 3/1264
{by assigning post-processing resources}

Definition statement
This place covers:
Determining resources to perform actions/functions on printed output (i.e. after printing) as specified by the job settings (e.g. folding, cutting, trimming, binding).
G06F 3/1265

{Printing by reference, e.g. retrieving document/image data for a job from a source mentioned in the job}

Definition statement

This place covers:

The print job as submitted does not comprise the document or print data that should be printed but only a reference to it or to its location (e.g. a URL, a file path). The document is later (e.g. when queuing the job or shortly before printing should commence) obtained from its location.

G06F 3/1267

{Job repository, e.g. non-scheduled jobs, delay printing}

Definition statement

This place covers:

Storing a print job for a certain time before it being printed (e.g. a job to be printed at or after a certain time) or in case it should be re-printed subsequently. Storing the job until certain condition is fulfilled, e.g. user authorisation, recovering from an error state...

References

Limiting references

This place does not cover:

Normal queuing, e.g. waiting a previous job to finish. G06F 3/126

G06F 3/1268

{Job submission, e.g. submitting print job order or request not the print data itself}

Definition statement

This place covers:

Sending a request to print a job. The real job data will be sent or requested later. All aspects of sending a print request (e.g. submitting a document for printing, submitting a print job or a print order) which do not fit in the sub-groups.

References

Limiting references

This place does not cover:


Special rules of classification

Specific ways to send a request to print a job, e.g. scanning a page with a barcode and receiving printed pages with information identified by the barcode from a remote source.
G06F 3/1269
{by broadcasting server}

Definition statement
This place covers:
Server storing user's desires about receiving printed materials, e.g. subscription, and sending personalized print jobs to all users (or users' printers) accordingly.

G06F 3/127
{by using hot folders, e.g. folder for which print settings or print data management rules are set in advance}

Definition statement
This place covers:
Folders with associated printing instructions (e.g. print settings or print-related tasks, such as automatic notifications). When a document or job is sent to a folder it will be processed according to the printing instructions associated with the folder.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Print workflow management | G06F 3/1275 |

G06F 3/1271
{Job submission at the printing node, e.g. creating a job from a data stored locally or remotely (G06F 3/1238 takes precedence)}

Definition statement
This place covers:
Using the UI of the printer to configure a new job. The data for the job could be stored on the printer or at a different location, e.g. server.

References
Limiting references
This place does not cover:

| Releasing a stored job according to the user identification | G06F 3/1238 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Printing by reference | G06F 3/1265 |
G06F 3/1272

{Digital storefront, e.g. e-ordering, web2print, submitting a job from a remote submission screen}

Definition statement
This place covers:
Configuring and submitting a job using online based resources, e.g. accessing remote print service providers, choosing from web based content.

G06F 3/1273

{Print job history, e.g. logging, accounting, tracking}

Definition statement
This place covers:
Creating, managing and using of print job history (see e.g. EP1860546).

G06F 3/1274

{Deleting of print job}

Definition statement
This place covers:
Specifically instructing or managing job deletion based on certain criteria, e.g. memory usage, privacy, avoiding mixing of received jobs (see e.g. US2005275864).

G06F 3/1275

{Print workflow management, e.g. defining or changing a workflow, cross publishing}

Definition statement
This place covers:
Designing or modifying the steps to be performed to a print request from choosing document(s) to be printed to finalising the printed job (e.g. post-processing actions). Adding conditional steps, e.g. what should happen in case of certain events (see e.g.US2008170254).

G06F 3/1276

{within a printer driver, e.g. driver resides either on a server or on a client}

Definition statement
This place covers:
Print workflow management is done by the driver, regardless where it resides - client or server.
G06F 3/1277
{using filter pipeline, e.g. outside the driver, adding traps}

Definition statement
This place covers:
No driver is involved in the filter pipeline. Workflow formed by pieces of software, called "filters" (see e.g. US2002135800).

References
Limiting references
This place does not cover:
Filters within a printer driver.

G06F 3/1278
{specifically adapted to adopt a particular infrastructure}

Special rules of classification
This group is not used for classifying documents in it, but to introduce one of the three classification criteria mentioned in the "Special rules for classification" section of G06F 3/1201.

G06F 3/1279
{Controller construction, e.g. aspects of the interface hardware}

Definition statement
This place covers:
All aspects of hardware structure of the interface controller of the printer device if the "invention information" mainly focuses on them.

G06F 3/128
{Direct printing, e.g. sending document file, using memory stick, printing from a camera}

Definition statement
This place covers:
Printing from an USB stick or digital camera directly connected to the printer device.

G06F 3/1281
{Multi engine printer devices, e.g. one entity having multiple output engines}

Definition statement
This place covers:
Printer device having plurality of print engines in order to increase printing speed.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel printing or parallel ripping</td>
<td>G06F 3/124</td>
</tr>
</tbody>
</table>

G06F 3/1289

{in server-client-printer device configuration, e.g. the server does not see the printer}

Definition statement

This place covers:
Network configuration where the information from the server to the printer device always goes via the client.

G06F 3/129

{in server-printer device-client configuration, e.g. print flow goes from server to printer and then bidirectional from printer to client, i.e. the client does not communicate with the server}

Definition statement

This place covers:
Network configuration where the client accesses the server via the printer.

G06F 3/13

Digital output to plotter {; Cooperation and interconnection of the plotter with other functional units}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangements for producing a permanent visual presentation of the output data using plotters</td>
<td>G06K 15/22</td>
</tr>
</tbody>
</table>

G06F 3/14

Digital output to display device; {Cooperation and interconnection of the display device with other functional units} (control of display in general G09G; arrangements for producing a permanent visual presentation of the output data G06K 15/00)

Definition statement

This place covers:
- Interfaces between processor and display system (with or without a standard bus);
• Multiple busses connecting processor, display system and/or other subsystems: e.g. video zoom busses, multimedia busses besides the standard bus.
• Data being furnished to the display system being generated by a multiplicity of sources.
• Data of different types being furnished to the system that displays the data (it can be a display system or a complete computer).
• Interfaces between the host and the display system, especially for system that have a structure different from the structure outlined above (older or special systems).
• Plurality of symbol or graphics generators cooperating with one display unit.
• Aspects of the operating system that have impact on the display system and are not related to a particular aspect of the display phisical construction.
• Transferring data from a Internet host to the display system
• kvm-switches, in the case that they switch (also) between a plurality of data sources (i.e. computers).

References

Limiting references

This place does not cover:

| Arrangements for producing a permanent visual presentation of the output data | G06K 15/00 |
| Control of display in general | G09G |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Kvm-switches, only linked to one computer as data source | G09G 5/006 |
| Audio-visual communications | H04N 7/14 |

Special rules of classification

• In the first case (standard bus present) the documents will be classified only if they contain details of the standard interface that are peculiar for the display system; in the second case are included all the "non standard" interfaces.
• Data handling that is pertinent neither to the kind of visualisation unit that is used nor to the frame buffer access (G09G 5/39 and subgroups)
• [2001] - Subclass reorganized in 2001. The description of the contents of the class has changed since some parts of the documents have been moved to G09G (for examples the documents dealing with graphics controllers).
• Old contents:
display cooperating with 2 or more processors in one terminal;
CRT controller cooperating with CRT and flat panel display(s);
power control of the flat panel if a CRT is also present;
detection of the connection of an extra display panel;
plurality of symbol generators cooperating with a plurality of display units;
plurality of displays cooperating with one memory;
workstation controller, console emulation;
• all viable Indexing Codes were assigned to the documents in this group at the moment of reorganisation (begin 2001). So all the documents in the main group (G06F 3/14) and in the new subgroups (C, C2, C4, C6, T, T1) are completely coded.


**G06F 3/1415**

{with means for detecting differences between the image stored in the host and the images displayed on the displays}

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Digital output to display device involving copying of the display data of a local workstation or window to a remote workstation or window so that an actual copy of the data is displayed simultaneously on two or more displays | G06F 3/1462 |

**G06F 3/1423**

{controlling a plurality of local displays, e.g. CRT and flat panel display}

**Definition statement**

This place covers:

General group for documents in which more than one display unit is connected to the display system, irrespective of the type of display. If it is clear that the display system contains one or more display controllers, then the subgroups C2 and C4 take precedence.

**References**

**Limiting references**

This place does not cover:

| Using a single graphics controller | G06F 3/1431 |
| Using more than one graphics controller | G06F 3/1438 |

**Special rules of classification**

• See G09G 2360/04 for documents where one display (device) controller controls two displays as well as for old documents (up to and including 2001).

Controlling a plurality of local displays, with or without display controller:

• In many cases, when more than one display terminal is controlled by a local host, there are also some details of the display controller present in the document. Should this document be classified in G06F 3/1423 (and subgroups) or in the G09G 5/363 (display controller)? I gave precedence to the G06F groups. So the “plurality of displays” takes precedence over the “display controller”. Of course, the code can be given if the details of the display controller are interesting and not only related to the fact that more than one display terminal is connected to it (Gigi Farricella, 14.05.2001).

Conflict between "plurality of local displays" and "conversion of CRT signals for a flat panel".
• Conflict between G06F 3/1423, G06F3/14C2 and G06F3/14C4 and G09G 5/366: the documents that have to be classified in the latter group might have more than one display, namely the crt AND the lcd. In these cases the documents should have both symbols, in the sense that they have to be classified in one group and receive the CODE of the other group. The choice between class and code is made depending on the content of the document: if the subject matter is mainly the interface, then the G06F class is preferred, if it is the graphic controller, than the G09G class is given.

Comments: reorganisation not finished. For search see also G09G 2360/04.

G06F 3/1431

{using a single graphics controller}

Definition statement

This place covers:

One single graphics controller (VGA, SVGA or other systems) controls two or more display units. Often one graphics controller card has interface circuitry for interfacing to CRT and to flat panel.

Special rules of classification

Documents are classified in G06F 3/1431 or G06F 3/1438 if there is a "graphics controller” present in the system, i.e. an interface between the standard bus and the display terminal that contains a graphics processor and a frame buffer. If the plurality of displays are connected to the host processor in a different, non standard, way, or if it is not possible to determine if a graphics controller is present (like for example in the old fashioned "terminals"), the documents will be classified in G06F 3/1423.
G06F 3/1446
{display composed of modules, e.g. video walls}

Definition statement

This place covers:

Illustrative example of subject matter classified in this group: GB2441353.

Special rules of classification

See also G09G 2300/026

G06F 3/1454

{involving copying of the display data of a local workstation or window to a remote workstation or window so that an actual copy of the data is displayed simultaneously on two or more displays, e.g. teledisplay}

Definition statement

This place covers:

Also screen sharing where the framebuffer is sent to remote displays, as is commonly done in application sharing (well know as Virtual Network Computing (VNC) pn:XP002142727 ).

Examples:

- pn:WO9201281 - This is a case of "remote display" on X-windows terminals, but the rendering is done centrally, and only the modified sections of the frame buffers are sent to the remote stations. This is a case of "remote" local display. There is no teledisplay in this case because the remote display stations are acting as "terminals" of the host. This document was classified in G06F 3/1423 but a code G06F 3/1462 was given to indicate that the x-Window terminals allow for teledisplay and that only the modified sections of the frame buffers were sent to the display units.
Another good example of "teledisplay" comes from the abstract: A collaborative work support system that is performed on plural computers each of which is assigned for an operator, and supports collaborative work in which the plural computers display common data and each operator operates the displayed common data through his own computer.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction techniques specific for application sharing, as now several users may want to interact with the same display</td>
<td>G06F 3/0481</td>
</tr>
<tr>
<td>Multiprogramming arrangements: (implementation details of the sharing technique if not framebuffer based, i.e. really the inner workings, exchanged data structures</td>
<td>G06F 9/46, G06F 9/54</td>
</tr>
<tr>
<td>Office automation, groupware</td>
<td>G06Q 10/10</td>
</tr>
<tr>
<td>Electronic classroom, remote teaching</td>
<td>G09B 5/00, G09B 7/00</td>
</tr>
<tr>
<td>Network arrangements for conferencing, chatrooms, etc</td>
<td>H04L 12/18</td>
</tr>
<tr>
<td>Network protocol for the sharing technique</td>
<td>H04L 29/0602, H04L 29/06027, H04L 29/06034</td>
</tr>
<tr>
<td>Telephonic multimedia conference systems</td>
<td>H04M 3/567</td>
</tr>
<tr>
<td>Videophones</td>
<td>H04N 7/14</td>
</tr>
</tbody>
</table>

Special rules of classification

DA wrt CPC: improvement of definition badly required; title requires displaying on two displays; description (teledisplay) appears to require display on remote (self-controlled) display.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCW</td>
<td>Computer Supported Collaborative Work</td>
</tr>
</tbody>
</table>

In patent documents, the following words/expressions are often used as synonyms:

- "Application sharing" and "Shared application"
- "Groupware" and "Computer Supported Collaborative Work"

G06F 3/1462

{with means for detecting differences between the image stored in the host and the images displayed on the remote displays}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital output to display device with means for detecting differences between the image stored in the host and the images displayed on the displays</td>
<td>G06F 3/1415</td>
</tr>
</tbody>
</table>
G06F 3/147
using display panels

Definition statement
This place covers:
Display panels: LEDs, PDP, LCD, etc. Interconnection of POS (point of sales) terminals. For details see G06F 3/14.

References
Limiting references
This place does not cover:

| Arrangements of circuits for control of indicating devices using static means to present variable information |
| G09G |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Data processing in buying/selling transactions, e.g. when dealing with POS terminals | G06Q 30/06 |
| Services or facilities specially adapted for wireless communication networks | H04W 4/00 |
| Services making use of the location of users or terminals | H04W 4/02 |

Special rules of classification

G06F 3/1475
{with conversion of CRT control signals to flat panel control signals, e.g. adapting the palette memory}

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| with conversion of CRT control signals to flat panel control signals | G09G 5/366 |

G06F 3/16
Sound input; Sound output (speech processing G10L)

Definition statement
This place covers:
General computer sound interfaces for interaction with computer programs or users
Relationships with other classification places

- information retrieval of audio data G06F 16/60;
- production of synthetic speech signals G10L 13/00;
- recognition of speech G10L 15/00;
- measurement of sound waves in general G01H;
- image data processing G06T;
- teaching or communicating with the blind, deaf or mute G09B;
- electronic musical instruments G10H;
- sound production G10K;
- information storage, e.g. sound storage, G11B;
- electronic circuits for sound generation H03B;
- electronic filters H03H;
- coding, decoding or code conversion, error protection in general H03M;
- telephonic communication H04M;
- switching systems H04Q;
- microphone arrangements, hearing aids, public address systems H04R;
- spatial sound reproduction H04S;

References

Limiting references

This place does not cover:

Speech processing G10L

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Handling natural language data | G06F 17/20 |
| Coding of audio signals in musical instruments | G10H |
| Devices for the storage of speech signals | G11B 27/00 |
| Amplifiers | H03F |
| Gain or frequency control | H03G 3/00 |
| Broadcasting | H04H |
| Encoding of compressed speech signals for transmission or storage | H04L |
| Spatial sound recording | H04R 5/00 |
| Spatial sound reproduction | H04S |

G06F 3/162

{Interface to dedicated audio devices, e.g. audio drivers, interface to CODECs}

Definition statement

This place covers:

Dedicated hardware or software components for interfacing to an audio device i.e. translating the audio stream from a host into a format accepted by the audio device and vice-versa. Providing hardware emulation for an audio source. Intermediation with OS when receiving audio to preserve
sound quality. Connecting a host to a mobile phone to aid processing audio to enhance quality. 
Adapting drivers to different audio source formats.

**References**

*Limiting references*

This place does not cover:

Interfacing to a peripheral in general: [G06F 13/385](#) CODECs as such: [G10L 19/14](#)

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

CODEC: coding / decoding, compression/decompression of an audio signal.

**Synonyms and Keywords**

CODEC audio device driversound card driver

---

**G06F 3/165**

{Management of the audio stream, e.g. setting of volume, audio stream path}

**Definition statement**

This place covers:

Management from a host of the audio device by means of the interface control for modifying the operation of the audio device. Only for control of the audio device/system from the host. Controlling the audio settings such as volume, mute, filters ... Controlling the audio stream path (switch output destination). Switch on or off of computer audio devices. Controlling the audio play, pause, replay.

**References**

*Limiting references*

This place does not cover:

Dedicated to TV appliances: [H04N 7/00](#) Control of streaming: [H04L 29/06](#) Control of speech to text / text to speech conversion: [G10L 13/00](#) and [G10L 15/00](#)

---

**G06F 3/167**

{Audio in a user interface, e.g. using voice commands for navigating, audio feedback}

**Definition statement**

This place covers:

Interface to a computer user by means of an audio device to send commands to the computer or receive feedback on an action. Limited to the navigation in a menu and sending control commands. Moving a mouse pointer on a screen using audio. Scrolling through a menu using audio. User interface of an audio card. Audio indicators to focus attention.

**References**

*Limiting references*

This place does not cover:

G06F 5/00
Methods or arrangements for data conversion without changing the order or content of the data handled (by coding or decoding H03M)

Definition statement
This place covers:
Data format conversions; Conversion between packed and unpacked BCD.

References

Limiting references
This place does not cover:

| Parallel-serial conversion. Code conversion | H03M 9/00, H03M 5/00, H03M 7/00 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Coding, decoding or code conversion, in general | H03M |

Special rules of classification
Use of Indexing Codes
ECLA reformed field, i.e. all ECLA classes have a corresponding G06F Indexing Code-code, which is to be used for secondary aspects (non-invention information).

G06F 5/01
for shifting, e.g. justifying, scaling, normalising (digital stores in which the information is moved stepwise, e.g. shift-registers G11C 19/00; digital stores in which the information circulates G11C 21/00)

Definition statement
This place covers:
Shifting which modifies the value being shifted, e.g. in arithmetic or for implementing shift instructions in processors; in particular the shifting functionality provided and the logic implementing it.

References

Limiting references
This place does not cover:

| Exception handling | G06F 7/49905 |
| Rounding | G06F 7/49942 |
| Sign extension | G06F 7/49994 |
| Electrical details of cells | G11C |
| Digital stores in which the information is moved stepwise, e.g. shift-registers | G11C 19/00 |
Digital stores in which the information circulates

Special rules of classification

Use of Indexing Codes:

Indexing Codes G06F 7/49905, G06F 7/49942, G06F 7/49994 are used for secondary aspects (non-invention information).

G06F 5/012

{in floating-point computations}

Definition statement

This place covers:
Details of the shifting arrangement.

References

Limiting references

This place does not cover:

Denomination or exception handling

G06F 5/015

{having at least two separately controlled shifting levels, e.g. using shifting matrices (G06F 5/012 takes precedence)}

Definition statement

This place covers:
For example, barrel shifter with multiple shifting stages.

References

Limiting references

This place does not cover:

Methods or arrangements for data conversion without changing the order or content of the data handled for shifting in floating-point computations

G06F 5/06

for changing the speed of data flow, i.e. speed regularising {or timing, e.g. delay lines, FIFO buffers; over- or underrun control therefor; (G06F 7/78 takes precedence)}

Definition statement

This place covers:
E.g. Shift registers with certain functionality and logic implementing it.
E.g. Buffer systems in general.
E.g. Fifos using linked lists.

E.g. Fifos of the types "shift-in, individual-out" or "individual-in, shift-out".

E.g. Effectuating transfer of data between different clock domains

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reordering based on contents of data in general</td>
<td>G06F 7/22</td>
</tr>
<tr>
<td>FIFOs having (limited) facilities for outputting other than the first data items, e.g. &quot;either first or second out&quot;</td>
<td>G06F 7/78, G06F 7/785</td>
</tr>
<tr>
<td>FIFO with priority-controlled output</td>
<td>G06F 13/18</td>
</tr>
</tbody>
</table>

G06F 5/065

{Partitioned buffers, e.g. allowing multiple independent queues, bidirectional FIFO's}

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addressing methods of the memory</td>
<td>G06F 12/02, G11C 8/00</td>
</tr>
</tbody>
</table>

G06F 5/08

having a sequence of storage locations, the intermediate ones not being accessible for either enqueue or dequeue operations, e.g. using a shift register {{G06F 5/065 takes precedence; shift registers per se G11C 19/00}}

Definition statement

This place covers:

E.g. physical shifting of data.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIFOs of the types &quot;shift-in, individual-out&quot; or &quot;individual-in, shift-out&quot;</td>
<td>G06F 5/06</td>
</tr>
<tr>
<td>Partitioned buffers, e.g. allowing multiple independent queues, bidirectional FIFO's</td>
<td>G06F 5/065</td>
</tr>
<tr>
<td>Shift registers per se</td>
<td>G11C 19/00</td>
</tr>
</tbody>
</table>
**G06F 5/10**

having a sequence of storage locations each being individually accessible for both enqueue and dequeue operations, e.g. using random access memory {((G06F 5/065 takes precedence))}

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIFOs of the types &quot;shift-in, individual-out&quot; or &quot;individual-in, shift-out&quot;</td>
<td>G06F 5/06</td>
</tr>
<tr>
<td>Partitioned buffers, e.g. allowing multiple independent queues, bidirectional FIFO's</td>
<td>G06F 5/065</td>
</tr>
<tr>
<td>Addressing methods of the memory</td>
<td>G06F 12/02, G11C 8/00</td>
</tr>
</tbody>
</table>

**G06F 5/12**

Means for monitoring the fill level; Means for resolving contention, i.e. conflicts between simultaneous enqueue and dequeue operations

**Definition statement**

*This place covers:*

E.g. signal generated / action taken before buffer runs full/empty.

**G06F 5/14**

for overflow or underflow handling, e.g. full or empty flags

**Definition statement**

*This place covers:*

Signal generated / action taken when buffer is already full/empty.

**G06F 5/16**

Multiplexed systems, i.e. using two or more similar devices that are alternately accessed for enqueue and dequeue operations, e.g. ping pong buffers

**Definition statement**

*This place covers:*

E.g. Alternating address by address, i.e. Odd-even.

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addressing methods of the memory</td>
<td>G06F 12/02, G11C 8/00</td>
</tr>
</tbody>
</table>
**G06F 7/00**

Methods or arrangements for processing data by operating upon the order or content of the data handled (logic circuits **H03K 19/00**)

**Definition statement**

*This place covers:*

The methods and arrangements in this main group are one level above logic circuits.

Examples of such methods and arrangements are: arithmetic circuits implemented using basic logic gates, implementation of complex logic gates, implementation at transistor level, specially designed for arithmetic operations

Other examples are:

Logical operations on words per se;

Finite state machines;

Grey System Theory (method of handling uncertainty),

- Asynchronous digital pipeline = clock-less operation of logical operations.

**References**

**Limiting references**

*This place does not cover:*

| Logical operations on words in combination with arithmetic operations | G06F 7/57 |
| Arrays of processors with common control | G06F 15/80 |
| Information retrieval, or database structures therefor | G06F 16/00 |
| Conversion between different representations of Boolean functions, e.g. Boolean formula synthesis from Karnaugh maps, generation of Reed-Muller expansions | G06F 17/00 |
| Complex mathematical operations | G06F 17/10 |
| Logic circuits, i.e. Implementation of basic logical circuits (AND, NAND, OR, NOR, EXOR, EXNOR), at transistor level | H03K 19/00 |

**Special rules of classification**

Use of Indexing Codes:

All ECLA classes have a corresponding G06F Indexing Code-code, which is to be used for secondary aspects (non-invention information).

Indexing Codes in the **G06F 2207/00** are used (i.e. compulsory) for invention information in certain ranges only:

- **G06F 2207/00+** for the entire **G06F 7/00**
- **G06F 2207/38+** for **G06F 7/38** and subgroups, i.e. **G06F 7/38 - G06F 7/575**
- **G06F 2207/48+** for **G06F 7/48** and subgroups, i.e. **G06F 7/48 - G06F 7/575**
Reconfigurable for different fixed word lengths (multigauge devices \texttt{G06F 2207/382}) i.e. a restricted number of fixed word-lengths, e.g. single & double precision

Unit distance code e.g. Grey codes

Clockless, i.e. asynchronous operation used as a design principle (\texttt{G06F 2207/3888} takes precedence) e.g. using a Muller C-element

Precharge of output to prevent leakage; i.e. precharge in general, not only for leakage prevention

Pipelining i.e. only synchronous pipelining;

Bit slicing i.e. data is split into slices of smaller width, each being processed separately

Cascode or current mode logic i.e. digit determination through current (not voltage)

Multiplexers used in an unusual way

**Glossary of terms**

\textit{In this place, the following terms or expressions are used with the meaning indicated:}

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual record carriers</td>
<td>Designates physically distinct carriers carrying digital information, e.g. sheets, cards.</td>
</tr>
</tbody>
</table>

**G06F 7/02**

Comparing digital values (\texttt{G06F 7/06}, \texttt{G06F 7/22}, \texttt{G06F 7/38} take precedence; information retrieval \texttt{G06F 16/00}; comparing pulses \texttt{H03K 5/22})

**Definition statement**

\textit{This place covers:}

For example, bit string matching, character string matching.

**References**

**Limiting references**

\textit{This place does not cover:}

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangements for sorting, selecting, merging or comparing data on individual record carriers</td>
<td>\texttt{G06F 7/06}</td>
</tr>
<tr>
<td>Arrangements for sorting or merging computer data on continuous record carriers, e.g. tape, drum, disc</td>
<td>\texttt{G06F 7/22}</td>
</tr>
<tr>
<td>Methods or arrangements for performing computations using exclusively denominalional number representation, e.g. using binary, ternary, decimal representation</td>
<td>\texttt{G06F 7/38}</td>
</tr>
<tr>
<td>Information retrieval</td>
<td>\texttt{G06F 16/00}</td>
</tr>
<tr>
<td>Comparing pulses</td>
<td>\texttt{H03K 5/22}</td>
</tr>
</tbody>
</table>
G06F 7/026

{Magnitude comparison, i.e. determining the relative order of operands based on their numerical value, e.g. window comparator}

Definition statement

This place covers:
Magnitude comparison generating less-than, greater-than, equal-to signals.

References

Limiting references

This place does not cover:

Min or max functions producing one of the two input values

G06F 7/06

Arrangements for sorting, selecting, merging or comparing data on individual record carriers (sorting of postal letters B07C; conveying record carriers from one station to another G06K 13/02)

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Sorting of postal letters B07C
Conveying record carriers from one station to another G06K 13/02

G06F 7/22

Arrangements for sorting or merging computer data on continuous record carriers, e.g. tape, drum, disc

Definition statement

This place covers:
E.g. classifying digital data.
E.g. maximum, minimum or median value of a set of data.
### References

#### Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum or maximum of two values</td>
<td>G06F 7/544</td>
</tr>
<tr>
<td>Classifying in pattern recognition</td>
<td>G06K 9/00</td>
</tr>
</tbody>
</table>

### Synonyms and Keywords

*In patent documents, the following words/expressions are often used as synonyms:*

- "Batcher sorter", "bitonic sorter" and "odd-even merge"

### G06F 7/38

**Methods or arrangements for performing computations using exclusively denominational number representation, e.g. using binary, ternary, decimal representation**

#### Definition statement

This place covers:

E.g. documents on number representations without dealing with the technical circuit implementation.

### G06F 7/544

**for evaluating functions by calculation** *(G06F 7/4824 takes precedence)*

#### References

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using signed-digit representation</td>
<td>G06F 7/4824</td>
</tr>
</tbody>
</table>

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>With a look-up table</td>
<td>G06F 1/02</td>
</tr>
<tr>
<td>Complex mathematical operations</td>
<td>G06F 17/10</td>
</tr>
</tbody>
</table>

### G06F 7/58

**Random or pseudo-random number generators**

#### Definition statement

This place covers:

Generation or transformation of stochastic functions; generation of output with certain random characteristics; post processing, e.g. pattern elimination, whitening, reducing auto-correlation or bias; breakdown detection.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformation of stochastic functions by table look-up</td>
<td>G06F 1/03</td>
</tr>
<tr>
<td>Lottery apparatus</td>
<td>G07C 15/00</td>
</tr>
<tr>
<td>Random pulse generators, random bit generators</td>
<td>H03K 3/84</td>
</tr>
<tr>
<td>Secret telegraphic communication</td>
<td>H04L 9/00</td>
</tr>
</tbody>
</table>

Special rules of classification

Random bit generators: In case of a bit sequence, which could be seen as a random number sequence, classification is done both in the appropriate (sub)group in G06F 7/58 and in H03K 3/84.

Methods both valid for random and pseudo-random number generators should be classified in the head group (G06F 7/58) and not in a sub-group, even if a specific PRNG/RNG is discussed.

Double classification head group / main group only

- on basis of other aspects, e.g. possibly non-trivial PRNG or RNG also disclosed
- in case it is not sure that the method is valid for both RNG and PRNG

Use of keywords

- Pseudo-random number generators i.e. only deterministic PRNGs; mixed RNGs in G06F 7/588 if more than one type of pseudo-random number generator is discussed; in case these PRNGs are clearly trivial: classify in head group (G06F 7/58) - in case a PRNG might be non-trivial: classify in relevant sub-group(s) G06F 7/582
- Using finite field arithmetic, e.g. using a linear feedback shift register generators including the 2^n state with all zeroes in G06F 7/582 G06F 7/584
- Random number generators, i.e. based on natural stochastic processes also mixed PRNG/RNGs Considered as random (G06F 7/588) are methods based on - radioactivity, zener, race, chaos- uncertain moment of pressing a key G06F 7/588
- Using non-contact-making devices, e.g. tube, solid state device; using unspecified devices e.g. 2's complementing G06F 7/48
- Using coordinate rotation digital computer (CORDIC) i.e. CORDIC in non-complex environment: G06F 7/5446 G06F 7/4818
- Using signed-digit representation Binary multipliers and dividers often use signed-digit representation internally for one operand or the result; see therefor "recoded" or "Booth" multipliers in G06F 7/523 - G06F 7/5338 and "recoded" or "SRT" dividers in G06F 7/535 - G06F 7/5375. G06F 7/4824
- Computations with numbers represented by a non-linear combination of denominational numbers, e.g. rational number, logarithmic number system, floating-point numbers (conversion to or from floating-point codes H03M 7/24) (G06F 7/4806, G06F 7/4824, G06F 7/49, G06F 7/491, G06F 7/544 take precedence) e.g. fused multiply add (FMA) also here, but add G06F 7/5443 G06F 7/483
- Logarithmic number system mainly for non-trivial operations such as addition, multiplication of binary operands via the log-domain is in G06F 7/5235 G06F 7/4833
| Adding; Subtracting (G06F 7/4833 takes precedence) e.g. floating-point addition | G06F 7/485 |
| Dividing i.e. floating-point division | G06F 7/4873 |
| Multiplying i.e. floating-point multiplication If in fact only the mantissa-multiplication is treated, classification should be made in another group, unless special features for switching between fixed and floating point operands are described. | G06F 7/4876 |
| Computations with a radix, other than binary, 8, 16 or decimal, e.g. ternary, negative or imaginary radices, mixed radix (non-linear PCM, G06F 7/4824 takes precedence) N-ary logic | G06F 7/49 |
| Multiplying; Dividing MULTIPLICATION ONLY division goes into G06F 7/4915. whether it uses 8421 code or not | G06F 7/496 |
| Mantissa overflow or underflow in handling floating-point numbers e.g. exponent adjustment | G06F 7/49915 |
| Normalisation mentioned as feature only 'i.e use of normalisation Implementation of floating-point normalisers: G06F 5/012 | G06F 7/49936 |
| Significance control i.e. number of significant bits | G06F 7/49942 |
| Implementation of IEEE-754 Standard Note: The standard uses sign magnitude representation | G06F 7/49957 |
| Rounding to nearest (G06F 7/49957 takes precedence) Note: The IEEE-754 way is "rounding to nearest even", which is rounds to nearest, and only when exactly in the middle to nearest even. Though rounding to nearest odd may in fact round to an even number, it normally doesn't. | G06F 7/49963 |
| Rounding towards zero (G06F 7/49957 takes precedence) e.g. as in IEEE-754 | G06F 7/49978 |
| Rounding away from zero way of rounding not provided for in IEEE-754 | G06F 7/49984 |
| Interval arithmetic i.e. computations with intervals as values | G06F 7/49989 |
| Adding; Subtracting (G06F 7/4806, G06F 7/4824, G06F 7/483 - G06F 7/491, G06F 7/544 take precedence) only binary, radix 8, radix 16.. using carry switching, i.e. the incoming carry is connected directly to the carry output under control of a carry propagate signal Full adders having in general the form1-bit adder stages (ripple carry) with simultaneous carry generation for or propagation over two or more stages e.g. using group carry signals, e.g. carry skip; all smart carry schemes except carry look-ahead and carry select/ conditional sum are in G06F 7/506 |
| Using selection between two conditionally calculated carry or sum values e.g. carry select, conditional sum | G06F 7/507 |
| for multiple operands, e.g. digital integrators i.e. operand-parallel addition of 3 or more operands (this is mainly "3" or "a lot"); multipliers in G06F 7/52 | G06F 7/509 |
| word-serial, i.e. with an accumulator-register i.e. OPERAND serial! | G06F 7/5095 |
Multiplying; Dividing (G06F 7/4806, G06F 7/4824, G06F 7/483 - G06F 7/491, G06F 7/544 take precedence) very rare cases only; normally documents are classified in one of the subgroups (or both) This subgroup does not cover G06F 7/544: multiplier-accumulators \((f = \sum a_i x_i)\), including simple cases \(f = ax + b, f = ax + by\) by G06F15/347: vector multipliers, matrix multipliers G06F 7/68: binary rate multipliers/dividers G06F 7/724: finite field multipliers

In serial-parallel fashion, i.e. one operand being entered serially and the other in parallel (G06F 7/533 takes precedence) In old documents these multipliers are often called "parallel", in newer documents they are often called "serial"!

with row-wise addition of partial products i.e. adding two rows each cycleIn majority: "add to accumulator and shift"

In parallel-parallel fashion, i.e. both operands being entered in parallel (G06F 7/533 takes precedence) e.g. single cells for cellular array multipliers, e.g. adding one column each cycle with a parallel counter

Using indirect methods, e.g. quarter-square method, via logarithmic domain if operands stay in the log-domain then G06F 7/483 quarter-square see XP013079891

In serial-serial fashion, i.e. both operands are entered serially (G06F 7/533 takes precedence) e.g. Lyon multipliers (see XP007901470)

With row-wise addition of partial products (G06F 7/5324 takes precedence) cellular array multipliers with ripple carry (=within rows) also skewed arrays of the type "McCanny & McWhirter" e.g. linear chain of cascaded adders

With column-wise addition of partial products, e.g. using Wallace tree, Dadda counters (G06F 7/5324 takes precedence) e.g. adder trees

Partitioned, i.e. using repetitively a smaller parallel-parallel multiplier or using an array of such smaller multipliers each smaller multiplier larger than 1 bit; multiprecision; also array multipliers A) \(n \times m\) bit multiplier consisting of an array of \(k \times l\) multipliers, \(k\) being a submultiple of \(n\) and \(l\) being a submultiple of \(m\) respectively, followed by an array or tree of adders, e.g. of Wallace type. B) \(n \times m\) bit multiplication realised by a single \(k \times l\) multiplier, \(k\) and \(l\) as above, used repetitively and followed by an accumulator. The \(k \times l\) bit multipliers may be single ROM's for example. Not to be confused with multi-bit-scanning, where a selection among precalculated multiples of the multiplicand is made; if the \(k \times l\) bit multipliers itself are of the latter type, double classification may be appropriate.
Reduction of the number of iteration steps or stages, e.g. using the Booth algorithm, log-sum, odd-even for Booth, use the subgroups! Note: the term "Booth" is often incorrectly used when intending to say "modified Booth". A Booth recoder module inputs some, e.g. two, consecutive bits and sends a 'Booth carry' to a more significant module. A modified Booth recoder module inputs some, at least three, consecutive bits, the most significant of which is also input to the next higher recoder module. In modified Booth the recoder modules are not connected to each other via a carry.

By skipping over strings of zeroes or ones, e.g. using the Booth Algorithm,e.g. using operand processing, e.g. simple (radix-2, 1st order) Booth, also canonical recoding to NAF form (sequential recoding with carry)

By using multiple-bit-scanning, i.e. by decoding groups of successive multiplier bits in order to select an appropriate pre-calculated multiple of the multiplicand as a partial product i.e. processing multiple bits per iteration (radix > 2) without overlap, e.g. using positive precalculated multiples only groups of MR-bits are decoded for selecting multiples of MD e.g. 2-bit groups: 3-bit groups: 00 0 × MD 000 0 × MD 01 1 × MD 001 1 × MD 10 2 × MD 010 2 × MD 11 3 × MD 011 3 × MD 100 4 × MD 101 5 × MD 110 6 × MD 111 7 × MD multiples, that are not a power of 2(3x, 7x, etc) have to be precalculated or looked up in a table.

Each bitgroup having two new bits, e.g. 2nd order MBAi.e. radix-4 modified Booth, i.e. 2nd order modified Booth

Reduction of the number of iteration steps or stages, e.g. using the Sweeny-Robertson-Tocher (SRT) algorithm (not used, see G06F 7/535 or G06F 7/5375 ) NOT USED, non-restoring in general gets the KW non-restoring, SRT in particular goes in G06F 7/5375

Non restoring calculation, where each digit is either negative, zero or positive, e.g. SRT; (WARNING Not complete. Provisionally see G06F 7/535 + G06F 7/5375) almost empty - everything is in Indexing Code G06F 7/5375

For evaluating functions by calculation (with a look-up table G06F 17/10; complex mathematical operations G06F 7/4806, G06F 7/4824 take precedence) e.g. min, max of two operands, absolute value, (sum of) absolute difference, finding a maximum value of a set (e.g. during sorting) is in G06F 7/22; direct table lookup of function values is in G06F 1/03; table lookup of coefficients during computation goes here, put "table lookup" in the TXT field;

Sum of products (for applications thereof, see the relevant places, e.g. G06F 17/10, H03H 17/00) e.g. MACs; fused multiply add (FMA) for floating point are in G06F 7/483 with G06F 7/5443

using crossaddition algorithms, e.g. CORDIC e.g. sin, cos, tan, sinh, cosh, tanh;CORDIC on complex numbers: G06F 7/4818

Powers or roots, e.g. Pythagorean sumse.g. powers by multiplying the operand by itself (which is not possible with non-integer powers)

Arithmetic logic units (ALU), i.e. arrangements or devices for performing two or more of the operations covered by groups G06F 7/483-G06F 7/556 or for performing logical operations (instruction execution G06F 9/30; G06F 7/49, G06F 7/491 take precedence; logic gate circuits H03K 19/00) e.g. arrangements for performing more than one operation using the same circuitry
Basic arithmetic logic units, i.e. devices selectable to perform either addition, subtraction or one of several logical operations, using, at least partially, the same circuitry: Note: multiplication is not seen as "basic",

G06F 7/575

G06F 7/60

Methods or arrangements for performing computations using a digital non-denominational number representation, i.e. number representation without radix; Computing devices using combinations of denominational and non-denominational quantity representations (e.g. using difunction pulse trains, STEELE computers, phase computers (conversion of digital data to or from non-denominational form H03M 5/00, H03M 7/00))

Definition statement

This place covers:

For example, documents concerning

• "permutograph";
• a "Negationsnetz";

Fibonacci code representation.

Further details of subgroups

G06F 7/602:

using difunction pulse trains (STEELE computers); phase computers (GAINES). e.g. Delta-Sigma sequences.

G06F 7/607:

number-of-ones counters, i.e. devices for counting the number of input lines set to ONE among a plurality of input lines, also called bit counters or parallel counters (for applications thereof, see the relevant places, e.g. G06F 7/49, G06F 7/5013, G06F 7/509, H03M 1/00, H03M 7/20)

e.g. number of ones counters (parallel counters), compressors, carry save adders 4-2, 7-3, etc, e.g. used in multipliers.

G06F 7/64:

Digital differential analysers, i.e. computing devices for differentiation, integration or solving differential or integral equations, using pulses representing increments; Other incremental computing devices for solving difference equations (G06F 7/70 takes precedence; differential analysers using hybrid computing techniques G06J 1/02) DDA application in numerical control G05B 19/18. Integration per se: G06F 17/10.

G06F 7/68:

Using pulse rate multipliers or dividers pulse rate multipliers or dividers per se (G06F 7/70 takes precedence) (frequency division in electronic watches G04G 3/02; frequency multiplication or division in oscillators H03B 19/00; frequency dividing counters per se H03K 23/00 - H03K 29/00)

e.g. phased locked loop (PLL) with digital divider (thus achieving pulse rate multiplication); PLLs in general are in H03L 7/06;

pulse rate doubling by adding delayed pulses and correcting the duty cycle are in H03K 5/1565; H03K 23/00 - H03K 29/00 mostly relate to analogue aspects.
References

Limiting references

This place does not cover:

| Conversion of digital data to or from non-denominational form | H03M 5/00, H03M 7/00 |

G06F 7/72

using residue arithmetic

Definition statement

This place covers:

A mod N, modulo addition, modulo subtraction

G06E 1/065: optical residue arithmetic devices

applications in:

H03M 13/00, Error detection/correction for coding in general.

G06F 11/00, Error detection/correction in computers.

H04L 1/00, Error detection/correction in transmission.

H04L 9/00, Secret communication. Further details of groups

G06F 7/721:

Modular inversion, reciprocal or quotient calculation (G06F 7/724, G06F 7/727, G06F 7/728 take precedence).

e.g. modular division; both with composite moduli and in prime number fields; inversion in extension fields is in G06F 7/726.

G06F 7/723:

Modular exponentiation (G06F 7/724, G06F 7/727, G06F 7/728 take precedence) [N0302] [C0302]. RSA in general is here.

G06F 7/724:

Finite field arithmetic (for error detection or correction in general H03M 13/00, in computers G06F 11/10).

Mainly (binary) extension fields; prime number fields using modular arithmetic and are in G06F 7/72 - G06F 7/723, G06F 7/727 and G06F 7/728.

For this type of arithmetic also the term "Galois field" and symbols of the type GF (2P) are characteristic.

G06F 7/725:

over elliptic curves

elliptic curve cryptography ECC goes here, but only give class if specific adaptation for ECs.

G06F 7/726:
Inversion; Reciprocal calculation; Division of elements of a finite field E.g. rational functions $p(x)/q(x)$.

**G06F 7/728**

Using Montgomery reduction

Montgomery reduction involves adding of multiples of the modulo, followed by right shifting.

**G06F 7/729**

using representation by a residue number system
e.g. Chinese Remainder Theorem for non-RSA

A residue number system (RNS) is a system in which a number is represented by a series of digits, each of which is the remainder of that number with respect to a different modulus $m_i$:

e.g.: moduli -> 5 3 2

$26_{10} = 1 2 0$

The maximum number representable is $M = (\prod_i m_i) - 1$
e.g.: $(2 \times 3 \times 5) - 1 = 29$ in the above case.

**G06F 7/74**

Selecting or encoding within a word the position of one or more bits having a specified value, e.g. most or least significant one or zero detection, priority encoders {(with shifting **G06F 5/01**)}

**Definition statement**

This place covers:
E.g. leading zero anticipation LZA, priority encoders.

With shifting (during/for detection) details: also in **G06F 5/01**.

**References**

**Limiting references**

This place does not cover:

| with shifting | G06F 5/01 |

**G06F 7/76**

Arrangements for rearranging, permuting or selecting data according to predetermined rules, independently of the content of the data (according to the content of the data **G06F 7/06, G06F 7/22**; parallel / series conversion or vice versa **H03M 9/00**)

**Definition statement**

This place covers:
For example, masking, shuffling

**G06F 7/764**: Masking. Boolean masking in block or stream ciphers in **H04L 2209/04**.
**G06F 7/76**: Generation of all possible permutations. i.e. serial or parallel generation of all permutations.

**G06F 7/768**: Data position reversal, e.g. bit reversal, byte swapping
e.g. endian conversion;

Endian conversion by memory addressing: **G06F 12/04.**

Bus coupling with endian conversion: **G06F 13/4013.**

Endian conversion instruction: **G06F 13/4013.**

**References**

**Limiting references**

This place does not cover:

| Arrangements for rearranging, permuting or selecting data according to the content of the data | G06F 7/06, G06F 7/22 |
| Parallel / series conversion or vice versa | H03M 9/00 |

**G06F 7/78**

for changing the order of data flow, e.g. matrix transposition, LIFO buffers;
Overflow or underflow handling therefor

**Definition statement**

This place covers:

LIFO, also called stack or pushdown store:
- Reversal of a train of data words.
- Reversal of a train of data bits.

Devices called FIFO, but having possibilities to extract also other data items than the first one.

Matrix transportation devices.

Other devices with an output sequence different from the input sequence, but independent of the contents of the data.

**References**

**Limiting references**

This place does not cover:

| FIFO-devices: | G06F 5/06 |
| cache-memories: | G06F 12/08 |
| "FIFO" with priority-controlled output: | G06F 13/18 |
| reordering based on contents of data, e.g. sort key: | G06F 7/22 |
**G06F 8/00**

Arrangements for software engineering (testing or debugging **G06F 11/36**; administrative, planning or organisation aspects of software project management **G06Q 10/06**)

**Definition statement**

*This place covers:*

The engineering discipline of creating software and the assistance of computer tools (CASE tools) in exercising the task of software engineering.

The phases, covered by **G06F 8/00**, range from the initial requirements collection up to and including the delivery of software to the end user, its maintenance and management but exclude the phase of testing and debugging.

**Relationships with other classification places**

Aspects of the particular application of the software being designed, e.g. commercial or financial software, are classified in the appropriate place.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Testing or debugging</th>
<th>G06F 11/36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative, planning or organisation aspects of software project management</td>
<td>G06Q 10/06</td>
</tr>
</tbody>
</table>

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Execution of a stored program</th>
<th>G06F 9/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware/software co-design</td>
<td>G06F 17/50</td>
</tr>
</tbody>
</table>

**Synonyms and Keywords**

*In patent documents, the following abbreviations are often used:*

| CASE | Computer-Aided Software Engineering |

**G06F 8/10**

Requirements analysis; Specification techniques

**Definition statement**

*This place covers:*

Capturing and formalising user requirements:
- Graph notations;
- Diagramming techniques, e.g. Dataflow diagrams;
- Requirements specifications;
- Use of modelling languages such as uml;
• Petri nets.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Circuit design</th>
<th>G06F 17/5045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification of network protocols</td>
<td>H04L 69/03</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>UML</th>
<th>Unified Modeling Language</th>
</tr>
</thead>
</table>

G06F 8/20

Software design

Definition statement

This place covers:
Software design, including the determination of the main structure, the modules that will be created and the relationships between them.

The use of design patterns for object-oriented development.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Computer-aided design in general</th>
<th>G06F 17/50</th>
</tr>
</thead>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>MVC</th>
<th>Model-View-Controller</th>
</tr>
</thead>
</table>

G06F 8/22

{Procedural}

Definition statement

This place covers:
The conventional design paradigm, where a design is defined in terms of a sequence of actions to be performed. An example is the Jackson Structured Programming method.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Declarative</th>
<th>G06F 8/313</th>
</tr>
</thead>
</table>

G06F 8/24

{Object-oriented}

Definition statement

This place covers:

The process of planning a system in terms of interacting objects for the purpose of solving a software problem as defined by the (formalised) user requirements. Examples are the design patterns from the book "Design Patterns: Elements of Reusable Object-Oriented Software" by Gamma et al.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Object-oriented method resolution</th>
<th>G06F 9/449</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inheritance</td>
<td>G06F 9/4492</td>
</tr>
<tr>
<td>Object-oriented databases</td>
<td>G06F 16/289</td>
</tr>
</tbody>
</table>

G06F 8/30

Creation or generation of source code

Definition statement

This place covers:

The conceptual step of converting an abstract representation (design or specification) of a software system, into a more concrete representation in the form of program code.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Specification techniques for generating programs</th>
<th>G06F 8/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compilation, i.e. the process of converting source code into binary code during the task of software engineering</td>
<td>G06F 8/41</td>
</tr>
<tr>
<td>Reverse engineering; Extracting design information from a source code</td>
<td>G06F 8/74</td>
</tr>
<tr>
<td>Porting source code to a different environment</td>
<td>G06F 8/76</td>
</tr>
<tr>
<td>Query generation in information retrieval</td>
<td>G06F 16/33, G06F 16/24</td>
</tr>
</tbody>
</table>
**G06F 8/31**

**{Programming languages or programming paradigms}**

**Definition statement**

*This place covers:*

Programming languages and paradigms that can be used by a programmer in order to create source code.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Processing or translating of natural language | G06F 17/28 |

**Synonyms and Keywords**

*In patent documents, the following abbreviations are often used:*

| HLL | High Level Language |

**G06F 8/311**

**{Functional or applicative languages; Rewrite languages}**

**Definition statement**

*This place covers:*

Languages designed for functional programming that treats computation as the evaluation of mathematical functions. Examples are Sasl, Miranda and Haskell.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Functional programming</th>
<th>software development model which expresses algorithms as functions, i.e. as stateless mappings of input values to output values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declarative programming</td>
<td>programming paradigm that expresses a computation without describing its control flow</td>
</tr>
</tbody>
</table>

**G06F 8/312**

**{List processing, e.g. LISP programming language}**

**Definition statement**

*This place covers:*

List processing languages, e.g. Lisp and Scheme.
Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>Function that determines the first element of a list</td>
</tr>
<tr>
<td>CDR</td>
<td>Function that determines the list after its first element</td>
</tr>
</tbody>
</table>

G06F 8/313
{Logic programming, e.g. PROLOG programming language}

Definition statement
This place covers:
Programming languages expressing a program as a collection of logical statements.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declarative programming</td>
<td>programming paradigm that expresses a computation without describing its control flow</td>
</tr>
<tr>
<td>Horn clause</td>
<td>logical statement</td>
</tr>
</tbody>
</table>

G06F 8/3135
{Unification or backtracking}

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unification</td>
<td>finding an assignment that satisfies all clauses</td>
</tr>
<tr>
<td>Backtracking</td>
<td>done on partial unifications that cannot succeed, and to continue to find more possible unifications</td>
</tr>
</tbody>
</table>

G06F 8/314
{Parallel programming languages (G06F 8/313 takes precedence)}

Definition statement
This place covers:
Programming languages having constructs for expressing parallelism, e.g. Occam.

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Term</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel logic programming</td>
<td>G06F 8/313</td>
</tr>
<tr>
<td>Detecting and extracting parallelism from program code</td>
<td>G06F 8/456</td>
</tr>
</tbody>
</table>
G06F 8/315

{Object-oriented languages}

Definition statement

This place covers:
Programming languages expressing algorithms as interacting objects, where an object is an aggregation of data (attributes) and actions (methods).

Examples of object oriented languages are Smalltalk, Ruby, Eiffel, C++, C#, Java, Oberon, Modula.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Term</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object-oriented design paradigms</td>
<td>G06F 8/24</td>
</tr>
<tr>
<td>Object-oriented systems</td>
<td>G06F 9/4488</td>
</tr>
<tr>
<td>Method invocation</td>
<td>G06F 9/449</td>
</tr>
<tr>
<td>Distributed object-oriented systems</td>
<td>G06F 9/465</td>
</tr>
<tr>
<td>Object-oriented databases</td>
<td>G06F 16/289</td>
</tr>
</tbody>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>the action to be performed on (attributes of) an object</td>
</tr>
</tbody>
</table>

G06F 8/316

{Aspect-oriented programming techniques}

Definition statement

This place covers:
Programming paradigm allowing different, orthogonal, aspects of a program (business rules, security, fault tolerance, data consistency) to be designed independently and to be merged later to produce a final source code product.

Aspect-Oriented Software Development foresees a full and independent design for all the secondary aspects of an application like security, persistency, synchronization, logging, etc., carried out at the same time as the design of the core functionality of the application.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspect Weaving</td>
<td>the process of merging the different aspects</td>
</tr>
<tr>
<td>Join Points</td>
<td>the actual places in the program where the aspects are merged</td>
</tr>
</tbody>
</table>
Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOSD</td>
<td>Aspect oriented software development</td>
</tr>
</tbody>
</table>

G06F 8/33

Intelligent editors

Definition statement

This place covers:
Intelligent editors that help a programmer to write programs, e.g. language-sensitive editors.

Examples:
- Proposing a closing bracket when an opening bracket is typed.
- Indenting of if-then-else statements.
- Verification of entered text (e.g. whether variables are already declared).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text processing</td>
<td>G06F 17/21</td>
</tr>
</tbody>
</table>

G06F 8/34

Graphical or visual programming

Definition statement

This place covers:
A programming technique whereby a program is created by handling graphical programming objects representing programming constructs/statements rather than writing program text.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of icons for interaction</td>
<td>G06F 3/048</td>
</tr>
<tr>
<td>Intelligent editors</td>
<td>G06F 8/33</td>
</tr>
<tr>
<td>Development of GUIs, User Interface Management Systems (UIMS)</td>
<td>G06F 8/38</td>
</tr>
<tr>
<td>Web page development</td>
<td>G06F 16/95</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating programs for controlling physical processes by graphically specifying the process to be controlled</td>
<td>G05B 19/0426</td>
</tr>
</tbody>
</table>
Creating relay ladder logic program for Programmable Logic controllers (PLC)  G05B 19/056
Multimedia authoring  G11B 27/031

G06F 8/35
model driven

Definition statement
This place covers:
Automatically generating program code (source code) from a specification/definition/model of what the program should do.
Specific topics included:
• Generating a debugger from a formal specification: EP1071016;
• Generation of source code for web applications: WO0171566;
• Convert spreadsheet data into source code: US2003106040, US2004064470;
• Generate source code from XML: US2003167444;
• Generate a shader program from a graphics file: US2003179220;
• OMG's Model driven architecture (MDA).

Synonyms and Keywords
In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDSD</td>
<td>Model driven software development</td>
</tr>
<tr>
<td>MDA</td>
<td>Model driven architecture</td>
</tr>
</tbody>
</table>

G06F 8/355
{Round-trip engineering}

Definition statement
This place covers:
Arrangement for keeping a model and the corresponding program code in sync when applying changes to any of them.

G06F 8/36
Software reuse

Definition statement
This place covers:
• Storing and retrieving reusable software modules into and from software repositories;
• Building, searching and maintaining software repositories containing reusable software parts;
• Managing repositories of software components, objects;
• Storing software components into a repository, thereby indicating additional information about the components, e.g. the function performed, what inputs are required, what outputs are generated;
• Querying the repository to retrieve components that satisfy the particular requirements, e.g. related to its function;
• Detecting program parts that are candidates for reuse;
• Design patterns.

References

Limiting references

This place does not cover:

| Exlining, i.e. finding similar sequences of code to replace them with a procedure invocation | G06F 8/4436 |
| Version control using repositories | G06F 8/71 |
| Code clone detection, i.e. detection of identical pieces of code for the purpose of maintenance | G06F 8/751 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Plagiarism detection in program code | G06F 21/10 |

G06F 8/37

{Compiler construction; Parser generation}

Definition statement

This place covers:
• Automatically generating a compiler or parser based on a specification of a grammar/syntax, e.g. Lex and Yacc.
• Generation of lexical analyzers.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Compilation per se | G06F 8/41 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Compiler Bootstrapping | creating a compiler using the language it is intended to compile |

G06F 8/38

for implementing user interfaces

Definition statement

This place covers:
The development and generation of source code for user interfaces, in particular GUIs.
References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| User interaction with graphical user interfaces | G06F 3/048 |
| Details relating to the actual functioning of (graphical) user interfaces | G06F 9/451 |

G06F 8/40
Transformation of program code

Definition statement
This place covers:
The transformation of program code from one form into another.

G06F 8/41
Compilation

Definition statement
This place covers:
The process of converting source code into binary code.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Compiler generators | G06F 8/30 |
| Runtime code conversion | G06F 9/455 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Binary code | a representation of a code understood by a machine |

G06F 8/42
{Syntactic analysis}

Definition statement
This place covers:
Determining grammatical structure of the source code with respect to a given formal grammar.
G06F 8/423

{Preprocessors}

**Definition statement**

*This place covers:*
Processing language-external elements, e.g. compiler directives, macro definitions and macro expansions, and inclusion of library source files.

G06F 8/425

{Lexical analysis}

**Definition statement**

*This place covers:*
Converting sequences of characters into tokens, skipping comments.

G06F 8/427

{Parsing}

**Definition statement**

*This place covers:*
Checking for correct syntax and building a data structure, e.g. parse tree.

Multibox parsers.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Parser generators</th>
<th>G06F 8/37</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parsing of XML code</td>
<td>G06F 17/20</td>
</tr>
</tbody>
</table>

G06F 8/43

{Checking; Contextual analysis}

**Definition statement**

*This place covers:*
Checking context-sensitive conditions, e.g. whether variables have been declared.

G06F 8/433

{Dependency analysis; Data or control flow analysis}

**Definition statement**

*This place covers:*
Determining the dependencies between different program parts (e.g. data dependencies, which variables/values are used in expressions, and control dependencies, which statements have influence
on other statements), in particular to determine whether such program parts should be placed in a certain order.

G06F 8/434
{Pointers; Aliasing}

Definition statement
This place covers:
Determining whether references, e.g. pointers, reference variables and indexed array elements, actually refer to the same underlying memory element.

G06F 8/436
{Semantic checking}

Definition statement
This place covers:
Checking semantic conditions which can be determined without actual execution of the program, e.g. whether variables are initialized.

G06F 8/437
{Type checking}

Definition statement
This place covers:
Checking type compatibility of values, variables, parameters and expressions.

G06F 8/44
{Encoding}

Definition statement
This place covers:
Generating an executable implementation of the program for the target machine architecture, usually via an internal form that is independent of the source programming language and that is also independent of the target machine architecture.

G06F 8/441
{Register allocation; Assignment of physical memory space to logical memory space}

Definition statement
This place covers:
Assigning logical registers to variables, assigning physical register to logical registers, coalescing, spilling.
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Coalescing | removing useless copy instructions from a program. This needs information about assigned registers and therefore it is commonly performed as a subtask of register allocation besides spilling and register assignment. |

G06F 8/443

{Optimisation}

Definition statement

This place covers:
Optimisation of the program code; the program code can take any form e.g. source code, assembly code, machine code.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Code refactoring | G06F 8/72 |

Special rules of classification

Whenever an optimisation concerns speed, size, etc, such documents should be classified in the corresponding subgroups. In this group should be classified only special optimisation techniques not present in any of the subgroups.

| Contains optimizations that do not involve a trade off between different factors (speed, size, energy consumption) | G06F 8/443 |
| Involve a trade-off. They are specifically aimed to optimize one aspect, likely at the cost of another aspect. | G06F 8/4432, G06F 8/4434, G06F 8/4441 |

G06F 8/4432

{Reducing the energy consumption}

Definition statement

This place covers:
Optimisation methods specifically aimed at reducing the energy consumption of program code.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Means for Saving Power, Power Management strategies | G06F 1/3203 |
G06F 8/4434
{Reducing the memory space required by the program code}

Definition statement

This place covers:

Optimisation methods specifically aimed at reducing the size of the program code, e.g. by replacing
sequences of recurring instructions with a new macro instruction/superinstruction. Requires that the
target architecture/virtual machine recognize this new instruction; Cross jumping; Tail Merging.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Data compression (e.g. PKZIP) | H03M 7/30 |

Special rules of classification

Note that this group does not cover the compression of program code, which requires a
decompression before it can be executed. Compression of program code in this sense does not result
in the actual program being smaller; there is only a saving in the secondary storage or transmission
via the network.

In contrast, the size-reduced code covered by this group is directly executable, so no decompression
is needed before execution.

G06F 8/4435

{Detection or removal of dead or redundant code}

Definition statement

This place covers:

Detecting and removing of dead or redundant code. Redundancy elimination optimizations avoid
repeated computation of the same value by computing the value once, saving it in a temporary
variable, and reusing the value from the temporary variable when it is needed again. Examples of
redundancy elimination optimizations include common subexpression elimination, loop invariant code
motion and partial redundancy elimination.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Dead code</th>
<th>code that is never executed or that is unreachable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundant code</td>
<td>code that produces results that are never used or are irrelevant to the program execution or code that computes values that were already computed before.</td>
</tr>
</tbody>
</table>
G06F 8/4436

{Exlining; Procedural abstraction}

**Definition statement**

*This place covers:*

Detecting recurring sequences of instructions and replacing each of them with a call to a procedure/function that contains those instructions.

**References**

*Informative references*

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Reuse, i.e. identifying recurring pieces of code for purposes of reuse</th>
<th>G06F 8/36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlining</td>
<td>G06F 8/4443</td>
</tr>
<tr>
<td>Code clone detection, i.e. detection of identical pieces of code for the purpose of maintenance</td>
<td>G06F 8/751</td>
</tr>
<tr>
<td>Plagiarism detection in a source code</td>
<td>G06F 21/10</td>
</tr>
</tbody>
</table>

G06F 8/4441

{Reducing the execution time required by the program code}

**Definition statement**

*This place covers:*

Optimisation methods specifically aimed at improving the execution speed of the program.

G06F 8/4442

{Reducing the number of cache misses; Data prefetching (cache prefetching G06F 12/0862)}

**Definition statement**

*This place covers:*

Avoiding cache misses at run-time. Cache can be instruction or data cache.

Splitting a program into frequently used and not frequently used parts (hot and cold parts) and keeping the hot parts in the cache.

Rearranging the individual instructions in order to have data/instructions present in the cache when they are needed.

**References**

*Limiting references*

*This place does not cover:*

| Cache prefetching | G06F 12/0862 |
**G06F 8/4443**

{Inlining}

**Definition statement**

*This place covers:*

Replacing a procedure invocation with the instructions of the procedure, thus removing the cost of procedure invocation.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Exlining | G06F 8/4436 |

**G06F 8/445**

{Exploiting fine grain parallelism, i.e. parallelism at instruction level (run-time instruction scheduling **G06F 9/3836**)}

**Definition statement**

*This place covers:*

Increasing the Instruction Level Parallelism (ILP) that can be exploited by the hardware at run-time (pipelines, superscalar processors executing multiple instruction streams). Typically this is done by reordering the instructions (scheduling).

**References**

**Limiting references**

*This place does not cover:*

| Exploiting coarse grain parallelism | G06F 8/45 |
| Run-time scheduling or reordering of instructions by the hardware | G06F 9/3836 |
| Process scheduling | G06F 9/4881 |

**Glossary of terms**

_In this place, the following terms or expressions are used with the meaning indicated:*

| Scheduling | reordering of instructions |

**Synonyms and Keywords**

_In patent documents, the following abbreviations are often used:*

| ILP | Instruction Level Parallelism |
G06F 8/4451

{Avoiding pipeline stalls}

Definition statement

This place covers:
Reducing or avoiding run-time pipeline stalls.

Pipeline stalls (or bubbles) are caused by control hazards — e.g. branches —, data hazards — one instruction depends on the result of another instruction and must wait for this instruction to finish — or resource hazards — there are not enough resources to serve all the instructions currently in flight — instructions must wait for resources to be freed in order to be fed to the pipeline. Control Hazards can handled by static branch-prediction, speculative execution or delayed branch. Data Hazards can be avoided by rearranging the instructions so that instructions that depend on each other’s result are farther separated.

In a pipeline, there is only one instruction stream. So the parallelism consists in the overlapping of the instructions of the stream rather than executing the instructions of 2 streams simultaneously.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Hardware aspects of pipelining | G06F 9/38 |

G06F 8/4452

{Software pipelining}

Definition statement

This place covers:
Software pipelining, e.g. Modulo Scheduling, transforms a loop described in a high-level programming language, such as C or FORTRAN, in such a way that the execution of successive iterations of the loop are overlapped rather than sequential. This technique exposes the instruction level parallelism (ILP) available between successive loop iterations to the compiler and to the processor executing the transformed code.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Hardware aspects of pipelining | G06F 9/38 |

G06F 8/447

{Target code generation}

Definition statement

This place covers:
Generation of executable code from the optimized compiler-internal representation of the source code, taking the target machine architecture into account.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Run-time compounding of instructions by the hardware | G06F 9/3853 |

G06F 8/45

{Exploiting coarse grain parallelism in compilation, i.e. parallelism between groups of instructions}

Definition statement

This place covers:

Speeding up the execution of a single task by subdividing the task into a plurality of subtasks and having the subtasks executed simultaneously on different processors. The subtasks are interdependent and they work together to achieve the same goal as the original task.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Exploiting fine grain parallelism | G06F 8/445 |

G06F 8/451

{Code distribution (considering CPU load at run-time G06F 9/505; load rebalancing G06F 9/5083)}

Definition statement

This place covers:

Distributing the code of each of the subtasks to the available processors.

References

Limiting references

This place does not cover:

| Considering CPU load at run-time | G06F 9/505 |
| Load rebalancing | G06F 9/5083 |

G06F 8/452

{Loops}

Definition statement

This place covers:

Distributing iterations of parallelizable loops among the processors.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Software pipelining</th>
<th>G06F 8/4452</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation of resources to service a request</td>
<td>G06F 9/5005</td>
</tr>
<tr>
<td>Techniques for rebalancing the load in a distributed system at run-time</td>
<td>G06F 9/5083</td>
</tr>
</tbody>
</table>

G06F 8/453

{Data distribution}

Definition statement

This place covers:
Dividing the data used by the subtasks over the different processors.

G06F 8/454

{Consistency (cache consistency protocols in hierarchically structured memory systems G06F 12/0815)}

Definition statement

This place covers:
Ensuring data consistency between subtasks.

References

Limiting references

This place does not cover:

| Cache consistency protocols in hierarchically structured memory systems | G06F 12/0815 |

G06F 8/456

{Parallelism detection}

Definition statement

This place covers:
Detecting parallelism in sequential programs, e.g. by making use of control flow and data flow information.

In this group the burden to detect and extract parallelism is put on the compiler or another software tool. This contrasts with the G06F 8/314, where the burden of indicating parallelism is put on the programmer.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Techniques and language constructs to create parallel programs | G06F 8/314 |
Definition statement

This place covers:
Communication between subtasks, allowing the generated tasks to interact with each other, for example to pass parameters or to return results.

References

Limiting references

This place does not cover:
Communication between independent tasks

Definition statement

This place covers:
Synchronisation between subtasks.

References

Limiting references

This place does not cover:
Synchronisation between independent tasks

Definition statement

This place covers:
Compiler structure allowing for several source languages (multiple front ends) and/or several target machine architectures (multiple back ends). Some examples of techniques and compilers for this are:
- Architecture Neutral Data Format (ANDF);
- UCSD Pascal P-code;
- Universal Compiler Language (UNCOL);
- GCC - GNU Compiler Collection.
G06F 8/47 (continued)

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Generating code for just one computing platform | G06F 8/447 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Retargetable compiler | a compiler that can relatively easily be modified to generate code for different CPU architectures. |

G06F 8/48

{Incremental compilation (software reuse G06F 8/36)}

Definition statement

This place covers:
Recompiling only those parts of source code that are affected by a modification.

References

Limiting references

This place does not cover:

| Software reuse | G06F 8/36 |

G06F 8/49

{Partial evaluation}

Definition statement

This place covers:
Specializing a program for some or all of its possible input values.

Different flavours are:

• "normal" PE (partial evaluation): specialize program for certain values of its inputs
• "predictive" PE: predict the run-time values of some inputs and specialize the program accordingly. At run-time, check if the prediction was correct. If yes, execute it. If no, recompile using the actual values.
• "multi-version" PE: generate multiple specialized versions of the program corresponding to different inputs. At run-time choose the appropriate version.
• "placeholder" PE: specialize the program for the known inputs. For the unknown inputs, provide placeholders, that will be filled in at run-time.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Optimizing a method invocation based on the type of the receiving object | G06F 9/4491 |
**G06F 8/51**

Source to source

**Definition statement**

*This place covers:*

Translating program code from a first high level programming language to a different second high-level programming language (e.g. from Java to C++). This transformation is independent of the target processor.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Source to binary translation</th>
<th>G06F 8/41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprocessors</td>
<td>G06F 8/423</td>
</tr>
<tr>
<td>Optimisation of source code</td>
<td>G06F 8/443</td>
</tr>
<tr>
<td>Binary to binary translation</td>
<td>G06F 8/52</td>
</tr>
<tr>
<td>Porting; modifying the source code of the application in order to adapt it to new/changed requirements</td>
<td>G06F 8/76</td>
</tr>
<tr>
<td>Porting source code to a different environment</td>
<td>G06F 8/76</td>
</tr>
</tbody>
</table>

**G06F 8/52**

Binary to binary

**Definition statement**

*This place covers:*

Static translation (i.e. pre-run-time) of binary code from one architecture to a different architecture.

This group covers the following forms of static binary code translation:

- Binary to binary
- Intermediate bytecode to another intermediate bytecode (e.g. Java bytecode, p-code)

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Source to source translation</th>
<th>G06F 8/51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary to source translation</td>
<td>G06F 8/53</td>
</tr>
</tbody>
</table>

**G06F 8/53**

Decompilation; Disassembly

**Definition statement**

*This place covers:*

Transformation of executable code into source code or assembly code.
Relationships with other classification places

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Reverse engineering | G06F 8/74 |
| Protecting software against software analysis or reverse engineering, e.g. by code obfuscation | G06F 21/12 |

G06F 8/54
Link editing before load time

Definition statement
This place covers:
Statically linking modules before load-time in order to create executable binary code.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Dynamic linking, i.e. linking at or after load time, during run-time | G06F 9/44521 |

G06F 8/60
Software deployment

Definition statement
This place covers:
- Installation and updating of computer software
- Methods that make the installation/update of software program transparent, automatic and user-friendly, both to the end-user and the network administrator. Methods that automatically select which programs should be updated, when and how this should happen, and where old and new programs should be located
Updating or installing software based on physical location of the target device.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation and upgrade of device drivers</td>
<td>G06F 9/4411</td>
</tr>
<tr>
<td>Network booting</td>
<td>G06F 9/4416</td>
</tr>
<tr>
<td>Program loading or initiating</td>
<td>G06F 9/445</td>
</tr>
<tr>
<td>Fault tolerant update or installation. For example when an error occurs during software upgrade, the system is rebooted and restored to the state before installation.</td>
<td>G06F 11/1433</td>
</tr>
<tr>
<td>Secure aspects of licensing; Try and buy software</td>
<td>G06F 21/10</td>
</tr>
<tr>
<td>Arrangements in connection with the implantation of stimulators; Changing the program; Upgrading firmware</td>
<td>A61N 1/37264</td>
</tr>
<tr>
<td>Downloading information (also software) into vehicles</td>
<td>G07C 5/008</td>
</tr>
<tr>
<td>Personalization of smart card applications</td>
<td>G07F 7/10</td>
</tr>
<tr>
<td>Download/install/upgrade software in mobile communication devices</td>
<td>H04M 1/72525</td>
</tr>
<tr>
<td>Multimedia set-top boxes under program control</td>
<td>H04N 5/4403</td>
</tr>
</tbody>
</table>

**G06F 8/61**

**Installation**

*Definition statement*

_This place covers:_

First-time installation of software.

Unattended installation, installation scripts (answer file)

Network installation.

Installation packages (containing list of files, program image, files itself, install/update instructions).

Network installation plans.

Type of installations.

Silent installation - no display of the progress of the installation

Unattended installation - installation performed without user interaction

Self installation - unattended installation without the need of initial launch of the process.

Headless installation - installation performed without using a monitor connected to the destination computer.

Clean installation - cleaning up a destination partition (formatting) before actual installation.

Flat installation - first copying installation files from a media to a hard disk and then installing them from the hard drive.

Network installation - installation of a program from a shared network drive
Virtual installation - performing a virtual installation to check for errors before committing the real installation.

References

Limiting references
This place does not cover:

| Network booting | G06F 9/4416 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Installation | setup, deployment |

G06F 8/62

{Uninstallation}

Definition statement
This place covers:
Removing software and all its related components.

Uninstallation of software i.e. removing software and all its related components, without interfering with the operation of other software;
Undoing installations/update.
Rollback, reverting to a previous installation/update status. Requires the use of some kind of log file.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Unloading program code from executable memory | G06F 9/445 |
| Garbage collection | G06F 12/0253 |

G06F 8/63

{Image based installation; Cloning; Build to order}

Definition statement
This place covers:
Installation of whole systems by copying disk images to target systems,
Cloning installed systems.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Software billing          | G06Q 30/00 |

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| BTO | Build to order |
| MTO | Make to order |

G06F 8/64

{Retargetable}

Definition statement

This place covers:

Installation or update explicitly taking into account hardware characteristics of the target.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Retargetable compilation | G06F 8/47 |
| Retargetable program loading | G06F 9/44542 |

G06F 8/65

Updates (security arrangements therefor G06F 21/57)

Definition statement

This place covers:

Updating of existing software, i.e. modifying already installed software to a desired version.

Being informed of new software that has become available in order to update including installation for the update.

Synchronization of software of disconnectable devices after their reconnection to the network automatically upgrading software to the correct version.

Transparent update (e.g. after boot, after update becomes available, regular check for updates,...)

User-initiated update.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronizing caches</td>
<td>G06F 12/00</td>
</tr>
<tr>
<td>Replication of documents/files</td>
<td>G06F 16/00</td>
</tr>
</tbody>
</table>

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>For set top boxes</td>
<td>H04N 5/4403</td>
</tr>
<tr>
<td></td>
<td>H04N 21/4586</td>
</tr>
</tbody>
</table>

G06F 8/654

using techniques specially adapted for alterable solid state memories, e.g. for EEPROM or flash memories

Definition statement

This place covers:

- Updating software stored in non-volatile, alterable, solid-state storage, e.g. flash or EEPROM.
- In place updating

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update program code stored in non-alterable ROM</td>
<td>G06F 8/66</td>
</tr>
<tr>
<td>Changing the capability of a processor by loading new microcode, e.g. representing a different instruction set</td>
<td>G06F 9/24</td>
</tr>
<tr>
<td>Low level details of writing to solid-state storage</td>
<td>G11C 16/10</td>
</tr>
</tbody>
</table>

G06F 8/656

while running

Definition statement

This place covers:

- Updating software while it is executing or running

Specific topics included:

- Hot-plugging of new software into a running system
- Run-time adaptation of the functionality of executable code by relinking to new code modules
G06F 8/658

Incremental updates; Differential updates

Definition statement

This place covers:

Update methods explicitly demonstrating how a new version of software is created from an old version and update instructions and/or differential data. The simplest way to update a piece of software from a first version to a second version is to remove the first version in its entirety and replace it by the entire second version. This method, although conceptually simple, is highly inefficient, especially in the case where the second version differs only slightly from the first version:

- It is always necessary to provide the target with the entire second version; if a network is involved, this puts a high burden on the network
- It might take a long time to perform the update because the entire first version has to be deleted and the entire second version has to be written.

This group tackles this problem in that the update is performed by using the existing instance of the first version as a basis and to generate the instance of the second version therefrom. The scope of the group can thus be described as dealing with the details of how to modify an existing instance of the first version in order to arrive at the second version.

Typically, the second version is created by only changing those parts of the first version that actually change. This can be accomplished by creating a difference file (delta) that describes the differences of the second version with regards to the first version. The delta is provided to the target and applied to the first version thus yielding the second version. This delta can be passive - the delta is applied by an updater - or active -the delta contains instructions to actually perform the update.

Incremental update more generally refers to details of the steps involved to convert one piece of software into another. Differential update is more specific and explicitly uses differences between the two pieces of software.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Updating remote displays by only transmitting differences | G06F 3/1454 |
| Comparing a list of software actually installed on a device and a list of software that should be installed on a device; identify software not installed that should be installed | G06F 8/61 |
| Delta for version control systems | G06F 8/71 |
| Delta in the context of file systems | G06F 16/1767 |
| Delta for text documents | G06F 17/2211 |
| Compression in general | H03M 7/30 |
G06F 8/66
{of program code stored in read-only memory [ROM]}

Definition statement
This place covers:
Updating software that is stored in non-alterable ROM.

G06F 8/70
Software maintenance or management

Definition statement
This place covers:
• Adapting the code of a program in response to new requirements, changes to the environment, detection of bugs, etc.
• When new functionality is required, analysing the code in order to find the points to edit; generating new code, and incorporating it into the application

G06F 8/71
Version control (security arrangements therefor G06F 21/57); Configuration management

Definition statement
This place covers:
Version control, administering version numbers and releases. Deals with the problem of managing a modular software system: keeping track of the changes and the different version of the modules, the interrelation between the modules, the effects of the changes of one module on the other modules, the problem of multiple users editing different modules.

Includes:
• Make, Build
• Analysing changes to/conflicts between sources
• SCCS-like tools
• dependency analysis
• Comparing/obtaining dates of last changes of sources/intermediates/targets;
• CVS - Concurrent Version Control, SVN, Git, ...

References
Limiting references
This place does not cover:

| Dependency analysis in compilers | G06F 8/433 |
| Dealing with different versions of software in the context of software updating | G06F 8/65 |
| Configuration of peripheral devices | G06F 9/4411 |
| Configuration in the sense of changing parameters | G06F 9/44505 |
| Version control for text documents | G06F 17/2288 |
**G06F 8/72**

**Code refactoring**

**Definition statement**

*This place covers:*

Applying any change to a computer program's code which improves its readability or simplifies its structure without changing its results. In software engineering, "refactoring" a source code module often means modifying the module without changing its external behavior, and is sometimes informally referred to as "cleaning it up".

Code refactoring can be considered the design-time equivalent of code optimization (**G06F 8/443**). Code refactoring is concerned with improving the structure of the code in view of easier maintenance whereas code optimization is concerned to make the code better for a particular aspect (speed, size, energy).

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Refactoring</td>
<td>the process of changing software such that the changes do not alter the external behavior of the code, yet improve the internal code structure</td>
</tr>
<tr>
<td>Re-engineering</td>
<td>In contrast to reverse engineering</td>
</tr>
</tbody>
</table>

**G06F 8/73**

**Program documentation**

**Definition statement**

*This place covers:*

Augmenting program code with additional information in order to increase its understandability in view of easier maintenance.

Documenting program code, inserting comments in source code.

**G06F 8/74**

**Reverse engineering; Extracting design information from source code**

**Definition statement**

*This place covers:*

Reverse engineering of HLL source code to its underlying design, model.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the reverse engineering is performed in the context of binary to binary translation</td>
<td>G06F 8/52</td>
</tr>
<tr>
<td>Decompilation and disassembly</td>
<td>G06F 8/53</td>
</tr>
</tbody>
</table>
Protecting software against software analysis or reverse engineering, e.g. by code obfuscation

G06F 8/75

Structural analysis for program understanding

Definition statement
This place covers:
Static analysis of the structure of program code.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Analysing program code in order to identify reusable program parts | G06F 8/36 |
| Monitoring program code execution | G06F 11/34 |

G06F 8/751

{Code clone detection}

Definition statement
This place covers:
Detecting code clones, e.g. introduced as a result of copy & paste by the programmer.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Reuse, i.e. identifying recurring pieces of code for purposes of reuse | G06F 8/36 |
| Exlining, i.e. finding similar sequences of code to replace them with a procedure invocation | G06F 8/4436 |
| Plagiarism detection for source code | G06F 21/10 |

G06F 8/76

Adapting program code to run in a different environment; Porting

Definition statement
This place covers:
Adapting program code to run in a different environment, i.e. a different architecture or operating system.
G06F 8/77
Software metrics

Definition statement
This place covers:
Measurement of software metrics related to a software development project, such as product metrics and process metrics.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Measuring certain characteristics of a program in view of debugging | G06F 11/362 |

Special rules of classification
Not to be confused with G06F 11/362, which deals with measuring certain characteristics of a program in view of debugging.

G06F 8/78
{Methods to solve the "Year 2000" [Y2K] problem}

Definition statement
This place covers:
The Year 2000 problem, i.e. adapting software so as to comply with a not-foreseen date format.

Synonyms and Keywords
In patent documents, the following abbreviations are often used:

| Y2K | Year 2000 |

G06F 9/00
Arrangements for program control, e.g. control units (program control for peripheral devices G06F 13/10)

Definition statement
This place covers:
Program control for general purpose computers.
Runtime execution of programs.

References
Limiting references
This place does not cover:
Program control for peripheral devices G06F 13/10
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Arrangements for development of programs; Software engineering | G06F 8/00 |
| Program control in regulating or control systems | G05B |

Special rules of classification
Note for use of these definitions:

In the sub-groups of G06F 9/00 there are rules of classification which differ from the rules of the IPC, and are specified in this section.

The sub-groups mentioned under "Informative references"; "Limiting references" and "Relationship between large subject matter areas" are to be taken as indicators as to where the document to be classified may be forwarded or circulated for classifying.

Specific combinations or conventions of classification are mentioned under "Special rules of classification".

G06F 9/02
using wired connections, e.g. plugboards

Special rules of classification
Not currently used, as old technology.

G06F 9/04
using record carriers containing only program instructions (G06F 9/06 takes precedence)

References
Limiting references
This place does not cover:

| Arrangements for program control using stored development of programs; Software engineering | G06F 9/06 |

Special rules of classification
Not currently used, as old technology.

G06F 9/06
using stored programs, i.e. using an internal store of processing equipment to receive or retain programs

Definition statement
This place covers:
Programming arrangements for computers having a stored program. Covers execution of stored programs, and arrangements therefor.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Program control for machine tools using a digital processor

G06F 9/22

Microcontrol or microprogram arrangements

Definition statement

This place covers:

Arrangements for executing microcode in general.

A next instruction of the program, when fetched from program store, is translated into lower level microinstructions, usually by using the instruction to index into a microprogram or control memory to fetch a series of microinstructions which are then decoded to obtain control signals to carry out the function of the machine instruction.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Execution of machine instructions

G06F 9/30

Special rules of classification

Precedence and classification rules:

The classification rules for subgroups G06F 9/22 - G06F 9/28 is different from those used in G06F 9/30 and subgroups.

All aspects disclosed in a document which are deemed useful for search receive a class, not just the subject matter of the invention. Hence multiple subgroups are to be used.

There is no distinction made between invention and additional subject matter, and the classes for additional subject matter are not used.

A single lower level group is given if appropriate. A higher level group is given for documents having features belonging to multiple subgroups.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprogram</td>
<td>Internal set of instructions used to translate a machine instruction of the stored program into a series of control signals. The microprogram is usually fixed at runtime, and defines the operations of the processor. Changing the microprogram changes the functionality of the processor, i.e. what type of operations it can carry out, and how these are carried out.</td>
</tr>
<tr>
<td>Nanoinstructions</td>
<td>Instructions of a level lower than microinstructions i.e. multiple nanoinstructions are used to execute a microinstruction.</td>
</tr>
</tbody>
</table>
Synonyms and Keywords
In patent documents, the following words/expressions are often used as synonyms:
- "microprogram", "microcode", "firmware" and "microinstructions"

G06F 9/223
{Execution means for microinstructions irrespective of the microinstruction function, e.g. decoding of microinstructions and nanoinstructions; timing of microinstructions; programmable logic arrays; delays and fan-out problems}

Definition statement
This place covers:
Microinstruction execution aspects independent of the type of microinstruction, e.g. decoding of microinstructions; timing.
Includes PLAs used as sequencers for microcode.

Synonyms and Keywords
In patent documents, the following words/expressions are often used as synonyms:
- "PLA" and "Programmable Logic Array"

G06F 9/226
{Microinstruction function, e.g. input/output microinstruction; diagnostic microinstruction; microinstruction format}

Definition statement
This place covers:
Specific types of microinstruction operations.
Microinstruction set, microinstruction format.

G06F 9/24
Loading of the microprogram

Definition statement
This place covers:
- Loading of microcode implying altering the processor functionality;
- Changing the processor operations by loading or modifying microcode in the control store, thereby altering the way in which instructions are implemented in microcode;
- Fetching control microcode from ROM into RAM for execution;
- Patching by loading new microcode. Usually implemented by substituting the microcode at a particular instruction address in the microstore by a correct version during instruction fetching.

Relationships with other classification places
Loading of operating system or application programs; loading of new versions of software G06F 9/445.
G06F 9/26

Address formation of the next micro-instruction (G06F 9/28 takes precedence); Microprogram storage or retrieval arrangements

Definition statement

This place covers:
- microinstruction addressing arrangements;
- sequencers for microcode;
- microinstruction storage, and microinstruction retrieval or fetching.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Enhancement of operational speed, e.g. by using several microcontrol devices operating in parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F 9/28</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:
- "microinstruction" and "microinstruction" or "microprogram" and "microprogram"

G06F 9/261

{Microinstruction address formation}

Definition statement

This place covers:
Formation of the microinstruction address e.g. using lookup table.

G06F 9/262

{Arrangements for next microinstruction selection}

Definition statement

This place covers:
Retrieval of the next microinstruction

G06F 9/264

{Microinstruction selection based on results of processing}

Definition statement

This place covers:
Address formation of the next microinstruction by selection according to the results of processing.

Next microaddress or microinstruction derived directly from the program flow, e.g. program counter, branch.
G06F 9/265
{by address selection on input of storage}

Definition statement

This place covers:
Address formation of the next microinstruction by selection of address on input of storage.

Selecting at the input to the control store, which address to use, and therefore which microinstruction is retrieved.

G06F 9/267
{by instruction selection on output of storage}

Definition statement

This place covers:
Address formation of the next microinstruction by selection of microinstruction on output of storage.

Inputting several addresses into the control store, and selecting at the output of the control store which microinstruction to execute.

G06F 9/268
{Microinstruction selection not based on processing results, e.g. interrupt, patch, first cycle store, diagnostic programs}

Definition statement

This place covers:
Address formation of the next microinstruction by selection not based on the results of processing.

Selecting next microaddress or microinstruction not derived directly from the program flow, e.g. interrupt, patching.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Patching by microcode loading                  | G06F 9/24 |
| Address formation of the next machine instruction for runtime patching | G06F 9/328 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Patching | repairing errors of microcode in read-only storage. Usually implemented by substituting the microcode at a particular address in the microstore by a correct version during fetching. |
| Interrupt | changing execution flow in response to an (external) event which must be handled with a higher priority. |
G06F 9/28

Enhancement of operational speed, e.g. by using several microcontrol devices operating in parallel

Definition statement

This place covers:
Means to improve speed of microcode execution e.g. dual control stores.
Parallel or concurrent execution of microinstructions.

Special rules of classification

Takes precedence over other sub-groups of G06F 9/22.

G06F 9/30

Arrangements for executing machine instructions, e.g. instruction decode (for executing microinstructions G06F 9/22)

Relationships with other classification places

• arrangements for executing specific programs G06F 9/44;
• arrangements for executing multiple programs G06F 9/46;
• arrangements for development of stored programs; Software engineering; CASE tools G06F 8/00.

References

Limiting references

This place does not cover:

| Arrangements for executing microinstructions | G06F 9/22 |

Special rules of classification

These rules of classification apply to the group G06F 9/30 and subgroups:

All aspects disclosed in a document which are deemed useful for search are classified.

There is no distinction made between invention and additional subject matter.

Note that combinations of subgroups are possible from different hierarchy levels, or from the same level within the hierarchy.

The following IPC subclasses are not used in this classification scheme, but are covered by the subgroups listed here:

IPC group G06F9/302 covered by CPC group G06F 9/3001;
IPC group G06F9/305 covered by CPC group G06F 9/30029;
IPC group G06F9/308 covered by CPC group G06F 9/30018;
IPC group G06F9/312 covered by CPC group G06F 9/30043;
IPC group G06F9/315 covered by CPC group G06F 9/30032;
IPC group G06F9/318 covered by CPC group G06F 9/30181.
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Machine instructions | Executable instructions of the processor, which can be decoded to obtain control signals |

G06F 9/30003

{Arrangements for executing specific machine instructions}

Definition statement

This place covers:

Execution of specific individual machine instructions.

Adaptation of hardware, and hardware control, to carry out the execution of a specific machine instruction.

Special purpose instructions, being instructions not classifiable under subclasses.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Multiple parallel functional units executing instructions | G06F 9/3885 |

Special rules of classification

In the subclasses of G06F 9/30003, if the execution of the machine instruction includes special arrangements for the setting of a condition code or flag, then also use G06F 9/30094.

In the case of a single machine instruction which carries out a combination of operations, use a subclass for each operation.

In the subclasses hereof, the terms in capitals which are used as examples, refer to well-known types of instructions characteristic to that subclass.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Machine instructions | Instructions executable by the processor, which can be decoded to obtain control signals |

G06F 9/30007

{to perform operations on data operands}

Definition statement

This place covers:

Specific instruction to perform operation between input data operands, usually returning an output data operand as the result.
Relationships with other classification places
Adders G06F 7/50
Multipliers G06F 7/52
Arithmetic Logic Units G06F 7/57

References
Informative references
Attention is drawn to the following places, which may be of interest for search:
| Specific instruction for operation on memory operands | G06F 9/3004 |

G06F 9/3001
{Arithmetic instructions}

Definition statement
This place covers:
Specific arithmetic instruction for example adding, multiplying, multiply accumulate.
Includes how to select the specific operation to execute in an ALU.

Relationships with other classification places
Adders G06F 7/50.
Multipliers G06F 7/52.
Arithmetic Logic Units G06F 7/57.

Synonyms and Keywords
In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>ALU</th>
<th>Arithmetic Logic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC</td>
<td>Multiply-Accumulate operation</td>
</tr>
<tr>
<td>MACU</td>
<td>Multiply-Accumulate Unit</td>
</tr>
</tbody>
</table>

G06F 9/30014
{with variable precision}

Definition statement
This place covers:
Arithmetic operation where the bit width operated on may be variable.
Bit-sliced arithmetic operation.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Multiple arithmetic units executing an instruction in tandem or cascaded | G06F 9/3893 |

G06F 9/30018

{Bit or string instructions; instructions using a mask}

Definition statement

This place covers:

Specific instruction for operation on a series of connected bits, bytes or characters, for example using a mask to select certain portions of a data string.

Examples include the EDIT instruction which alters a portion of a character string, or a Find-First-One instruction which detects the position of the first '1' in a string of bits.

Includes cyclic redundancy check instructions.

G06F 9/30021

{Compare instructions, e.g. Greater-Than, Equal-To, MINMAX}

Definition statement

This place covers:

Specific instruction for comparison between two operands.

Includes matching, greater/less than, minmax instruction.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| MINMAX | Instruction to find the minimum of a series of input operands, alternatively to find the maximum of the same. |

G06F 9/30025

{Format conversion instructions, e.g. Floating-Point to Integer, decimal conversion}

Definition statement

This place covers:

Specific instruction for conversion from one data format to another.

Includes Endian conversion; Conversion between integer and floating-point; Decimal conversion instructions.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Data re-arranging instruction, e.g. Shuffle, Permute

G06F 9/30032

G06F 9/30029

{Logical and Boolean instructions, e.g. XOR, NOT}

Definition statement

This place covers:

Specific instruction for logical operation or combination.

G06F 9/30032

{Movement instructions, e.g. MOVE, SHIFT, ROTATE, SHUFFLE}

Definition statement

This place covers:

Specific instruction for moving, rearranging, or operating on data within a register.

Examples include: Move instruction which transfers data between registers; Permute instruction which changes the order of data in a register; Rotate or Shift instruction which moves bits or bytes within a register.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Instruction for operation on string operands

G06F 9/30018

Instructions for format conversion operations

G06F 9/30025

Instruction for operation on memory operands

G06F 9/3004

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move</td>
<td>Instructions to pass data between memory locations, or between registers, without operating on the data.</td>
</tr>
<tr>
<td>Shift</td>
<td>Instructions to move data in a serial fashion from one location to another, where the distance moved is usually less than a word, e.g. shifting data within a register by a few bits.</td>
</tr>
<tr>
<td>Rotate</td>
<td>Instructions which are shift instructions where the bits shifted serially out are inserted into the location at the opposite end.</td>
</tr>
<tr>
<td>Permute or Shuffle</td>
<td>Instruction which intermingles parts of a datum to produce a new datum.</td>
</tr>
</tbody>
</table>
G06F 9/30036

{Instructions to perform operations on packed data, e.g. vector operations}

Definition statement

This place covers:
Specific instruction operating on multiple data stored in a single register, thereby effecting a SIMD operation.

Includes instructions operating on vector data.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Multiple functional units executing an instruction in parallel | G06F 9/3885 |

Special rules of classification

This subclass may be used in combination with other subclasses of G06F 9/30007, according to the operation performed.

G06F 9/3004

{to perform operations on memory}

Definition statement

This place covers:
Specific instruction for operation on memory operands in general.
Specific instruction for control operation on memory.
Memory to memory Move instruction.
Stack instructions POP, PUSH
Table lookup instructions.
A combination of a memory operation and further operation e.g. atomic memory operations such as read-modify-write, test-and-set.
Register allocation instructions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Specific instruction for data operation | G06F 9/30007 |

Special rules of classification

For atomic memory operations use in combination with serialisation control instructions G06F 9/30087, and possibly G06F 9/3834 for memory consistency.
G06F 9/30043

{LOAD or STORE instructions; Clear instruction}

Definition statement

This place covers:
Specific instruction to read or write data from a memory location, e.g. LOAD, STORE, Load Multiple.
Specific instruction to clear or reset a memory location, e.g. CLEAR.
Register reset or clear instructions are also found here.
Table look-up instructions.
Context saving or restoring instructions.

Special rules of classification

Register reset or clear instructions are also found here.
For atomic memory operation use also serialisation control operation G06F 9/30087.
For Load Multiple when executed as an iterative instruction use also G06F 9/30065.

G06F 9/30047

{Prefetch instructions; cache control instructions}

Definition statement

This place covers:
Specific instruction for control data or instruction prefetching from memory, e.g. Hint instruction.
Specific instruction to control cache operation, e.g. Cache Flush.

G06F 9/3005

{to perform operations for flow control}

Definition statement

This place covers:
• Specific instruction to control program flow in general.
• Execution of an instruction to select a next instruction other than the next sequential instruction, e.g. for branching.
• Execution of an instruction for facilitating branching, e.g. Prepare-To-Branch instruction.

Includes specific instruction for monitoring or tracing program flow e.g. breakpoint instruction; flow signature instruction.
G06F 9/30054
{Unconditional branch instructions}

Definition statement
This place covers:
Special adaptations to execute a specific instruction which branches to a target address independent of any condition.

Examples of unconditional branch instructions are CALL, GOTO insofar as these are unconditional.

Special rules of classification
Only to be used when there is subject matter relating to special adaptations or details of handling of a branch instruction.

G06F 9/30058
{Conditional branch instructions}

Definition statement
This place covers:
Specific instruction which causes branching to a target address dependent on a runtime condition, else continues execution with the next sequential instruction.

Includes IF-THEN-ELSE constructions.

Special rules of classification
Only to be used when there is subject matter relating to special adaptations or details of handling of a branch instruction.

G06F 9/30061
{Multi-way branch instructions, e.g. CASE}

Definition statement
This place covers:
Specific instruction which causes branching to one of several alternative target addresses depending on a runtime condition.

Instruction which branches to a variable target address, e.g. indirect (register specified) branch target address,

G06F 9/30065
{Loop control instructions; iterative instructions, e.g. LOOP, REPEAT}

Definition statement
This place covers:
Specific instruction used for loop control, e.g. specific loop start or end instructions.

Specific instruction which is repeatedly executed, thereby forming a (short) loop.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Address formation for loops, loop detection | G06F 9/325 |
| Loop buffering | G06F 9/381 |

G06F 9/30069

{Instruction skipping instructions, e.g. SKIP}

Definition statement

This place covers:

Specific instruction which causes a number of instructions to be skipped i.e. not executed, thus effecting a (short) forward branch, e.g. SKIP.

A skip of a single instruction is regarded as conditional instruction execution, not skipping.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Conditional branch instruction | G06F 9/30058 |
| Single instruction skip as conditional execution. | G06F 9/30072 |

G06F 9/30072

{to perform conditional operations, e.g. using guard}

Definition statement

This place covers:

Specific instruction for conditional operation depending on a runtime condition, which are not for control of program flow.

The operation carried out depends on a runtime condition, for example ADD or SUBTRACT depending on the value of the sign bit. Another example is a MOVE which is executed or not depending on a runtime condition.

Includes instructions which are executed conditional on a predicate or guard.

Includes conditional instructions in a branch shadow.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Conditional branch instruction | G06F 9/30058 |
| Multiple instruction skipping for forward branch. | G06F 9/30069 |
| Instruction which executes differently according to a mode | G06F 9/30189 |
Special rules of classification

*G06F 9/30058* has precedence.

May be used in combination with other sub-groups of the *G06F 9/30003* according to the operation performed by the conditional instruction, e.g. conditional MOVE in combination with *G06F 9/30032*.

Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional</td>
<td>dependent on a runtime condition or operational status.</td>
</tr>
<tr>
<td>Guard</td>
<td>a tag indicating a condition which is assigned to an instruction.</td>
</tr>
<tr>
<td></td>
<td>According to the outcome of the condition evaluation, the instruction</td>
</tr>
<tr>
<td></td>
<td>is executed or skipped. Often assigned by the compiler to avoid</td>
</tr>
<tr>
<td></td>
<td>branches</td>
</tr>
<tr>
<td>Predicate</td>
<td>same meaning as 'guard'</td>
</tr>
</tbody>
</table>

*G06F 9/30076*

{to perform miscellaneous control operations, e.g. NOP}

Definition statement

*This place covers:*

Specific instruction for operation control in general.

Includes mode switching instruction.

Specific instruction for instruction execution control in general.

Includes mode switching instruction.

NOP instructions are here, but multicycle NOPs are considered pipeline delay control instructions, and are in 30A8H.

References

*Informative references*

*Attention is drawn to the following places, which may be of interest for search:*

| Specific instruction for program flow control NOP used as a pipeline delay instruction | *G06F 9/3005* | *G06F 9/30079* |

*G06F 9/30079*

{Pipeline control instructions}

Definition statement

*This place covers:*

Specific instruction to control an instruction pipeline, e.g. HALT, FLUSH

Instructions for variable delay of pipeline or execution, e.g. multicycle NOP.
G06F 9/30083

{Power or thermal control instructions}

Definition statement
This place covers:
Specific instruction to control power consumption or thermal aspects of the processor, e.g. SLEEP.

G06F 9/30087

{Synchronisation or serialisation instructions}

Definition statement
This place covers:
Specific instruction to control serialisation of instruction execution; to control synchronisation of instruction execution.

Includes specific instructions used to implement memory locks; barriers. Includes instructions to facilitate atomic execution.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Program synchronisation ; Mutual exclusion | G06F 9/52 |

Special rules of classification
For atomic memory operations use also G06F 9/3004.

For barrier or fence instructions use also G06F 9/3834.

For synchronisation instruction which affects the execution of a thread use also G06F 9/3009.

G06F 9/3009

{Thread control instructions}

Definition statement
This place covers:
Specific instruction to control multi-threading; starting and stopping threads, e.g. FORK; JOIN.

G06F 9/30094

{Condition code generation, e.g. Carry, Zero flag}

Definition statement
This place covers:
Special arrangements for the generation or storage of runtime conditions, e.g. flags; status register.
References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Execution mode flags | G06F 9/30189 |

G06F 9/30098

{Register arrangements}

Definition statement
This place covers:
Groups of registers; register files.
Register file addressing; addressing partial registers.
Accessing register file e.g. contention.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Register address space extension | G06F 9/30138 |
| Register renaming               | G06F 9/384   |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Register                  | set of one-bit storages, e.g. latches, accessed in parallel |
| Register file             | set of registers. May be implemented in a single or in multiple memories |

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| GPR                        | general purpose register |

G06F 9/30101

{Special purpose registers}

Definition statement
This place covers:
Special adaptation of the use of single or multiple registers for a dedicated purpose, not being general purpose registers. May not be part of the register file.

Examples include particular use of dedicated address register, control register, status register, condition code register, Top Of Stack register.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Program counter registers | G06F 9/321 |

Special rules of classification

Only to be used when there is subject matter relating to special adaptations or details of use of a special purpose register.

G06F 9/30105

{Register structure}

Definition statement

This place covers:
Details of the structure of an individual register.

Registers having associated bits e.g. valid bits, tags, flags.

G06F 9/30109

{having multiple operands in a single register}

Definition statement

This place covers:
Registers which are logically partitioned into multiple operands, e.g. for packed data.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Multiple registers used for variable length operands | G06F 9/30112 |

G06F 9/30112

{for variable length data, e.g. single or double registers}

Definition statement

This place covers:
Register structure for variable length operands i.e. variable length data can be stored.

Use of partial registers for short data.

Combinations of registers for longer or higher precision data, e.g. by concatenation.

Accessing of variable length registers.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Partitioned registers for multiple operands, e.g. packed data | G06F 9/30109 |

G06F 9/30116

{Shadow registers, e.g. coupled registers, not forming part of the register space}

Definition statement

This place covers:

Registers which cannot be addressed by an instruction, and hence are invisible to the architecture.

Register with an associated copy, e.g. for saving of architectural state.

Special rules of classification

Use in combination with G06F 9/30123 for shadow register set used for another context.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Register space | the address space used by registers i.e. the range of program addressable register locations. |

G06F 9/3012

{Organisation of register space, e.g. banked or distributed register file}

Definition statement

This place covers:

The physical or logical organisation of the register space in general.

Includes partitioned, distributed or banked register files, e.g. per execution unit.

Local and global register files.

Special rules of classification

Register banks for register space extension use G06F 9/30138.

Register banks for context data use G06F 9/30123.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Register space | logical address space for registers, i.e. the range of addresses defined by a register specifier |
**G06F 9/30123**

(according to context, e.g. thread buffers)

**Definition statement**

This place covers:
Organisation of sets of registers used for storing the data of a particular context, e.g. local variables.

Includes thread buffers used to hold the context of a thread, and forming part of an instruction stream.

**Special rules of classification**

Use in combination with G06F 9/30116 for shadow register set used for another context.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Context data | operands and data representing the architectural state of a context, and which needs to be saved on a context switch |

**G06F 9/30127**

:Register windows

**Definition statement**

This place covers:
Organisation of sets of registers used to implement register windows.

May have a pointer to the first window location, which may be used as a base address. Used for example for fast context switching, by moving from a current window to a next window.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Register window | set of contiguous registers used to implement a window to hold context data |

**G06F 9/3013**

(according to data content, e.g. floating-point registers, address registers)

**Definition statement**

This place covers:
Organisation of sets of registers used to store different types of data.

Includes address registers, Boolean registers, floating point registers, parameter registers.
G06F 9/30134

{Register stacks; shift registers}

Definition statement

This place covers:

Register stacks are a series of register locations implementing a stack. The register stack is addressable generally using a register containing the Top-of-Stack pointer. Writing to the TOS location implies adding an entry to the top of the stack, reading implies removing an entry from the top of the stack.

The implementation of stack read/write operation in a register stack may involve physically shifting the entries in the queue up or down using shift registers; or alternatively may involve incrementing or decrementing the TOS pointer to access the next or previous register.

Details of shift registers implementing a FIFO buffer are also found here.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Special purpose register for TOS pointer | G06F 9/30101 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Register stack | contiguous set of register locations used to implement a stack. May be implemented as a shift register |
| Shift register | register which shifts its contents in a bit-parallel fashion into an adjacent register. |

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| TOS | Top of Stack |

G06F 9/30138

{Extension of register space, e.g. register cache}

Definition statement

This place covers:

Increasing or decreasing the number of available addressable locations in register address space, e.g. more or less physical registers than logical registers, register cache.

Extension of register address length e.g. using indexing.
G06F 9/30141

{Implementation provisions of register files, e.g. ports}

Definition statement

This place covers:
- Hardware implementation of register files.
- Register file port architecture; address or data ports.
- Internal bypass path of register files.
- Adaptations of register file hardware for particular problems, e.g. for power saving; for fault tolerance.

Includes transposing register file being accessible vertically or horizontally.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Bypass path | direct connection between a register file input and output. |

G06F 9/30145

{Instruction analysis, e.g. decoding, instruction word fields}

Definition statement

This place covers:
Decoding of instructions in general, of opcode in particular.
Instruction format, instruction encoding.
Instruction set as a whole.

Relationships with other classification places
Decoding of microinstructions G06F 9/223.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Runtime instruction translation | G06F 9/3017 |

Special rules of classification

Runtime instruction translation using a decoder is classified under G06F 9/3017 and sub-groups, even if this involves decoding, since the purpose is translation.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| RISC | Reduced Instruction Set Computer. Architecture having set of simple instructions which are decoded into direct control signals, and which take a single cycle to execute. |
Complex Instruction Set Computer. Architecture having set of complex instructions which are decoded into internal (native; microcode) instructions, and which may take multiple cycles to execute.

G06F 9/30149
{of variable length instructions}

Definition statement
This place covers:
Decoding of variable length instructions.
Includes instruction where the relative length of operation and operand part is variable.
Ensuring a whole instruction is decoded. Parsing VLI instructions.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:
Instruction pre-fetching when instruction length is variable, e.g. line-crossing fetch; alignment in instruction buffer

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:
VLI instructions of varying lengths

Synonyms and Keywords
In patent documents, the following abbreviations are often used:
VLI Variable Length Instruction

G06F 9/30152
{Determining start or end of instruction; determining instruction length}

Definition statement
This place covers:
Arrangements for determining and/or marking the boundaries of a variable length instruction; Special arrangements for determining the length of a variable length instruction other than by decoding the length.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:
Pre-decoding of instructions
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLI</td>
<td>instructions of varying lengths</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Term</th>
<th>Synonym</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLI</td>
<td>Variable Length Instruction</td>
</tr>
</tbody>
</table>

G06F 9/30156

{Special purpose encoding of instructions, e.g. Gray coding}

Definition statement

This place covers:
Instruction encodings to achieve a secondary effect, e.g. power saving, saving memory space, security, fault tolerance.

Relationships with other classification places

Computer-aided instruction set design G06F 17/50.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>Classification Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runtime instruction translation for compressed or encrypted instructions</td>
<td>G06F 9/30178</td>
</tr>
</tbody>
</table>

Special rules of classification

Use in combination with G06F 9/30178 for decompression by translation, or with G06F 9/3822 for format field decoding for VLIW.

G06F 9/3016

{Decoding the operand specifier, e.g. specifier format}

Definition statement

This place covers:
Decoding operand fields of instructions; Format of operand fields of instructions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference Description</th>
<th>Classification Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decoding the opcode of instructions</td>
<td>G06F 9/30145</td>
</tr>
</tbody>
</table>
**G06F 9/30163**

{with implied specifier, e.g. top of stack}

**Definition statement**

This place covers:

Instruction format which is shorter by having operand specifier field(s) missing but implied, e.g. Top of Stack, accumulator, dedicated register.

**G06F 9/30167**

{of immediate specifier, e.g. constants}

**Definition statement**

This place covers:

Decoding of immediate operand specifiers or constants; Concatenation of immediates; Buffering of immediates.

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>Data in an instruction to be used directly as an operand, e.g. without storing in a register</td>
</tr>
<tr>
<td>Constant</td>
<td>Same meaning as 'immediate'</td>
</tr>
</tbody>
</table>

**G06F 9/3017**

{Runtime instruction translation, e.g. macros}

**Definition statement**

This place covers:

Runtime translation of an instruction by decoding an instruction which is non-native, to produce an executable instruction or set of instructions. The decoding of instructions into microinstructions, being of a lower level, is not meant.

Includes altering the format or encoding of the input instruction, e.g. length of fields.

Includes translating a single instruction into multiple executable instructions, or the reverse (macro formation).

**Relationships with other classification places**

- Decoding of microinstructions [G06F 9/223];
- Instruction emulation or interpretation [G06F 9/455].

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Decoding of instructions</th>
<th>G06F 9/30145</th>
</tr>
</thead>
</table>
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Macro</th>
<th>An opcode which is an alias for a series of instructions, i.e. a function; Non-native instruction; An instruction which is not executable in the architecture of the processor.</th>
</tr>
</thead>
</table>

G06F 9/30174

{for non-native instruction set, e.g. Javabyte, legacy code}

Definition statement

This place covers:
Runtime translation of a non-native instruction into an executable instruction using hardware means, e.g. decoder, look-up table.

Relationships with other classification places

Instruction emulation or interpretation G06F 9/455.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Non-native instruction set</th>
<th>set of instructions intended to execute on a different architecture, which cannot run without translation or reformatting. Legacy code may be considered non-native.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-native instruction</td>
<td>an instruction which is not executable in the architecture of the processor.</td>
</tr>
</tbody>
</table>

G06F 9/30178

{of compressed or encrypted instructions}

Definition statement

This place covers:
Runtime translation of an encrypted or compressed instruction into an instruction which can be executed.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Special encoding of instructions for saving memory or power.         | G06F 9/30156                                                                                                   |
**G06F 9/30181**

{Instruction operation extension or modification}

**Definition statement**

*This place covers:*

Modification or extension of the execution of an instruction in general.

Modifications to the instruction itself, or to the architecture, which increase the number of operations available to the architecture.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Execution unit with adaptable datapath for complex operation | G06F 9/3897 |

**G06F 9/30185**

{according to one or more bits in the instruction, e.g. prefix, sub-opcode}

**Definition statement**

*This place covers:*

Modification of the operation of an instruction according to one or more bits comprised in the instruction.

**G06F 9/30189**

{according to execution mode, e.g. mode flag}

**Definition statement**

*This place covers:*

Modification of the operation of an instruction according to a mode of operation, e.g. mode flag.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Mode switching instruction | G06F 9/30076 |

**G06F 9/30192**

{according to data descriptor, e.g. dynamic data typing}

**Definition statement**

*This place covers:*

Modification of the operation of an instruction according to a data type descriptor, e.g. dynamic data typing.
**G06F 9/30196**

{using decoder, e.g. decoder per instruction set, adaptable or programmable decoders}

**Definition statement**

*This place covers:*

Modification of the operation of an instruction using more than one decoder, or a decoder which is adaptable.

Extension of the instruction set using multiple decoders for multiple instruction sets.

**G06F 9/32**

Address formation of the next instruction, e.g. by incrementing the instruction counter ([G06F 9/38](#) takes precedence)

**Definition statement**

*This place covers:*

Selecting or calculating the next instruction address.

Sequencers for machine instructions.

**References**

**Limiting references**

*This place does not cover:*

| Concurrent instruction execution, e.g. pipeline, look ahead | G06F 9/38 |

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Subprogram jump | G06F 9/4486 |

**G06F 9/321**

{Program or instruction counter, e.g. incrementing}

**Definition statement**

*This place covers:*

Incrementing/decrementing means for the program counter.

Selection of next PC from pre-calculated constant values, e.g. +1, +2, 0, -1.

PC arrangements, e.g. multiple PCs.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Program counter | a dedicated register which holds the address of the current instruction in the program sequence |
Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>Program counter</td>
</tr>
</tbody>
</table>

G06F 9/322

{for non-sequential address}

Definition statement

This place covers:
Address formation, or selection, for the next instruction, being a non-sequential address.
Address calculation or selection, for the execution of branch instructions in general, e.g. for multiple types of branch.
Selection of next instruction address from various alternatives, e.g. PC, a constant, branch target, branch fall-through.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term or Expression</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC address formation</td>
<td>address calculation, i.e. address selection</td>
</tr>
</tbody>
</table>

G06F 9/324

{using program counter relative addressing}

Definition statement

This place covers:
Formation of the next instruction address using an offset from the program counter.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address formation of the instruction operand or result using PC-relative addressing</td>
<td>G06F 9/3557</td>
</tr>
</tbody>
</table>

G06F 9/325

{for loops, e.g. loop detection, loop counter}

Definition statement

This place covers:
Formation of the next instruction address for a loop.
Loop formation; loop detection.
Loop counters.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Specific loop control instructions or iterative instructions | G06F 9/30065 |
| Buffering of loop instructions | G06F 9/381 |

G06F 9/327

{for interrupts}

Definition statement

This place covers:
Formation of the next instruction address for an interrupt, using hardware means e.g. look-up table.

G06F 9/328

{for runtime instruction patching}

Definition statement

This place covers:
Formation of the address of a next instruction for the purpose of patching an instruction.
Includes detection of program addresses or instructions to be patched.

Relationships with other classification places

Patching of software or loading of new version of software G06F 9/445.
Instruction emulation G06F 9/455.
Runtime patching of microcode in ROM G06F 9/268.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Patching | repairing errors in machine instructions in read-only storage at runtime. Usually implemented by substituting the instruction at a particular address in the memory by a correct version. |

G06F 9/34

Addressing or accessing the instruction operand or the result {; Formation of operand address; Addressing modes (address translation G06F 12/00)}

Definition statement

This place covers:
• Addressing the instruction operand or the result.
• Operand addressing modes in general.
• Endian conversion.
Relationships with other classification places
Addressing of memories in general, address translation G06F 12/00.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Accessing an operand in a pipeline</th>
<th>G06F 9/3824</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address translation</td>
<td>G06F 12/00</td>
</tr>
</tbody>
</table>

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Addressing mode                     | type of operand addressing e.g. indirect, indexed |

G06F 9/342
{Extension of operand address space}

Definition statement
This place covers:
Increasing the size of the addressable operand memory space i.e. increasing the number of available addressable locations.
Extending the operand address space by increasing the bit length of addresses.
Extending the operand address space by use of multiple address spaces; bank pointer.

Relationships with other classification places
Address space extension in memory systems G06F 12/0615

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Organisation of register space      | G06F 9/3012 |

G06F 9/345
of multiple operands or results {(addressing multiple banks G06F 12/06)}

Definition statement
This place covers:
Address formation for a series or group of operands, e.g. for an array.
Address formation for pairs of operands at adjacent addresses i.e. addr;addr+1.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Prediction of operand addresses for operand prefetching | G06F 9/3832 |
| Addressing multiple banks | G06F 12/06 |

Special rules of classification

May also be classified according to the addressing mode.

**G06F 9/3455**

{using stride}

Definition statement

*This place covers:*

Address formation for a series of operands by adding a stride value to the previous address to form the next address.

May be used to predict the next operand address.

Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

| Stride | offset or displacement which may be a constant. |

**G06F 9/35**

Indirect addressing {, i.e. using single address operand, e.g. address register}

Definition statement

*This place covers:*

Address formation using a single address operand, e.g. using the contents of an address register or GPR.

Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

| Indirect addressing | the address is the value contained in the register specified in the instruction. |
| Direct addressing | the address is the value specified in the instruction. |
| GPR | general purpose register |
G06F 9/355

Indexed addressing {, i.e. using more than one address operand}

Definition statement
This place covers:
Operand address formation using more than one address operand, e.g. using base + index/offset registers.

Indexed address formation or calculation details.

Uses at least two address operands which are added or concatenated. The resulting address may be longer than the base address, hence indexed addressing may be also used for address space extension.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Address space extension | G06F 9/342 |

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Indexed addressing | the address is the value contained in the base register specified in the instruction summed with the value contained in the index register specified in the instruction. The index part of the address usually consists of less bits than the base part of the address, and is therefore an offset from the base address |

Synonyms and Keywords
In patent documents, the following words/expressions are often used as synonyms:
- "index", "offset", "displacement" and "delta"

G06F 9/3552
{using wraparound, e.g. modulo or circular addressing}

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Wraparound | incrementing the maximum address value, e.g. 11111111 leads to wraparound to the lowest address value, e.g. 00000000, so that addressing is continuous, avoiding an overflow error |
| Modulo or circular addressing | same meaning than Wraparound |
G06F 9/3555
{using scaling, e.g. multiplication of index}

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling</td>
<td>Indexed addressing where the index address is multiplied by a factor before adding to the base address</td>
</tr>
</tbody>
</table>

G06F 9/3557
{using program counter as base address}

Definition statement

This place covers:
- Address formation using the program counter as a base for indexed addressing;
- PC-relative addressing.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next instruction addressing using an offset from the program counter.</td>
<td>G06F 9/324</td>
</tr>
</tbody>
</table>

G06F 9/38
Concurrent instruction execution, e.g. pipeline, look ahead

Definition statement

This place covers:
Simultaneous execution of instructions in general, in parallel or pipelined.
Special architectures where instruction execution is concurrent.
Includes stack machines.

Relationships with other classification places

Concurrent program execution: G06F 9/46.

G06F 9/3802
{Instruction prefetching}

Definition statement

This place covers:
Prefetching and fetching of instructions for execution, in general.
Instruction buffering; instruction caches
G06F 9/3804
{for branches, e.g. hedging, branch folding}

Definition statement
This place covers:
Prefetching of instructions for branch paths.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hedging</td>
<td>Fetching both paths of an unresolved conditional branch</td>
</tr>
<tr>
<td>Branch folding</td>
<td>Removal of a branch instruction from the instruction stream, e.g. by including the branch condition in an instruction as a predicate</td>
</tr>
</tbody>
</table>

G06F 9/3806
{using address prediction, e.g. return stack, branch history buffer}

Definition statement
This place covers:
Using a history of previous branch target addresses to predict the address to fetch from, e.g. branch target buffer;

Address buffers for predicting next fetch address for a branch, e.g. return address stack.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Name</th>
<th>G06F 9/3844</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic prediction of branch direction</td>
<td></td>
</tr>
<tr>
<td>Static prediction of branch direction</td>
<td></td>
</tr>
<tr>
<td>Hybrid prediction of branch direction</td>
<td></td>
</tr>
</tbody>
</table>

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTB</td>
<td>buffer indexed by an instruction fetch address or PC, which returns the predicted target address if the instruction is a taken branch.</td>
</tr>
<tr>
<td>BHT</td>
<td>buffer indexed by a branch instruction address, which returns a prediction of whether the branch is taken or not.</td>
</tr>
<tr>
<td>BDT</td>
<td>buffer indexed by a branch type at decode time, which returns a prediction of whether the branch is taken or not.</td>
</tr>
<tr>
<td>Return address stack</td>
<td>Stack to hold the program address to return to after a Call-type branch. The stack structure allows nesting of Calls.</td>
</tr>
</tbody>
</table>
Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTB</td>
<td>Branch Target Buffer</td>
</tr>
<tr>
<td>BHT</td>
<td>Branch History Table</td>
</tr>
<tr>
<td>BTAC</td>
<td>Branch Target Address Cache</td>
</tr>
<tr>
<td>BDT</td>
<td>Branch Decode Table</td>
</tr>
</tbody>
</table>

G06F 9/3808

{for instruction reuse, e.g. trace cache, branch target cache}

Definition statement

This place covers:

- Prefetching of instructions intended to be used more than once, thereby saving fetch time;
- Buffering of instructions for reuse, e.g. trace cache;
- Branch target caches.

Relationships with other classification places

Program tracing for monitoring G06F 11/3466.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch target cache</td>
<td>History buffer of first instruction at a branch target, which returns an instruction rather than an address, thus saving fetch time.</td>
</tr>
<tr>
<td>Trace cache</td>
<td>Cache storing a history of previously executed paths through the program, as sequences of instructions. Accessing the trace cache returns the next predicted instructions in the sequence.</td>
</tr>
</tbody>
</table>

G06F 9/381

{Loop buffering}

Definition statement

This place covers:

- Prefetching of instructions intended to be used in a loop, thereby saving fetch time;
- Buffering of instructions for loops.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Term</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific loop control instructions</td>
<td>G06F 9/30065</td>
</tr>
<tr>
<td>Formation of the next instruction address for a loop; detection of loops</td>
<td>G06F 9/325</td>
</tr>
</tbody>
</table>
Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Loopshort backward branch | Sequence of instructions executing repetitively |

G06F 9/3812
{with instruction modification, e.g. store into instruction stream}

Definition statement
This place covers:
Instruction prefetching in an architecture allowing instruction modification.

How to handle store-into-instruction-stream, wherein an instruction in memory is modified, e.g. by writing back a new operand value, hence the prefetched copy of the instruction is stale.

G06F 9/3814
{Implementation provisions of instruction buffers, e.g. prefetch buffer; banks}

Definition statement
This place covers:

• Special arrangements for buffering of prefetched instructions;
• Prefetch buffers;
• Banked or partitioned instruction buffers.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Prefetch buffer | In this subclass, a buffer to hold a recently fetched set of instructions, usually between the instruction memory and the instruction decoder, e.g. cache line buffer. |

Synonyms and Keywords
In patent documents, the following words/expressions are often used with the meaning indicated:

| "cross-modifying code" | "instructions which can modify other instructions". |
| "self-modifying code" | "instructions which can modify themselves". |

G06F 9/3816
{Instruction alignment, e.g. cache line crossing}

Definition statement
This place covers:
Arrangements for (correct) alignment of instructions in prefetch buffers.

Instruction prefetching which crosses a line in memory or cache, for example for variable length instructions.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Variable length instructions</th>
<th>G06F 9/30149</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predecoding instructions for alignment information</td>
<td>G06F 9/382</td>
</tr>
</tbody>
</table>

G06F 9/3818

{Decoding for concurrent execution}

Definition statement

This place covers:
Decoding for enabling the concurrent execution of instructions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Decoding of a single instruction | G06F 9/30145 |

G06F 9/382

{Pipelined decoding, e.g. using predecoding}

Definition statement

This place covers:
Decoding for enabling the pipelined execution of instructions.

Predecoding stage in a pipeline.
Partitioned decoding stage.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Instruction alignment using predecode information | G06F 9/3816 |

G06F 9/3822

{Parallel decoding, e.g. parallel decode units}

Definition statement

This place covers:
Decoding for enabling the parallel execution of instructions.

Special details of decoding multiple instructions in parallel, e.g. decoding of Very Long Instruction Word format field.
References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Compressed VLIW instructions | G06F 9/30156 |

**G06F 9/3824**

{Operand accessing}

**Definition statement**

This place covers:

Retrieving operands for instructions, from memory, registers, other pipeline stages or execution units.

**References**

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Load, Store instructions | G06F 9/30043 |
| Register file accessing in general | G06F 9/30098 |

**Synonyms and Keywords**

In patent documents, the following words/expressions are often used as synonyms:

- "input operand" and "source"
- "output operand", "result" and "destination"

**G06F 9/3826**

{Data result bypassing, e.g. locally between pipeline stages, within a pipeline stage}

**Definition statement**

This place covers:

Arrangements for the transfer of an instruction result to a dependent instruction, without first storing in the architected state, e.g. bypassing the register file;

Transfer of operand data from the output of a functional unit to the input of another functional unit, without waiting for the completion of the data producing instruction, or without waiting for the data to be stored in the register file.

**References**

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Transfer of data between Store and Load instructions for memory consistency | G06F 9/3834 |
Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "bypassing" and "forwarding"

G06F 9/3828

{with global bypass, e.g. between pipelines, between clusters}

Definition statement

This place covers:

Bypass of an instruction result to a dependent instruction in another pipeline, or group of execution units, e.g. between clusters;

Bypass arrangements for global data.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Parallel execution units organised in clusters

G06F 9/3889

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Cluster | Group of execution units and register resources

G06F 9/383

{Operand prefetching (cache prefetching G06F 12/0862)}

Definition statement

This place covers:

Prefetching of data operands;

Software data prefetching;

Prefetching from a data cache reduces cache misses during execution of the instruction using the data.

Relationships with other classification places

Prefetching between higher level memories: G06F 12/0862.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Specific instruction to prefetch data from memory

G06F 9/30047

Instruction prefetching

G06F 9/3802

Speculative load instructions

G06F 9/3842
G06F 9/383 (continued)

<table>
<thead>
<tr>
<th>Glossary of terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this place, the following terms or expressions are used with the meaning indicated:</td>
</tr>
</tbody>
</table>

| Operand prefetching | Look-ahead fetching of an operand before the execution of the instruction which will use the operand |

<table>
<thead>
<tr>
<th>G06F 9/3832</th>
</tr>
</thead>
<tbody>
<tr>
<td>{Value prediction for operands; operand history buffers}</td>
</tr>
</tbody>
</table>

**Definition statement**

This place covers:
- Reuse or prediction of the value of an operand;
- Operand value prediction using a history of the value of an operand;
- Operand value buffering for reuse;
- Prediction of the address of an operand.

**Relationships with other classification places**
- Data caches in general: G06F 12/08.

<table>
<thead>
<tr>
<th>G06F 9/3834</th>
</tr>
</thead>
<tbody>
<tr>
<td>{Maintaining memory consistency (cache consistency protocols G06F 12/0815)}</td>
</tr>
</tbody>
</table>

**Definition statement**

This place covers:
- How to maintain memory consistency during operand accessing for instruction execution.
- Avoiding errors caused by loads and/or stores to the same memory address being executed out of order or concurrently.
- Ensuring stored operands and fetched operands are consistent, e.g. memory disambiguation.
- Ensuring out-of-order loads receive the latest store information by forwarding.

**Relationships with other classification places**
- Cache consistency protocols: G06F 12/0815.
- Multiprogramming arrangements for transaction processing: G06F 9/466.
- Multiprogramming arrangements for program synchronisation: G06F 9/52.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific atomic or synchronisation instructions, e.g. Read-Modify-Write</td>
<td>G06F 9/30087,</td>
</tr>
<tr>
<td></td>
<td>G06F 9/3004</td>
</tr>
<tr>
<td>Operand bypassing between Load and Store instructions</td>
<td>G06F 9/3826</td>
</tr>
<tr>
<td>Consistency of architectural state</td>
<td>G06F 9/3857</td>
</tr>
<tr>
<td>Cache consistency protocols</td>
<td>G06F 12/0815</td>
</tr>
</tbody>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory consistency</td>
<td>Keeping data in the memory up-to-date. Read data should not be stale; written data should not be overwritten by older data, which may occur in out-of-order execution.</td>
</tr>
<tr>
<td>Memory disambiguation</td>
<td>Checking stores against earlier executed out-of-order loads, and re-issuing the loads if their data is stale.</td>
</tr>
</tbody>
</table>

G06F 9/3836

{Instruction issuing, e.g. dynamic instruction scheduling, out of order instruction execution}

Definition statement

This place covers:

Runtime scheduling or issuing of instructions.

Instruction dispatching to execution units or execution buffers.

Concurrent execution of instructions.

Synchronisation of instruction execution.

Relationships with other classification places

Runtime scheduling of tasks: G06F 9/4806

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessing of operands for issue</td>
<td>G06F 9/3824</td>
</tr>
<tr>
<td>Re-issuing of faulting instructions</td>
<td>G06F 9/3861</td>
</tr>
</tbody>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issuing</td>
<td>Runtime selection or scheduling of the instructions to execute.</td>
</tr>
</tbody>
</table>
Superscalar | Architecture where more than one instruction is selected to be executed in parallel in one cycle.
---|---
VLIW | Very Long Instruction Word being a compound instruction word formed by the compiler, containing multiple sub-instructions to be issued and completed together in one cycle.

**G06F 9/3838**

{Dependency mechanisms, e.g. register scoreboard}

**Definition statement**

*This place covers:*

Special arrangements to detect or record data dependencies between instruction operands at issue time.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data dependency</td>
<td>When a first instruction specifies an operand which is also specified in a following second instruction, the second instruction is dependent on the first, and cannot be executed until the dependency is resolved, or the operand is available.</td>
</tr>
<tr>
<td>Register scoreboard</td>
<td>Table of indicators of which instructions use which registers. May be used for dependency checking by detecting two instructions having a matching indicator.</td>
</tr>
</tbody>
</table>

**Synonyms and Keywords**

*In patent documents, the following words/expressions are often used as synonyms:*

- "Pseudo data dependency", "false data dependency", "anti-dependency", "write-after-write dependency" and "output dependency"

**G06F 9/384**

{Register renaming}

**Definition statement**

*This place covers:*

Special arrangements to carry out register renaming, e.g. as a means of avoiding pseudo dependencies;

Rename tables and buffer, which may form part of a reorder buffer.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder buffers</td>
<td>G06F 9/3855</td>
</tr>
</tbody>
</table>
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register renaming</td>
<td>Associating a logical register specified in an instruction to a unique physical register. Allows multiple physical registers to be assigned to hold data for multiple instances of a logical register, thus avoiding false dependencies. Relies on the set of physical registers being larger than the set of logical registers.</td>
</tr>
<tr>
<td>RAW, read-after-write dependency</td>
<td>Occurs when a read to the same location occurs after a write to the same location. If the instructions are not in program order, this may lead to wrong execution.</td>
</tr>
<tr>
<td>WAW, write-after-write dependency</td>
<td>It occurs when a write to the same location occurs after another write to the same location. If the instructions are not in program order, this may lead to wrong execution.</td>
</tr>
<tr>
<td>Pseudo data dependency, false dependency, anti-dependency, output dependency</td>
<td>Dependency which may be resolved without wrong execution, e.g. a write followed in program order by another write; a read followed in program order by a write.</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "RAW" and "read-after-write dependency"
- "WAW" and "write-after-write dependency"
- "pseudo data dependency", "false dependency", "anti-dependency", "output dependency"

G06F 9/3842

{Speculative instruction execution}

Definition statement

This place covers:

Execution of instructions ahead of program order, with the presumption that execution will prove to be correct e.g. speculative loads, boosting.

Speculative instructions which are executed e.g. alternative paths of a branch.

Execution of instructions dependent on a branch before its outcome is known.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional instruction execution, e.g. predication</td>
<td>G06F 9/30072</td>
</tr>
<tr>
<td>Result nullification for executed instructions</td>
<td>G06F 9/3859</td>
</tr>
<tr>
<td>Recovery after mis-speculation</td>
<td>G06F 9/3861</td>
</tr>
</tbody>
</table>
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speculative instructions</td>
<td>Executed instructions which may not be on the actual path taken through the program, and therefore may require recovery after execution if mis-speculation occurs.</td>
</tr>
<tr>
<td>Speculative loads</td>
<td>Look-ahead or early execution of load instructions, where recovery would be needed in the case of mis-speculation.</td>
</tr>
</tbody>
</table>

G06F 9/3844

{using dynamic prediction, e.g. branch history table}

Definition statement

This place covers:
Speculative execution of instructions using dynamic branch prediction;
Using runtime conditions, and the previous behaviour of branches, to predict the outcome of a branch, without having to wait for its execution;
Early generation of branch results.

References

Limiting references

This place does not cover:
Using hybrid branch prediction

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic prediction</td>
<td>Branch prediction based on runtime conditions, as opposed to compile-time branch prediction.</td>
</tr>
<tr>
<td>Branch history table</td>
<td>Branch prediction based on runtime conditions, as opposed to compile-time branch prediction.</td>
</tr>
<tr>
<td>Branch Target Buffer</td>
<td>Buffer indexed by an instruction fetch address or PC, which returns the predicted target address if the instruction is a taken branch.</td>
</tr>
<tr>
<td>Branch History Table</td>
<td>Buffer indexed by a branch instruction address, which returns a prediction of whether the branch is taken or not.</td>
</tr>
<tr>
<td>Branch Decode Table</td>
<td>Buffer indexed by a branch type at decode time, which returns a prediction of whether the branch is taken or not.</td>
</tr>
<tr>
<td>Branch Prediction Counter</td>
<td>Saturating counter used to obtain a weighting for a branch prediction based on several branch executions.</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTB</td>
<td>Branch Target Buffer</td>
</tr>
<tr>
<td>BHT</td>
<td>Branch History Table</td>
</tr>
</tbody>
</table>
G06F 9/3846
{using static prediction, e.g. branch taken strategy}

Definition statement
This place covers:
Speculative execution of instructions using static branch prediction;
Branch prediction performed by compiler, and not dependent on runtime conditions, e.g. hint bits;
Static bit may be used to indicate an unconditional branch, if this is not clear from the opcode;
Static prediction may be used as default when no dynamic prediction is available.

References
Limiting references
This place does not cover:
Using hybrid branch prediction

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static prediction</td>
<td>Branch direction is predicted based on compile-time branch prediction.</td>
</tr>
<tr>
<td>Hint bit</td>
<td>Bit in branch instruction inserted by compiler to give an indication whether branch predicted taken or not.</td>
</tr>
</tbody>
</table>

Synonyms and Keywords
In patent documents, the following words/expressions are often used as synonyms:
- "hint bit" and "static bit"

G06F 9/3848
{using hybrid branch prediction, e.g. selection between prediction techniques}

Definition statement
This place covers:
Prediction schemes involving more than one type of predictor;
Static and dynamic prediction used alternately;
Local and global prediction mechanisms;
Two-level branch prediction.
References

Limiting references

This place does not cover:

- Using dynamic prediction, e.g. branch history table
- Using static prediction, e.g. branch taken strategy

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Two-level branch prediction | History of the outcome of a set of branches is used to select the predictor for a particular branch. |

G06F 9/3851

(from multiple instruction streams, e.g. multistreaming (initiation or dispatching of multiple tasks or threads G06F 9/48))

Definition statement

This place covers:

- Issuing instructions from multiple threads each having a context, including at least a program counter, and possibly registers and execution resources;
- Includes multiple streams for different threads, or from both directions of a branch;
- Interleaved execution of threads in a single or in multiple streams;
- Stream selection.

Relationships with other classification places

Thread scheduling or multithreading at OS or application level G06F 9/46.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Context registers for multiple streams | G06F 9/30123 |
| Execution units or pipeline architectures for executing multiple streams | G06F 9/3889 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Instruction stream | Architectural aspects, e.g. resources and context, used to execute a thread or series of instructions. Includes at least a program counter, and possibly including dedicated instruction buffers, registers, status register, execution units. |
G06F 9/3853
{of compound instructions}

Definition statement

This place covers:
Issuing of compound instructions;
Compounding single instructions into a group;
Issuing a group of instructions, that must complete in the same cycle;
Dispatching aspects of compound instructions, e.g. variable format VLIW instructions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Decoding of VLIW format field

G06F 9/3822

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Compound instruction | Consisting of sub-instructions, i.e. contains multiple opcodes, e.g. VLIW instructions. |

G06F 9/3855
{Reordering, e.g. using a queue, age tags}

Definition statement

This place covers:
Special arrangements for reordering of instructions issued out-of-order. Usually occurs at writeback stage;
Queue arrangements include reorder buffers;
Age tags include marking the instructions with the original program order.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Reordering | Restoring the program order after instruction execution, ensuring that the instructions complete in the correct order. |
| Age tag    | An indicator associated with an instruction to indicate its original program order, e.g. in the case of instructions executed out-of-order. |
**G06F 9/3857**

{Result writeback, i.e. updating the architectural state}

**Definition statement**

This place covers:

Special arrangements to write back results to the architectural state, ensuring correctness of the architectural state;

Instruction completion.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Recovery of architectural state after an exception | G06F 9/3861 |

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

| Architectural state | Runtime data in the pipeline resources, including program counter, instruction queue, status register, condition codes, general purpose and special purpose registers, rename data, pipeline registers, etc. The state is updated when one of these resources is written to. |

**G06F 9/3859**

{with result invalidation, e.g. nullification}

**Definition statement**

This place covers:

Ensuring correctness of the architectural state by nullifying the results of wrongly executed instructions.

Nullifying may use, for example, preventing writeback; tagging the result as invalid; clearing of result.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Cancellation of an instruction before execution using, for example, predication | G06F 9/30072 |
| Recovery from exceptions | G06F 9/3861 |
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nullification</td>
<td>In this subgroup, the invalidation of an instruction result. The instruction has already executed, but the results are invalid, and must not update the architectural state.</td>
</tr>
</tbody>
</table>

G06F 9/3861

{Recovery, e.g. branch miss-prediction, exception handling (error detection or correction G06F 11/00)}

Definition statement

This place covers:
Recovery of correct instruction execution after an exception or fault;
Restoring the correct architectural state after an exception, e.g. after branch mis-prediction, arithmetic overflow.
May require nullifying wrong results; flushing the instructions in the pipeline; restarting the pipeline from the point of exception.

Relationships with other classification places

Error detection or correction: G06F 11/00.
Exception handling in genera: G06F 11/0793.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Term</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction result nullification</td>
<td>G06F 9/3859</td>
</tr>
</tbody>
</table>

Special rules of classification

The group is only to be used for the handling of exceptions caused by instruction execution.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural state</td>
<td>The runtime data in the pipeline resources, including program counter, instruction queue, status register, condition codes, general purpose and special purpose registers, rename data, pipeline registers etc.</td>
</tr>
<tr>
<td>Exception, fault</td>
<td>Error caused by the execution of an instruction, e.g. floating point overflow; page fault; mis-speculation.</td>
</tr>
</tbody>
</table>
G06F 9/3863
{using multiple copies of the architectural state, e.g. shadow registers}

Definition statement
This place covers:
Recovery using multiple copies of architectural state;
Restoring the architectural state to that previous to an exception using a previous version of the state, e.g. checkpoint, future file, shadow registers.

Relationships with other classification places
Software debugging: G06F 11/36.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Shadow register structure | G06F 9/30116 |

Special rules of classification
The subgroup is only to be used for the handling of exceptions caused by instruction execution. In particular, checkpointing for software debugging is not meant.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Architectural state | the runtime data in the pipeline resources, including program counter, instruction queue, status register, condition codes, general purpose and special purpose registers, rename data, pipeline registers etc. |

G06F 9/3865
{using deferred exception handling, e.g. exception flags}

Definition statement
This place covers:
Instruction exception handling which does not occur in the cycle in which the exception is detected, but later, e.g. at writeback stage.

G06F 9/3867
{using instruction pipelines}

Definition statement
This place covers:
Concurrent execution using instruction pipelines;
Control of instructions moving through a pipeline of functional stages. A typical pipeline consists of these stages: Instruction fetch; Instruction decode; Operand fetching; Instruction issue; Instruction execution; Instruction completion/Result writeback;

Pipeline control, e.g. flushing, halting;

Pipeline stages, e.g. type of stage, number of stages;

Variable length pipeline, e.g. elastic pipeline;

Counterflow pipeline;

Cascaded pipelines.

**Relationships with other classification places**

Data-driven systems, e.g. tokens: G06F 9/4494.

Computer architectures for data-driven systems: G06F 15/82.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Specific instructions for pipeline control</th>
<th>G06F 9/30079</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchronous pipeline control, e.g. using handshaking</td>
<td>G06F 9/3871</td>
</tr>
</tbody>
</table>

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline</td>
<td>Series of linearly sequential execution stages for executing instructions. The stages have buffers between them for output data which is input into the next stage. The buffers may be clocked so that data from one stage moves into the next stage on a clock signal. All stages move at once, else an asynchronous pipeline.</td>
</tr>
<tr>
<td>Counterflow pipeline</td>
<td>Pipeline in which instructions travel down pipeline, but data travels up pipeline.</td>
</tr>
<tr>
<td>Cascaded pipeline</td>
<td>Parallel pipelines where a group of instructions are issued in successive cycles to produce a staggered execution of the group.</td>
</tr>
</tbody>
</table>

**G06F 9/3869**

{Implementation aspects, e.g. pipeline latches; pipeline synchronisation and clocking}

**Definition statement**

*This place covers:*

Instruction pipeline synchronisation;

Timing aspects of instruction pipelines, e.g. clock cycle, derating;

Clocking of pipeline stages; clock domains;

Clock skew problems;
Clock gating in pipelines, e.g. for power saving;
Latches and buffers between pipelines stages.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Specific instructions for pipeline control. | G06F 9/30079 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Clock skew | lack of synchronicity between instances of a clock signal caused, e.g. by differing clock wire lengths. |

G06F 9/3871

{Asynchronous instruction pipeline, e.g. using handshake signals between stages}

Definition statement
This place covers:
Asynchronous pipeline, e.g. using handshake signals between stages, e.g. ACK, DONE signals.
Pipelines where the stages do not all move at the same time.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Asynchronous pipeline | Pipeline where not all stages move at once, e.g. execution in a stage starts when a signal is received from previous stage, and ends by sending a done signal to next stage. |
| Handshake signals | Exchange of signals between stages, e.g. to inform a next stage when data is available to process, and to inform a previous stage when data may be forwarded. |

G06F 9/3873

{Variable length pipelines, e.g. elastic pipeline}

Definition statement
This place covers:
Pipeline with dynamically varying length.
Multiple pipelines having different lengths.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Pipeline length | The number of pipeline stages. |
G06F 9/3875
{Pipelining a single stage, e.g. superpipelining}

Definition statement

This place covers:

Pipeline architecture where a single stage is split into sub-stages using pipeline buffer, with higher
clocking rate implied for that stage, e.g. pipelined execution unit; pipelined decode unit.

Pipeline architecture having multiple stages for the same function, e.g. two execution stages, without
higher clock rate.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Pipelined decoding                  | G06F 9/382 |

G06F 9/3877
{using a slave processor, e.g. coprocessor (peripheral processor G06F 13/12;
vector processor G06F 15/8053)}

Definition statement

This place covers:

Concurrent instruction execution using slave processor or coprocessor which controls its own
execution i.e. has a decode unit or sequencer;

Means and protocol to transfer instructions and data to a slave processor, and to receive results in
return;

Detection of presence or absence of a slave processor;

Reconfigurable coprocessors i.e. not special purpose.

Relationships with other classification places

Vector processors: G06F, G06F 15/8053.

Cryptographic processors: G06F 21/123.

I/O or DMA processors: G06F 13/12.

Image or graphics processors: G06T 1/20.

Digital data processing G06F 17/00, G06F

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Execution units executing under control of a master decoder | G06F 9/3885 |
| Peripheral processor                                      | G06F 13/12  |
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host</td>
<td>master processor to which the coprocessor is a slave</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:
- "COP" and "coprocessor"

G06F 9/3879

{for non-native instruction execution, e.g. executing a command; for Java instruction set}

Definition statement

This place covers:

Slave processors which receive and decode instructions which are not explicit in the instruction set of the host e.g. commands; function calls; using ESC; using memory-mapped commands;

Slave processors which are adapted to execute another instruction set, e.g. Java coprocessor.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-native instruction set</td>
<td>Instructions which cannot be executed on the master processor</td>
</tr>
</tbody>
</table>

G06F 9/3881

{Arrangements for communication of instructions and data}

Definition statement

This place covers:

Special arrangements or protocols for transfer of instructions or commands, and for exchange of data with a slave processor which executes non-native instructions.

G06F 9/3885

{using a plurality of independent parallel functional units}

Definition statement

This place covers:

Special arrangements for concurrent instruction execution using parallel functional units, implying the concurrent execution of multiple instructions, one in each of the functional units;

Parallel execution pipelines.

Relationships with other classification places

Arrays of processors G06F 15/78, G06F 15/80, G06F 15/16.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel decode units</td>
<td>G06F 9/3822</td>
</tr>
<tr>
<td>Concurrent execution using a slave processor</td>
<td>G06F 9/3877</td>
</tr>
</tbody>
</table>

Special rules of classification

This group is only to be used for special architectural arrangements to enable the concurrent execution of instructions, not for the mere presence of parallel functional units.

Parallel functional units does not usually mean parallel processors. Multicore architectures may be found here only if they carry out concurrent execution of instructions from the same program.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional unit</td>
<td>Unit within the processor which carries out part of the execution of an instruction.</td>
</tr>
</tbody>
</table>

G06F 9/3887

{controlled by a single instruction, e.g. SIMD}

Definition statement

This place covers:

Multiple parallel functional units controlled by a single instruction.

For SIMD execution, this class contains details relevant to the execution aspects, e.g. executing a global instruction according to local conditions.

Relationships with other classification places

SIMD architectures : G06F 15/80.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMD</td>
<td>Acronym for &quot;single instruction multiple data&quot; being an architecture having a set of homogenous execution units which execute the same instruction in any given cycle, but which each have their own operand data, e.g. vector data.</td>
</tr>
</tbody>
</table>

G06F 9/3889

{controlled by multiple instructions, e.g. MIMD, decoupled access or execute}

Definition statement

This place covers:

Multiple parallel functional units controlled collectively by multiple instructions.
Includes special techniques of parallel functional unit control in a superscalar or VLIW architecture.

Hardware streams.

**Relationships with other classification places**

MIMD architectures: [G06F 15/16](#).

**Special rules of classification**

This group is only to be used for special architectural arrangements to enable the concurrent execution of instructions, not for the mere presence of parallel functional units executing multiple instructions.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MIMD</strong></td>
<td>Acronym for &quot;multiple instruction multiple data&quot; being an architecture having a set of homogenous execution units which execute different instructions in any given cycle, and which each have their own operand data.</td>
</tr>
<tr>
<td><strong>VLIW</strong></td>
<td>Acronym for &quot;very long instruction word&quot; being an architecture having a compound instruction word formed by the compiler, containing multiple sub-instructions to be issued and completed together in one cycle, and having no interdependencies.</td>
</tr>
<tr>
<td><strong>Hardware stream</strong></td>
<td>Hardware resources used for the context and execution of a stream or thread of instructions.</td>
</tr>
</tbody>
</table>

**G06F 9/3891**

{organised in groups of units sharing resources, e.g. clusters}

**Definition statement**

*This place covers:*

Control of parallel execution by groups of functional units, such as multiple execution units sharing local memory;

Partitioned architectures, e.g. for hardware multistreaming.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cluster</strong></td>
<td>Group of execution units with shared register resources.</td>
</tr>
<tr>
<td><strong>Hardware stream</strong></td>
<td>Hardware resources used for the context and execution of a stream or thread of instructions.</td>
</tr>
</tbody>
</table>

**G06F 9/3893**

{controlled in tandem, e.g. multiplier-accumulator}

**Definition statement**

*This place covers:*

Multiple functional units which are controlled in tandem or cascade to carry out an instruction.
Multiple functional units controlled by the same instruction but not in the same cycle.

**Relationships with other classification places**

Hierarchical adders: G06F 7/50.

**Synonyms and Keywords**

*In patent documents, the following abbreviations are often used:*

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC</td>
<td>Multiplier-accumulator unit</td>
</tr>
</tbody>
</table>

**G06F 9/3895**

{for complex operations, e.g. multidimensional or interleaved address generators, macros}

**Definition statement**

*This place covers:*

Multiple functional units which are controlled in tandem or cascade to carry out an instruction which is a complex operation, possibly over multiple cycles.

**G06F 9/3897**

{with adaptable data path}

**Definition statement**

*This place covers:*

Parallel functional units controlled in tandem to execute complex operations using adaptable datapath.

**Relationships with other classification places**

Reconfigurable computer architectures: G06F 15/7867.

**G06F 9/44**

Arrangements for executing specific programs

**Definition statement**

*This place covers:*

Execution of a single program.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program initiating or program switching in the context of multiprogramming</td>
<td>G06F 9/48</td>
</tr>
</tbody>
</table>
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level language</td>
<td>refers to what is commonly known in the art, i.e. a language containing human readable constructs intended to be used by a human programmer and to be translated to binary code for execution. The fact that it is theoretically possible to read, understand and directly program binary code does not qualify this type of code as HLL.</td>
</tr>
<tr>
<td>Low-level language</td>
<td>language that provides little or no abstraction from a computer's instruction set architecture</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLL</td>
<td>High level language</td>
</tr>
</tbody>
</table>

G06F 9/4401

Bootstrapping (security arrangements therefor G06F 21/57)

Definition statement

This place covers:
Starting up or shutting down a computer system and loading of the operating system.

References

Limiting references

This place does not cover:

Security arrangements for bootstrapping G06F 21/57

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For set top boxes H04N 21/443

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level details of resetting means</td>
<td>G06F 1/24</td>
</tr>
<tr>
<td>Compiler bootstrapping</td>
<td>G06F 8/37</td>
</tr>
<tr>
<td>Installation of computer software</td>
<td>G06F 8/61</td>
</tr>
<tr>
<td>Fault tolerant booting</td>
<td>G06F 11/1417</td>
</tr>
<tr>
<td>Details of Power-On Self Test (POST)</td>
<td>G06F 11/2284</td>
</tr>
</tbody>
</table>
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bootstrap</td>
<td>a simple program that begins initialisation of the computer's operating system</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPL</td>
<td>Initial program load</td>
</tr>
</tbody>
</table>

G06F 9/4403

{Processor initialisation}

Definition statement

This place covers:

Initialisation of the processor and the processor's direct environment immediately after the initial reset signal.

This group deals with local issues - there is no network involved.

Includes:

- Initial microcode loading;
- Selecting the very first instructions to be executed after a hardware reset;
- Processor address boot facilities;
- I/O channel initialisation (see also G06F 9/4416);
- Making BIOS ROM invisible after booting;
- Means to shadow BIOS from ROM to (faster) RAM.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading microcode per se</td>
<td>G06F 9/24</td>
</tr>
<tr>
<td>Configuring of multiprocessors</td>
<td>G06F 15/177</td>
</tr>
</tbody>
</table>

G06F 9/4405

{Initialisation of multiprocessor systems}

Definition statement

This place covers:

Initialisation of processors in a multiprocessor system immediately after the initial reset signal.
G06F 9/4405 (continued)

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Configuring of multiprocessors | G06F 15/177 |

G06F 9/4406

{Loading of operating system}

Definition statement

This place covers:

Loading of the operating system and the preparatory steps for loading the OS.

Also includes the launching of application programs once the OS has been loaded, and OS formats on storage devices.

G06F 9/4408

{Boot device selection}

Definition statement

This place covers:

Searching and selecting a bootable boot device.

G06F 9/441

{Multiboot arrangements, i.e. selecting an operating system to be loaded}

Definition statement

This place covers:

Computer systems having more than one bootable OS

• Choosing one of the available bootable OSs and booting from that OS (dual-boot or multi-boot);

• Providing mechanical means to switch between the OSs (see US2006107029);

• When a computer is switched on for the first time, the user is required to choose one of the OSs available on the computer. Once an OS is chosen, the other OSs are made unavailable. The next time the computer is started, it will boot only the selected OS (see EP0794484).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Emulating one OS using another | G06F 9/45504 |
| Two active OSs, where one OS (the guest OS) is running as an application in the other OS (the host OS) | G06F 9/45545 |
| Multiple OSs running simultaneously in the context of a VMM | G06F 9/45558 |
| When one of this plurality of OSs serves as a backup OS in case of failure, recovery OS | G06F 11/00 |
G06F 9/4411
{Configuring for operating with peripheral devices; Loading of device drivers}

Definition statement

This place covers:
Initialisation and configuration of peripheral devices, insofar as this configuration is related to the interaction with the operating system.

Also deals with the configuration of the operating system in order to be able to interact with peripheral devices.

A peripheral device in this class should be understood as a passive entity, i.e. whose functioning is controlled by the host computer to which it is attached. Systems involving a host computer with attached devices that have processing capabilities of their own should be treated as a multiprocessor or a networked distributed system.

This initialisation/configuration does not have to occur during booting (although it typically does) - it can also take place e.g. when a device is hot-inserted (plug and play).

This group deals with local issues - there is no network involved.

- Assigning IRQ lines, I/O addresses;
- Configuring registers on the peripheral;
- Device discovery: detecting which devices are present; building device trees;
- Adapting OS for device configuration;
- Device initialisation;
- Config.sys peripheral device facilities.

Loading or installation of device drivers. This does not necessarily have to occur at boot time.

References
Informative references

Attention is drawn to the following places, which may be of interest for search:

| Configuration of printer parameters | G06F 3/1297 |
| Updating of firmware in peripheral devices | G06F 8/65 |
| Configuring software or OS when this configuration is not related to interacting with the peripheral device | G06F 9/44505 |
| Program control for peripheral devices - the inner workings of a device driver, i.e. how the driver performs its job of interfacing between OS & device, how the driver is structured, etc. | G06F 13/102 |
| Electrical details of hot-plugging, plug and play | G06F 13/4081 |
| Peripherals with a processor and software running thereon together with the computer's processor can be considered a multiprocessor system. A distinction has to be made between the device driver - i.e. the software that runs on the host to interface with the peripheral - and the software running on the peripheral. | G06F 15/177 |
| Reconfiguration of FPGAs, PLDs | G06F 17/5054 |
| HAVi networks | H04L 12/2803 |
| Configuration of network elements | H04L 41/0803 |
Management of devices over a network

Special rules of classification

A device driver is understood to be software used by a computer to control/operate a peripheral device. A peripheral is any kind of device that can be attached to/inserted into a computer in order to expand its functionality (modem, sound card, disk drives). A device driver - i.e. the piece of software that is loaded on a host computer and that enables the host computer to control the operation of an attached peripheral - differs from the peripheral's operating software - i.e. the piece of software that resides on the peripheral itself and executed by the peripheral's processor that allows the peripheral to operate as an independent unit.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Internal</td>
<td>an expansion card that is plugged into one of the ISA/PCI slots</td>
</tr>
<tr>
<td>Peripheral External</td>
<td>an external device connected through the serial/parallel port a PC card</td>
</tr>
</tbody>
</table>

G06F 9/4413

{Plug-and-play [PnP]}

Definition statement

This place covers:

Arrangements for automating the process of device driver loading or configuration of a peripheral device or the operating environment of the computing element hosting the peripheral device in in response to dynamic changes in the peripheral constitution of the computing element (addition or removal of peripheral devices).

Plug-and-play in the context of this class occurs either during boot time or during run-time (live addition or removal).

G06F 9/4415

{Self describing peripheral devices}

Definition statement

This place covers:

The peripheral device itself contains all the information (or a reference to a place where the information is stored) required for its configuration and the configuration of the operating environment. In other words, it is the peripheral device and not the operating environment that is burdened with the task of providing configuration information or device drivers.
G06F 9/4416
{Network booting; Remote initial program loading [RIPL]}

Definition statement

This place covers:
Booting of client computers, processors or devices that do not have the necessary boot code locally available but retrieve the boot code from a remote source, e.g. a boot server in a network environment.

Specific topics included:
- Booting of diskless computers ("net" computers);
- "Push" booting: a server computer boots a client computer by sending a boot program to the client computer;
- PXE (Preboot Execution Environment)

The Preboot Execution Environment (PXE) is an industry standard client/server interface that allows networked computers that are not yet loaded with an operating system to be configured and booted remotely by an administrator. The PXE process consists of the client notifying the server that it uses PXE. If the server uses PXE, it sends the client a list of boot servers that contain the operating systems available. The client finds the boot server it needs and receives the name of the file to download. The client then downloads the file using Trivial File Transfer Protocol and executes it, which loads the operating system.
- Booting a thin client in a "client device/data center" environment (see US2006/161765);
- Network booting;
- Booting diskless workstations;
- Booting thin clients.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booting of multiprocessor systems, e.g. where one processor (the master) sends the boot or initialisation code to the other processors (slaves)</td>
<td>G06F 15/177</td>
</tr>
<tr>
<td>Wake-on-LAN (WoL)</td>
<td>H04L 12/12</td>
</tr>
<tr>
<td>BOOTP, DHCP protocol</td>
<td>H04L 61/2023, H04L 61/2015</td>
</tr>
<tr>
<td>Network protocols involving booting</td>
<td>H04L 67/34</td>
</tr>
</tbody>
</table>

Special rules of classification

Remote booting in the context of a first-time and one-off installation of an OS is also classified in the G06F 8/61.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIPL</td>
<td>Remote Initial Program Load</td>
</tr>
<tr>
<td>PXE</td>
<td>Preboot Execution Environment</td>
</tr>
</tbody>
</table>
G06F 9/4418

{Suspend and resume; Hibernate and awake}

Definition statement

This place covers:

Suspend/Resume and Hibernate/Wake Up refer to techniques to put a system in a low power, non-operating mode, thereby preserving the system state that existed at the time of going into Suspend or Hibernate. The next time the computer is started, operation continues at the point where it left off, rather than starting from scratch.

- Speeding up the boot process by restoring persisted data from previous executions rather than going to the whole boot process.
- Hibernating a system to persistent storage on a first computer, transporting the storage to a second computer and resuming the execution there. Please note that this is not process migration.
- Multiple removable storage devices, each having a different hibernated system image stored thereon; resuming the different system images on one computer by switching the storage devices.
- Quickly bringing a computer into an operational state by copying a memory image from persistent storage to RAM, thereby bypassing the lengthy conventional boot process.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Low-level, electrical details of suspend and resume | G06F 1/32 |
| Power Management | G06F 1/3203 |
| Normal Shutdown (without saving state information - the next boot starts from scratch) | G06F 9/4401 |
| Suspending a running process and resuming its execution later in the context of process scheduling | G06F 9/461, G06F 9/4881 |
| Booting a computer system when an error/ fault is involved. Includes Dealing with errors that occur during the boot process itself (e.g. when encountering a corrupt BIOS); * Rebooting the system after a previous irregular shutdown (e.g. due to a power failure), thereby restoring as much as possible the system state that existed before the irregular shutdown occurred. In absence of an emergency power supply, a power failure will cause the computer system to be simply powered down, inevitably resulting in the loss of system state. The next time the computer is booted, the system state will be restored as much as possible. | G06F 11/1417 |
| Graceful shutdown: When a power failure is detected, an emergency power supply (e.g. UPS) is activated giving the system enough time to do a proper shutdown (when shutting down a computer system, no state information is saved). Graceful hibernation:When a power failure is detected, an emergency power supply (e.g. UPS) is activated giving the system enough time to do a proper hibernation (thereby saving the system state) before eventually powering down. Dealing with power failures that occur when the system is in suspend mode, i.e. when the RAM is still powered; In battery-powered systems, suspending or hibernating the system when the battery level drops below a predetermined level | G06F 11/1441 |
| Wake-on-LAN | H04L 12/12 |
Special rules of classification
The techniques of Suspension and Hibernation differ from each other in the degree of persistency of saving the system state.

With Hibernation, the system state is stored on a non-volatile memory device, e.g. HDD, while in the case of Suspension, the system state is stored in volatile memory (e.g. RAM).

In the G06F 9/4418 we only deal with situations where the reason or the system to suspend or hibernate is controlled/intentional e.g. after user presses power off button, after a preset period of inactivity for power saving purposes. When the reason to suspend or hibernate is the occurrence of a power failure, low battery voltage or another anomaly (e.g. system hang), then the document should be classified in G06F 11/1441 (see Related Fields). The subsequent restart of the system is classified in G06F 11/1417.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hibernation</td>
<td>also known as Suspend-to-Disk (S2D) and is defined as sleeping mode S4 in the ACPI specification.</td>
</tr>
<tr>
<td>Suspension</td>
<td>also known as Suspend-to-RAM (STR) and is defined as sleeping mode S3 in the ACPI specification.</td>
</tr>
</tbody>
</table>

G06F 9/442
{Shutdown}

Definition statement
This place covers:
Shutting down the computer, the opposite operation of bootstrapping (G06F 9/442).

References
Application-oriented references
Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

<table>
<thead>
<tr>
<th>Term</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspend and resume</td>
<td>G06F 9/4418</td>
</tr>
<tr>
<td>Graceful shutdown in case of power failure, e.g. using an uninterruptible power supply (UPS)</td>
<td>G06F 11/1441</td>
</tr>
</tbody>
</table>

G06F 9/445

Program loading or initiating (bootstrapping G06F 9/4401; security arrangements for program loading or initiating G06F 21/57)

Definition statement
This place covers:
Preparing a program for execution including the actual launching of the program.
References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bootstrapping</td>
<td>G06F 9/4401</td>
</tr>
<tr>
<td>Security arrangements for program loading or initiating</td>
<td>G06F 21/57</td>
</tr>
</tbody>
</table>

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updating of computer software</td>
<td>G06F 8/65</td>
</tr>
<tr>
<td>Loading of microcode</td>
<td>G06F 9/24</td>
</tr>
<tr>
<td>Process Migration</td>
<td>G06F 9/4856,</td>
</tr>
<tr>
<td></td>
<td>G06F 9/5088</td>
</tr>
<tr>
<td>Protocols for network applications involving the movement of software and/or configuration parameters, e.g. applets</td>
<td>H04L 67/34</td>
</tr>
</tbody>
</table>

G06F 9/44505

{Configuring for program initiating, e.g. using registry, configuration files}

Definition statement
This place covers:
Run-time configuration of software and computer applications, for example:
Configuring the Windows registry;
User profiles: roaming (i.e. restoring the user's settings at a different computer), multiple users (i.e. each user has a different profile).

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration management in the context of software development</td>
<td>G06F 8/71</td>
</tr>
<tr>
<td>Configuration of peripheral devices</td>
<td>G06F 9/4411</td>
</tr>
<tr>
<td>Configuration of FPGA, PLA</td>
<td>G06F 17/50</td>
</tr>
<tr>
<td>Gaming configure</td>
<td>G07F</td>
</tr>
<tr>
<td>Personalization of smart cards</td>
<td>G07F 7/10</td>
</tr>
<tr>
<td>Configuration of parameters specifically aimed at networking/communication</td>
<td>H04L 41/08</td>
</tr>
<tr>
<td>Protocols for network applications involving terminal/user profiles</td>
<td>H04L 67/306</td>
</tr>
<tr>
<td>Differentially changing configuration parameters</td>
<td>H04L 67/34</td>
</tr>
</tbody>
</table>

Special rules of classification
Configuration wizards that assist a user in configuring a software application, are also classified in G06F 9/453 (Help systems).
G06F 9/44521
{Dynamic linking or loading; Link editing at or after load time, e.g. Java class loading}

Definition statement

This place covers:
Ways to load program code whereby, rather than first loading the entire program code before starting execution, the program code is loaded only when needed.

Also includes:
• Saving memory space and preventing unnecessary processing by only loading the program parts that are actually used; Parts that are never executed are never loaded;
• Starting execution once certain parts are loaded: no need to wait for the whole program to be loaded;
• Executing instructions as they are loaded: the idea of streaming;
• Java constant pool resolution
• Dynamic linking/loading is also known as: incremental, partial, run-time, lazy; on-demand linking/loading.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>DLLs</th>
<th>Dynamic Link Library</th>
</tr>
</thead>
</table>

G06F 9/44526
{Plug-ins; Add-ons}

Definition statement

This place covers:
Dynamically loading special software components to existing applications in order to extend their functionality, e.g. Adobe Flash-Player.

G06F 9/44536
{Selecting among different versions}

Definition statement

This place covers:
Determining the right version of a software component to be loaded.

G06F 9/44542
{Retargetable}

Definition statement

This place covers:
Program loading explicitly taking into account hardware characteristics of the target.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Retargetable program installation/update | G06F 8/64 |

G06F 9/44547

{Fat binaries}

Definition statement

This place covers:

Computer programs containing code native to multiple instruction sets (processor architectures).

G06F 9/44557

{Code layout in executable memory}

Definition statement

This place covers:

How software components should be placed in a RAM, e.g. occupying neighbouring sections.

G06F 9/44573

{Execute-in-place [XIP]}

Definition statement

This place covers:

Skipping or reducing the step of loading and initialization of program code.

Techniques used:

- XIP: eXecute-In-Place: execute programs from where they are persistently stored. There is no program loading.
- Pre-initialise modules: program code may be loaded, but it is already partially or totally initialised
- Romization of program code

XIP (Execute In Place) refers to the execution program code directly from the memory where it is stored, without first loading the program code to volatile executable memory (RAM).

Where the G06F 9/445 relates to the preparatory process of making program code ready for execution - loading, i.e. transferring the code to executable memory; linking, i.e. resolving references; initializing data structures - XIP relates to methods where the program code can be directly executed without having to go through this preparatory process.

One definition of XIP, taken from US2002/069342: "A XIP architecture is defined by a system's ability to execute one or more bytes of code while still resident within non-volatile memory (e.g., read-only memory (ROM)), without first transferring the code to volatile memory (e.g., random access memory (RAM))."

Another definition of XIP, taken from US2004/193864: "A called execute-in-place (XIP) technology refers to a specific function provided with a storage device, which data or command codes stored in the storage device can be directly accessed by a central processing unit (CPU) in a computer system,
without pass through a random access memory (RAM), thus reducing power consumption and data loss, and increasing executing speed."

For program code to be directly executable from the memory where it is stored, it is required that the memory is suitable to directly execute code (read US2002/138702, [0004]-[0008]), and that the code is in such a form that it can be directly executed.

Examples of XIP:
- In normal computer systems, directly executing program code from an externally connected memory device;
- In embedded systems, executing the software directly from the non-volatile memory where it is stored.

Also included:
- Romization, romizer: processes and tools to generate a directly-executable program image.
- Semi-directly-executable code: the code is partially prepared for execution, the rest takes place at load time.

**Special rules of classification**

The U3 technology does not fall under the XIP technology, because the program code is not executed directly from the USB stick.

**G06F 9/44584**

**{Portable applications, i.e. making applications self-contained, e.g. U3 standard}**

**Definition statement**

_This place covers:_

Executing applications without installing them before, for example according to the U3 standard, or portable application packages ("Portable App") started directly from a USB stick.

**G06F 9/44589**

**{Program code verification, e.g. Java bytecode verification, proof-carrying code (high-level semantic checks G06F 8/43; testing and debugging software G06F 11/36)}**

**Definition statement**

_This place covers:_

Verification of program code, for example:

Java bytecode verification.

Proof carrying code.

inter instruction consistency checks.

**References**

**Limiting references**

_This place does not cover:_

| High-level semantic checks | G06F 8/43 |
Special rules of classification

- In G06F 11/36 group, the question is: does the program do what it is expected to do? In other words, for a given input, does the program produce the expected output? The program is considered as a black box, only the external behaviour is studied. The tests that are performed do not take into account the implementation or the language that is used to write the program. We are here on the level of users/developers/specifications.
- In G06F 9/44589, a test is performed to see whether the (compiled) program code does not do anything that is not allowed by the rules of the target machine. In other words, the question is: does the program comply with code specific requirements?

The two groups are on a different level. It is possible for a program to respect all code specific requirements and thus to pass G06F 9/44589 tests, but not to produce the expected output and thus not to pass the G06F 11/36 test.
- In the G06F 8/43 (Compile-time checking), source code is checked. In most cases, this is done by the compiler but it can also be performed by a separate program. In contrast, the G06F 9/44589 tests already compiled code. In the G06F 8/43, the verification is performed based on source code specific aspects, whereas in the G06F 9/44589 this is done on the basis of target machine related aspects.

G06F 9/44594

{Unloading}

Definition statement

This place covers:
- Unloading program components from memory or terminating applications, e.g. when they are not needed anymore.
- Java class unloading: removing Java classes from memory when they are not used anymore, e.g. because the class has become “unreachable”.

Class unloading is not the same as Garbage Collection: in class unloading, what is removed is program code in executable memory (classes), whereas in Garbage Collection it is data (objects, i.e. class instances) that are removed.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

<table>
<thead>
<tr>
<th>Uninstallation</th>
<th>G06F 8/62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garbage collection</td>
<td>G06F 12/0253</td>
</tr>
</tbody>
</table>
G06F 9/448
Execution paradigms, e.g. implementations of programming paradigms

Definition statement
This place covers:
Implementations of specific programming paradigms to execute computer programs, the programming paradigms being e.g. object-orientated, procedural, data driven or finite state machine

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OO</td>
<td>Object-oriented</td>
</tr>
</tbody>
</table>

G06F 9/4484
{Executing subprograms}

Definition statement
This place covers:
Invocation and execution of subroutines, for example:
- Implementation of a call stack: creating and deleting activation records, reserving space on the stack to store local variables and to pass the arguments
- Argument passing
- Locating variables at higher level in the invocation chain
- Co-routines
- Re-entrant functions
- Function or method overloading: considering the type of all actual arguments/return type of a function to select a proper function instance to execute Calling functions in another programming language

Also covered are other combinations of several instructions, for example combinations of instructions to perform (counted) loops.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware implementation of instructions that change the program flow to another address (jumps, branches, goto)</td>
<td>G06F 9/30</td>
</tr>
<tr>
<td>Remote procedure calls (RPC)</td>
<td>G06F 9/547</td>
</tr>
<tr>
<td>Stack caching</td>
<td>G06F 12/0875</td>
</tr>
</tbody>
</table>

Synonyms and Keywords
In patent documents, the following words/expressions are often used as synonyms:
- Subprograms, subroutines, functions, procedures, object oriented methods
G06F 9/4486

{Formation of subprogram jump address}

Definition statement

This place covers:
Finding the entry address of a subroutine and how to preserve the return address

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Static linking, i.e. before load-time</th>
<th>G06F 8/54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware implementation of instructions specifically designed to keep the return address (e.g. branch-and-link, jsr)</td>
<td>G06F 9/30</td>
</tr>
<tr>
<td>Branch prediction in a pipelined system</td>
<td>G06F 9/3844, G06F 9/3846</td>
</tr>
<tr>
<td>Dynamic linking, i.e. at or after load-time</td>
<td>G06F 9/44521</td>
</tr>
</tbody>
</table>

G06F 9/4488

{Object-oriented}

Definition statement

This place covers:
Execution aspects of object-oriented programs

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>OO</th>
<th>Object-oriented</th>
</tr>
</thead>
</table>

G06F 9/449

{Object-oriented method invocation or resolution}

Definition statement

This place covers:
- Object-oriented method resolution, i.e. given a method invocation on a reference (pointer) to an object, how to locate the correct code that implements this method. Typically this is done using virtual function tables.
- Only deals with the resolution of an object-oriented method.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Remote method invocation (RMI) | G06F 9/548 |
G06F 9/4491
{Optimising based on receiver type}

Definition statement

This place covers:

• Speeding up the run-time object-oriented method resolution by predicting the type of the referenced object

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>PIC</th>
<th>Polymorphic inline cache</th>
</tr>
</thead>
</table>

G06F 9/4492
{Inheritance}

Definition statement

This place covers:

Object oriented class hierarchies including run-time addition of classes to a hierarchy and/or virtual inheritance polymorphism

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Object-oriented method resolution</th>
<th>G06F 9/449</th>
</tr>
</thead>
</table>

Special rules of classification

Documents in G06F 9/449 deal with Object-oriented method invocation and will inevitably talk about class hierarchies, which is the subject of G06F 9/4492. However, this alone does not justify classification in G06F 9/4492: only when the document discloses specific details about class hierarchies, the symbol G06F 9/4492 should be given.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Method overriding</th>
<th>subclass provides a specific implementation of a method that is already provided by one of its superclasses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymorphism</td>
<td>creating a variable, a method or an object that has more than one form</td>
</tr>
</tbody>
</table>

### G06F 9/4493

**{Object persistence}**

**Definition statement**

*This place covers:*

- Making objects persistent and restoring objects from persisted form.

**Includes:**

- Pointer swizzling
- Flattening objects

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serialization in the context of RPC, RMI</td>
<td>G06F 9/547, G06F 9/548</td>
</tr>
<tr>
<td>OO databases</td>
<td>G06F 16/30</td>
</tr>
</tbody>
</table>

### G06F 9/4494

**{data driven}**

**Definition statement**

*This place covers:*

- Software aspects of data driven systems, i.e. systems where the action is dictated by the presence or availability of data at the inputs of the logical circuits, rather than by sequential instruction execution under supervision of a central clock

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification techniques, e.g. Petri nets</td>
<td>G06F 8/10</td>
</tr>
<tr>
<td>Data flow analysis during compilation</td>
<td>G06F 8/433</td>
</tr>
<tr>
<td>Architectures for data or demand driven systems</td>
<td>G06F 15/82</td>
</tr>
</tbody>
</table>

### G06F 9/451

**Execution arrangements for user interfaces**

**Definition statement**

*This place covers:*

The inner working of user interfaces, in particular graphical user interfaces (GUIs), including:

- interaction of the GUI with applications and OSs
- the structure and interaction of software components of GUIs
implementation of GUI concepts typically used in operating systems, e.g. desktop metaphors, widgets or windowing mechanisms

implementation of GUI automation mechanisms, e.g. record/replay of user interactions on the GUI

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

| User interfaces for testing or debugging software | G06F 11/36 |
| User interface for databases, visualization of query results | G06F 16/248, G06F 16/338, G06F 16/34 |
| User interfaces to web services | G06F 16/954, G06F 16/9577 |
| User interfaces for the field of automation | G05B 19/00 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Methods for a user to interact with the GUI, e.g. scrolling, drag and drop, menus | G06F 3/048 |
| Digital output to a display device | G06F 3/14 |
| Development and generation of source code for user interfaces | G06F 8/38 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| User interface | is the space where interaction between humans and machine occurs |

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

| HCI | Human-computer interaction |
| MMI | Man-machine interaction |
| CHI | Computer-human interaction |
| GUI | Graphical user interface |
G06F 9/452

{Remote windowing, e.g. X-Window System, desktop virtualisation (protocols for telewriting H04L 67/38)}

Definition statement

This place covers:
Methods to execute and interact with an application, whereby the application's program code runs on the server, and the GUI runs on the client (terminal). The user interacts with the remotely running application through the local GUI. GUI events/commands run back and forth between client and server. All processing is done at the server.

References

Limiting references

This place does not cover:

| Protocols for telewriting | H04L 67/38 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Communication between two running processes | G06F 9/54 |
| Terminal emulation | G06F 13/107 |

G06F 9/453

{Help systems}

Definition statement

This place covers:
- Customizing the help according to the user's previous actions
- Getting help by pressing f1
- Wizards, application assistants, visual cues
- Online tutorials

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Intelligent code editors | G06F 8/33 |
| Teaching appliances; GUIs specially adapted for deaf, mute or blind persons | G09B |
G06F 9/454
{Multi-language systems; Localisation; Internationalisation}

Definition statement
This place covers:
• User interfaces in multiple human languages, adapting user interfaces to suit a foreign culture
• Game localisation

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Pseudo-localisation</th>
<th>G06F 11/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural language translation</td>
<td>G06F 17/28</td>
</tr>
</tbody>
</table>

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Language localisation | internationalisation (i18n), globalisation |

G06F 9/455
Emulation; Interpretation; Software simulation, e.g. virtualisation or emulation of application or operating system execution engines

Definition statement
This place covers:
The emulation (see glossary) of entities, e.g. operating systems, processors, classified under G06F 9/00.

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>In-circuit emulation</th>
<th>G06F 11/36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic binary instrumentation may use techniques similar to emulators and binary optimizers</td>
<td>G06F 11/3644</td>
</tr>
<tr>
<td>Virtual memory</td>
<td>G06F 12/00</td>
</tr>
<tr>
<td>Terminal emulation</td>
<td>G06F 13/105</td>
</tr>
<tr>
<td>Computer simulation, in which a model of a system under investigation is being simulated</td>
<td>G06F 17/50</td>
</tr>
</tbody>
</table>
**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulation</td>
<td>In computing, emulation refers to the duplication and imitation of the functions of one computer system/program by another computer system/program, different from the first one, so that the emulated behaviour fully or closely resembles the behaviour of the original system/program.</td>
</tr>
</tbody>
</table>

**G06F 9/45504**

*Abstract machines for programme code execution, e.g. Java virtual machine [JVM], interpreters, emulators*

**Definition statement**

*This place covers:*

Software implementation of a machine (computer) that executes programs like a physical machine:
- Java Virtual Machine (JVM);
- Microsoft .NET common language runtime (CLR);
- Smalltalk virtual machines.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compile time binary to binary translation</td>
<td>G06F 8/52</td>
</tr>
<tr>
<td>Run-time interpretation of high level language programs</td>
<td>G06F9/4551</td>
</tr>
<tr>
<td>Run-time binary to binary translation</td>
<td>G06F 9/45516</td>
</tr>
</tbody>
</table>

**G06F 9/45508**

*Runtime interpretation or emulation, e.g. emulator loops, bytecode interpretation*

**Definition statement**

*This place covers:*

Interpretation of high-level language code, e.g. BASIC.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling plain, natural text, word processors, spreadsheets, XML, etc</td>
<td>G06F 17/28</td>
</tr>
</tbody>
</table>
G06F 9/45512

{Command shells}

Definition statement

This place covers:

Giving commands to a computer (OS) by means of a (graphical) user interface.

These commands can be given via the command line or by performing actions on GUI objects. The commands are typically interpreted by a command interpreter.

- Scripts, recording and executing GUI command scripts.

G06F 9/45516

{Runtime code conversion or optimisation}

Definition statement

This place covers:

The execution of binary code/bytecode that is not native to the current run-time execution environment by translating the non-native binary code/bytecode into native code just before execution and subsequently executing the native code.

Subsequently, execution can be optimised as follows:

- By performing a retranslation of the non-native binary code/bytecode yielding more optimal native binary code e.g. by taking into account run-time information;
- By directly transforming the native binary code yielding more optimal native binary code.

The G06F 9/45516 also deals with the initial and subsequent run-time transformation of native binary code into more optimal native binary code.

For the purpose of completeness, the G06F 9/45516 also deals with the translation of intermediate bytecode to a different intermediate bytecode (e.g. Java bytecode to UCSD P-code). This however, is a more theoretic possibility and will not occur frequently.
The majority of the documents in this class deal with the translation of intermediate bytecode to native binary code and more specifically with the dynamic compilation of Java bytecodes into native code (JIT compilation).

**Relationships with other classification places**

- The [G06F 9/45516](#) is the dynamic counterpart of the [G06F 8/52](#)

Both classes have the same goal (i.e. translation from one binary format into another) but the point in time when this translation is performed is different: at run-time, just before or during execution ([G06F 9/45516](#)) and statically, pre-run-time ([G06F 8/52](#)).

- Because the translation in the [G06F 9/45516](#) takes place just before execution, there is less time available
- Difference between [G06F 9/45516](#) and [G06F 9/3017](#)

Both [G06F 9/45516](#) and [G06F 9/3017](#) deal with run-time translation of binary code. However, in the [G06F 8/455B4](#) the translation relates to a program as a whole and is realised by a software translator, whereas in the [G06F 9/3017](#) the translation relates to individual instructions that are about to be executed and is performed by the processor's internal hardware and.

In [G06F 9/45516](#), the processor is fed with the translated, native instructions; it doesn't know anything about the translation that took place. However, in [G06F 9/3017](#) the processor is fed with the non-native instructions; translation into native code takes place on-the-fly (i.e. at the moment the instruction is actually executed by the internal hardware of the processor).

- Difference between [G06F 9/45516](#) and [G06F 9/45508](#)
- The [G06F 9/45508](#) is also related to the execution of binary, non-native code. However, the non-native code is emulated rather than translated: an emulator acts as an virtual machine and interprets the non-native code.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Run-time instruction translation</th>
<th>G06F 9/3017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profiling per se</td>
<td>G06F 11/34</td>
</tr>
</tbody>
</table>

**Special rules of classification**

Compilation techniques that occur at runtime but that are independent of the runtime aspect, i.e. that might equally well be used in an offline context, should be classified in [G06F9/45](#) and get Indexing Code [G06F 9/45516](#).

**G06F 9/4552**

*{Involving translation to a different instruction set architecture, e.g. just-in-time translation in a JVM}*

**Definition statement**

*This place covers:*

Translation of code at runtime prior to executing it natively, e.g. bytecode into native machine code. Dynamic compilation.
References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

Translation of one binary program to another before the program is ever executed. Static binary translation.

G06F 8/52

G06F 9/45533

{Hypervisors; Virtual machine monitors}

Definition statement

This place covers:

- Simultaneously executing multiple operating systems using a Virtual Machine Monitor (VMM).
  The following passage, taken from US2004230794, provides a good definition of a VMM: 'A VMM enables plural operating systems to run on a single machine by "virtualizing" the entire machine. Conventionally, an operating system controls the use of the physical hardware resources of a machine (e.g., the memory, the processor, etc.), and thus the actual hardware of the machine is exposed to the operating system. When a VMM is used, however, the machine's hardware (e.g., devices) are only exposed to the VMM. The VMM, then, exposes "virtual" machine components to the operating systems'. In G06F 9/45545, plural operating systems execute simultaneously as guest and host (without a VMM).
- Process switching for virtual machines;
- Handling of non-implemented instructions;
- Address trapping for emulating other memory architectures;
- Host/guest and mode switching instructions;
- Switching between endian modes (endian conversion on a bus G06F 13/40).

References

Limiting references

This place does not cover:

- Loading of microprogram
- Mode switching during interrupts per se

G06F 9/45537

{Provision of facilities of other operating environments, e.g. WINE (I/O emulation G06F 13/105)}

Definition statement

This place covers:

Emulation of one OS by another OS

- Simultaneously executing first and second operating systems by executing the second OS as a guest OS on top of the first OS (the host OS). No virtual machine monitor (VMM) is needed. The use of guest and host OSs is described in the following passage, taken from US2004230794: ‘ Certain techniques allow operating systems to exist side-by-side on the same machine without the use of a virtual machine monitor. One such technique is to have one operating system act as a "host" for the other operating system. (The operating system that the "host" is hosting is sometimes
called a "guest.") In this case, the host operating system provides the guest with resources such as memory and processor time.

- Interrupt handling of other OS
- Non I/O services of other OS, e.g. facilities for emulation of virtual memory
- Memory mapping and address trapping for emulating I/O

**Relationships with other classification places**

Associated address trapping is in **G06F 9/45533**.

**References**

**Limiting references**

This place does not cover:

| I/O emulation | G06F 13/105 |

**G06F 9/45541**

{**Bare-metal, i.e. hypervisor runs directly on hardware**}

**Definition statement**

This place covers:

A bare-metal hypervisor runs directly on the host's hardware to control the hardware and to manage guest operating systems, e.g. Citrix XenServer, VMware ESX, Microsoft Hyper-V..

**G06F 9/45545**

{**Guest-host, i.e. hypervisor is an application program itself, e.g. VirtualBox**}

**Definition statement**

This place covers:

Hypervisor runs within a conventional operating system environment.

**G06F 9/4555**

{**Para-virtualisation, i.e. guest operating system has to be modified**}

**Definition statement**

This place covers:

Para-virtualisation is a virtualization technique that presents a software interface to virtual machines that is similar but not identical to that of the underlying hardware.

**G06F 9/45554**

{**Instruction set architectures of guest OS and hypervisor or native processor differ, e.g. Bochs or VirtualPC on PowerPC MacOS**}

**Definition statement**

This place covers:

Mechanisms to adapt the instruction set of a guest system to the instruction set offered by the underlying hypervisor and/or native processor.
**G06F 9/45558**

{Hypervisor-specific management and integration aspects}

**Definition statement**

*This place covers:*

Relates to specific management and integration aspects of hypervisors.

Functions needed to manage virtual machines or to integrate them into the execution environment that are specific to a hypervisor system, e.g. handling of virtual machine instances, creating, cloning, deleting instances, starting and stopping virtual machines, distributing and migrating instances, managing I/O and storage access, isolating virtual machines for security reasons, managing memory of instances.

**G06F 9/46**

Multiprogramming arrangements

**Definition statement**

*This place covers:*

aspects of multiprogramming, i.e. where more than one process / task is present and this presence is essential for identifying the problem and / or the solution; a process / task is defined here as a program in execution.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

| Object-oriented software design | G06F 8/24 |
| Multi-threading at the hardware level | G06F 9/3851 |
| Saving and restoring the state of a system, i.e. hibernation | G06F 9/4418 |
| Batch processing | G06F 9/4843 |
| Suspend and resume task / process / thread execution without details on context saving and restoring | G06F 9/485 |
| Saving and restoring the state of a mobile agent together with additional details on the mobile agent itself | G06F 9/4862 |
| Saving and restoring program state during debugging | G06F 11/3636 |
| Access rights for memory resources, e.g. access to memory according to privilege rings | G06F 12/14 |
| Access rights associated to human beings or documents where the final aim is to enforce protection at the user level without giving technically relevant details on the multiprogramming implementation | G06F 21/30 |
| Documents just mentioning a multiprocessing / distributed object-oriented systems and which focus on a specific use / application (e.g. e-commerce, monitoring, information retrieval, security) | G06Q 30/00, G06F 11/00, G06F 16/00, G06F 21/00 |
| Documents mentioning a transaction but dealing, in fact, with nothing more than techniques involving a request for a service, without any detail on the ACID (Atomicity, Consistency, Isolation, Durability) properties; e.g. e-commerce transactions | G06Q 30/00 |
| Network- and protocol-specific aspects | H04L 29/06 |
Special rules of classification

Rule 1

When a document qualifies for one of the groups in the table of rule 2 below, the group **G06F 9/46** should not be assigned.

Rule 2

The following table specifies the group to be assigned:

<table>
<thead>
<tr>
<th>Technical details on</th>
<th>Group to be assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saving or restoring of program or task context</td>
<td>G06F 9/461</td>
</tr>
<tr>
<td>Saving or restoring of program or task context with multiple register sets. This group takes precedence over G06F 9/461</td>
<td>G06F 9/462</td>
</tr>
<tr>
<td>Program control block organisation. This group takes precedence over G06F 9/461</td>
<td>G06F 9/463</td>
</tr>
<tr>
<td>Structure and arrangements for distributed object oriented systems, e.g. CORBA, Jini, DCOM</td>
<td>G06F 9/465</td>
</tr>
<tr>
<td>Transaction processing, namely transactions involving the ACID (Atomicity, Consistency, Isolation, Durability) properties</td>
<td>G06F 9/466</td>
</tr>
<tr>
<td>Transactional memory, i.e. transparent support for the definition of regions of code that are considered a transaction, the support being provided either in hardware, software or with hybrid-solutions. This group takes precedence over G06F 9/466. For speculative lock acquisition, G06F 9/528 takes precedence</td>
<td>G06F 9/467</td>
</tr>
<tr>
<td>Specific access rights for resources, e.g. using capability register</td>
<td>G06F 9/468</td>
</tr>
</tbody>
</table>

Rule 3

The following text specifies the groups which could be assigned in addition to the groups of rule 2 above, to cover further technical details; the group(s) identified as context information should also be checked and assigned, if relevant:

Further technical details on:

The structure of bridges between different distributed object-oriented systems
  - Context information: G06F 9/465

The lookup of interfaces and/or the structure of lookup servers / repositories
  - Context information: G06F 9/465

The handling of references to remote objects / namespace implementation details within the context of distributed object-oriented systems
  - Context information: G06F 9/465
**G06F 9/48**

Program initiating; Program switching, e.g. by interrupt

**Definition statement**

*This place covers:*

Transfer, initiation or dispatching of tasks, i.e. programs in execution, either locally or within a distributed system

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Specific details on power distribution and power saving                     | G06F 1/3203 |
| Scheduling of printer jobs                                                | G06F 3/1296 |
| Instruction streams within a processor (e.g. hardware threads) and instruction level details | G06F 9/3836 |
| Suspension and resumption at system level (i.e. involving the bootstrapping) | G06F 9/4418 |
| Mere loading of code linked to the initiation                              | G06F 9/445  |
| Details on the task context structure as well as on its saving and restoring| G06F 9/461  |
| Scheduling in terms of space                                               | See special rules of classification for G06F 9/50 |
| Process migration in the context of load (re-)balancing, without any technically relevant detail on the migration itself | G06F 9/5088 |
| Mere starting of a backup application at a certain date/time               | G06F 11/1461|
| Low level (bus-related) details of interrupt handling and interrupt controllers | G06F 13/24 |
| Mere starting of an antivirus application at a certain date/time           | G06F 21/56  |
| Scheduling of human resources                                             | G06Q 10/00  |

**Special rules of classification**

**Rule 1**

When a document qualifies for one of the groups in the table of rule 2 below, the group G06F 9/48 should not be assigned.

**Rule 2**

The following table specifies the group to be assigned:

<p>| Technical details on initiation of a task by means of an interrupt, i.e. the aspects of handling/servicing an interrupt | G06F 9/4812 |
| Interrupt interrupt priority mechanisms. This group takes precedence over G06F 9/4812 | G06F 9/4818 |</p>
<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation of a task by means of an interrupt related to a timer. This group takes precedence over G06F 9/4812</td>
<td>G06F 9/4825</td>
</tr>
<tr>
<td>Initiation of a task by means of an interrupt with variable priority. This group takes precedence over G06F 9/4812</td>
<td>G06F 9/4831</td>
</tr>
<tr>
<td>Initiation of a task by means of an interrupt with variable priority, said priority being time dependent. This group takes precedence over G06F 9/4812 and G06F 9/4831</td>
<td>G06F 9/4837</td>
</tr>
<tr>
<td>Initiation, transfer and dispatch of a task, i.e. a program in execution, by another program; creation, e.g. fork() system call, and initiation, e.g. exec() system call, of a task / process / thread, virtual machine in the same or different machine</td>
<td>G06F 9/4843</td>
</tr>
<tr>
<td>Task life-cycle, e.g. stopping, restarting, resuming execution. This group takes precedence over G06F 9/4843. For scheduling algorithms and internal operation of a scheduler, G06F 9/4881 takes precedence</td>
<td>G06F 9/485</td>
</tr>
<tr>
<td>Resuming the execution of a task on a different machine, i.e. migration. This group takes precedence over G06F 9/4843. This group takes precedence over G06F 9/485. For migration for load balancing purposes, G06F 9/5088 takes precedence</td>
<td>G06F 9/4856</td>
</tr>
<tr>
<td>Mobile agents, i.e. tasks specifically designed to migrate. This group takes precedence over G06F 9/4843. This group takes precedence over G06F 9/485. For cloning and replication of mobile agents, only G06F 9/4868 should be assigned. For migration policy, e.g. auction, contract negotiation, of mobile agents, only G06F 9/4875 should be assigned.</td>
<td>G06F 9/4862</td>
</tr>
<tr>
<td>Scheduling strategies for dispatcher, e.g. round robin, multilevel priority queues; internal operation of a scheduler</td>
<td>G06F 9/4881</td>
</tr>
<tr>
<td>Algorithms for real-time scheduling of processes, i.e. scheduling taking into account the deadlines of the applications being executed. This group takes precedence over G06F 9/4843. This group takes precedence over G06F 9/4881.</td>
<td>G06F 9/4887</td>
</tr>
<tr>
<td>Power and heat aware scheduling of tasks. This group takes precedence over G06F 9/4843. This group takes precedence over G06F 9/4881</td>
<td>G06F 9/4893</td>
</tr>
</tbody>
</table>

**Rule 3**

The following text specifies the groups which could be assigned in addition to the groups of rule 2 above, to cover further technical details; the group(s) identified as context information should also be checked and assigned, if relevant:
Further technical details on:

Exception handling
   • Context information: G06F 9/4812

Application starting, stopping, resuming
   • Context information: G06F 9/485

Scheduling of tasks on multiprocessor systems
   • Context information: G06F 9/4881, G06F 9/4887, G06F 9/4893

Scheduling of a set of tasks by taking into account precedence and dependency constraints, or time and/or occurrence of events
   • Context information: G06F 9/4881, G06F 9/4887, G06F 9/4893

Scheduling of a set of tasks by taking into account constraints on resources, resource based scheduling of tasks
   • Context information: G06F 9/4881, G06F 9/4887, G06F 9/4893

Internals of a task scheduler
   • Context information: G06F 9/4881, G06F 9/4887, G06F 9/4893

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

<table>
<thead>
<tr>
<th>[scheduling in terms of time]</th>
<th>[with the acceptance of task scheduling, i.e. when to assign a task to a computing unit]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[scheduling in terms of space]</td>
<td>[with the acceptance of resource scheduling, i.e. which resource(s) to allocate and how to partition them]</td>
</tr>
</tbody>
</table>

It is the first interpretation, the one which can be found in the context of the G06F 9/48

G06F 9/50

Allocation of resources, e.g. of the central processing unit [CPU]

Definition statement

This place covers:

selection, allocation and de-allocation of hardware and/or software resources, like servers, processes, threads, CPUs, memory; combination and/or partitioning of resources, e.g. cloud computing, hypervisors and logical partitions; mapping of tasks onto parallel / distributed machines; load balancing and re-balancing of resources in distributed systems.

References

Limiting references

This place does not cover:

| Specific details on power distribution and power saving | G06F 1/3203 |
| Allocation of disk resources and storage resources in general not being RAM | G06F 3/0604 |
| Scheduling of printer jobs | G06F 3/1296 |
| Specific details on emulation and internal functioning of a virtual machine | G06F 9/455 |
Mapping of tasks onto multi-processor systems carried out at compile-time | G06F9/45M1
---|---
Pure scheduling aspects, i.e. scheduling in terms of time, without considering resource allocation | G06F 9/4881, G06F 9/4887, G06F 9/4893
Garbage collection techniques | G06F 12/023
Allocation of human resources | G06Q 10/00
Allocation based on bandwidth, protocol and network related aspects | H04L 29/06
Allocation of resources within a printer / multifunctional peripheral | H04N 1/00

**Special rules of classification**

Rule 1

When a document qualifies for one of the classes in the table of rule 2 below, the class **G06F 9/50** should not be assigned.

Rule 2

The following table specifies the class to be assigned:

<table>
<thead>
<tr>
<th>Technical details on:</th>
<th>Class to be assigned:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation of resources to service a request</td>
<td>G06F 9/5005</td>
</tr>
<tr>
<td>Allocation of resources to service a request, the resources being hardware resources other than CPUs, Servers and Terminals</td>
<td>G06F 9/5011</td>
</tr>
<tr>
<td>Allocation of memory resources to service a request</td>
<td>G06F 9/5016</td>
</tr>
<tr>
<td>Allocation of processing resources, e.g. CPUs, Servers, Terminals, processes, threads, virtual machines</td>
<td>G06F 9/5027</td>
</tr>
<tr>
<td>A location of processing resources by considering data affinity</td>
<td>G06F 9/5033</td>
</tr>
<tr>
<td>A location of processing resources by considering the execution order of a plurality of tasks, e.g. taking priority or time dependency constraints into consideration. Candidates for this group are documents dealing with requests for composite (web) services, where the various components should execute in a certain order and resources for said execution should be assigned accordingly. Also included are documents dealing with &quot;workflow&quot; like systems, where a request to &quot;execute&quot; a project definition, comprising a set of interrelated actions, is sent to a server</td>
<td>G06F 9/5038</td>
</tr>
<tr>
<td>A location of processing resources by considering hardware capabilities This class takes precedence over G06F 9/5005 this class takes precedence over G06F 9/5027</td>
<td>G06F 9/5044</td>
</tr>
<tr>
<td>Allocation of processing resources by considering the load This class takes precedence over G06F 9/5005 This class takes precedence over G06F 9/5027</td>
<td>G06F 9/505</td>
</tr>
<tr>
<td>Allocation of processing resources by considering software capabilities, namely software resources associated or available to the machine, e.g. Web services offered by a specific machine This class takes precedence over G06F 9/5005 This class takes precedence over G06F 9/5027</td>
<td>G06F 9/5055</td>
</tr>
<tr>
<td>Partitioning or combining of resources This class should contain also documents dealing with cluster membership, i.e. assignment of a server to a certain group based on some criteria (see exemplary documents WO0156785, EP0805393).</td>
<td>G06F 9/5061</td>
</tr>
<tr>
<td>Algorithms for mapping a plurality of inter-dependent sub-tasks onto a plurality of physical CPUs This class takes precedence over G06F 9/5061</td>
<td>G06F 9/5066</td>
</tr>
<tr>
<td>Grid computing, cloud computing With the expression grid / cloud computing it is meant an environment where multiple services are offered by the various members of the grid (often making use of idle periods), said members being usually located over a large scale network. Candidate documents should have at least one of the following concepts: i) set up of a grid, e.g. registering a new member, re-organizing the grid; ii) usage of a service in the grid, e.g. locating the member, servicing a request. This class takes precedence over G06F 9/5061</td>
<td>G06F 9/5072</td>
</tr>
<tr>
<td>Logical partitioning of resources; management and configuration of virtualized resources This group deals with the creation and management (e.g. allocation) of logical partitions and resulting virtual machines in multiprocessor systems; it also deals with the concept of virtualization in general, namely the mere management (e.g. creation, deletion) of an abstract, logical representation of a resource and its configuration (e.g. re-definition of its behaviour). This class takes precedence over G06F 9/5061 For documents detailing the migration of a virtual machine to a different node, the class G06F 9/4856 should also be assigned</td>
<td>G06F 9/5077</td>
</tr>
<tr>
<td>Techniques for balancing or rebalancing the load in a distributed system by taking into account the load of the whole system</td>
<td>G06F 9/5083</td>
</tr>
<tr>
<td>Techniques for balancing or rebalancing the load in a distributed system by migrating tasks / jobs / virtual machines This class takes precedence over G06F 9/5083 For documents detailing the migration of a task/job/virtual machine to a different node, the class G06F 9/4856 should also be assigned</td>
<td>G06F 9/5088</td>
</tr>
<tr>
<td>Allocation of resources based on power and heat considerations</td>
<td>G06F 9/5094</td>
</tr>
</tbody>
</table>

**Rule 3**

The following table specifies the classes which could be assigned in addition to the classes of rule 2 above, to cover further technical details; the class(es) identified as Context information should also be checked and assigned, if relevant:

Further details on:
Allocation based on performance criteria
• Class to be assigned: S06F209/5001

Allocation based on proximity
• Class to be assigned: S06F209/5002

Indication of availability of resources
• Class to be assigned: S06F209/5003
• Context information: All groups belonging to G06F 9/50

Enforcing and/or taking into account lower and/or upper ceilings on resource usage in the context of resource allocation
• Class to be assigned: S06F209/5004
• Context information: All groups belonging to G06F 9/50

Cluster membership
• Class to be assigned: S06F209/5005
• Context information: G06F 9/5061

Dependency or time-specific aspects which are taken into account during the allocation
• Class to be assigned: S06F209/5006
• Context information: G06F 9/5038

Allocation of low-level processor resources, e.g. logical units, registers, cache lines, decoding stages
• Class to be assigned: S06F209/5007
• Context information: G06F 9/5011, G06F 9/5016, G06F 9/5022

Monitoring techniques used in conjunction with the CPU / thread allocation
• Class to be assigned: S06F209/5008
• Context information: All groups belonging to G06F 9/50

Offloading computations (e.g. because lacking some of the necessary capabilities)
• Class to be assigned: S06F209/5009

Allocation based on priority
• Class to be assigned: G06F 2209/5011

Creation, use, management of pool of resources
• Class to be assigned: S06F209/5010
• Context information: All groups belonging to G06F 9/50

Controlling aspects of an already submitted request, e.g. polling for a status, deleting / modifying the request
• Class to be assigned: G06F 2209/5013
Reservation of resources so as to have them ready at the time of the actual allocation

- Class to be assigned: G06F 2209/5014
- Context information: All groups belonging to G06F 9/50

Selection, by a broker, based on the submitted request, of an appropriate server via a registry or a yellow pages server

- Class to be assigned: G06F 2209/5015

Session management

- Class to be assigned: G06F 2209/5016

Task decomposition

- Class to be assigned: G06F 2209/5017

Selection of a thread / process within a multithreaded / multiprocessing machine, said selection being aimed to service a request

- Class to be assigned: G06F 2209/5018

Workload prediction within the context of CPU / process allocation and load rebalancing

- Class to be assigned: G06F 2209/5019
- Context information: G06F 9/5083, G06F 9/5088

Workload threshold within the context of CPU / process allocation and load rebalancing

- Class to be assigned: G06F 2209/5019
- Context information: G06F 9/5083, G06F 9/5088

remote execution techniques whereby program code is executed remotely from the client that initiated the execution and the client provides the code to the remote machine

- Class to be assigned: S06F209/5409
- Context information: All groups belonging to G06F 9/50

**Synonyms and Keywords**

The expression "scheduling", in the patent- and non patent-documentation, can have two distinct meanings when referring to task and resources:

1) scheduling in terms of time, with the acceptation of task scheduling, i.e. when to assign a task to a computing unit,

2) scheduling in terms of space, with the acceptation of resource scheduling, i.e. which resource(s) to allocate and how to partition them.

It is the second interpretation, the one which can be found in the context of G06F 9/50.
**G06F 9/52**

**Program synchronisation; Mutual exclusion, e.g. by means of semaphores**

**Definition statement**

*This place covers:*
Arbitrating access from tasks to shared resources (e.g. mutual exclusion), synchronising the execution of tasks with respect to each others (e.g. producer - consumer); a task is defined here as a program in execution.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Speculative instruction issuing and/or data consistency</th>
<th>G06F 9/3842, G06F 9/3834</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction processing</td>
<td>G06F 9/466</td>
</tr>
<tr>
<td>Arbitration of access on a bus</td>
<td>G06F 13/14</td>
</tr>
<tr>
<td>Concurrency management in a database</td>
<td>G06F 16/2308</td>
</tr>
</tbody>
</table>

**Special rules of classification**

**Rule 1**

When a document qualifies for one of the groups in the table of rule 2 below, the group **G06F 9/52** should not be assigned.

**Rule 2**

The following table specifies the group to be assigned:

<table>
<thead>
<tr>
<th>Technical details on</th>
<th>Group to be assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier synchronisation</td>
<td>G06F 9/522</td>
</tr>
<tr>
<td>Algorithms to detect and / or avoid deadlocks when tasks interact with each other</td>
<td>G06F 9/524</td>
</tr>
<tr>
<td>Mutual exclusion algorithms, specific implementations of locks and other means to ensure a “correct” (from the concurrency point of view) access to a shared resource</td>
<td>G06F 9/526</td>
</tr>
<tr>
<td>Speculative execution beyond synchronisation primitives (e.g. busy lock). This group takes precedence over <strong>G06F 9/526</strong>: e.g. if a document discloses a mutual exclusion algorithm involving speculative execution beyond busy locks, then it should be classified only in the <strong>G06F 9/528</strong> and not also in the <strong>G06F 9/526</strong></td>
<td>G06F 9/528</td>
</tr>
</tbody>
</table>

**Rule 3**

The following text specifies the groups which could be assigned in addition to the groups of rule 2 above, to cover further technical details:
Further technical details on:

Low level features of atomic instructions (e.g. test & set) used to implement locks / mutual exclusion primitives
  • Context information: G06F 9/526, G06F 9/528

Tokens (e.g. cooperative locking), token managers and lock managers
  • Context information: G06F 9/526, G06F 9/528

Multi-mode locks, i.e. with locks specifying also a mode (e.g. read-write)
  • Context information: G06F 9/526, G06F 9/528

G06F 9/54

Interprogram communication

Definition statement

This place covers:
Communication between tasks, i.e. programs, processes, threads in execution, either on the same machine or on different ones, where the multiprogramming aspect is relevant, e.g. Inter-Process-Communication.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Communication between a device and a CPU without any technically relevant detail on multiprogramming concepts or with device specific details | G06F 3/00, G06F 13/00, G06F 13/102 (for device drivers) |
| Interaction of the user with the system, i.e. the GUI, and not between the Processes / applications subsequent to the user interaction | G06F 3/048 |
| Communication which does not involve multiprogramming concepts, e.g. invocation of a subroutine | G06F 9/44 |
| Pattern-adapters | G06F 9/44 |
| Non-remote method invocation between objects | G06F 9/449 |
| Architectural details, e.g. interface repositories, object adapters, on distributed object-oriented systems, e.g. CORBA, DCOM Communication-specific details of the remote method invocation should (also) be classified in G06F 9/548 | G06F 9/465 |
| Allocation of a remote service to a client | G06F 9/50 |
| Communication between tasks but predominant aspect peculiar of another field, e.g. monitoring, information retrieval on the web, software download and installation | G06F 11/30, G06F 16/95, G06F 8/65 |
| Addressing memory | G06F 12/02 |
| Hardware mechanisms for inter-CPU communication | G06F 15/163 |
| Collaborative editing on a file without any technically relevant details on the event handling aspect | G06F 17/22, G06Q 10/10 |
| Network- and protocol-specific details | H04L 29/06 |
Event management relating to network management, e.g. alarms produced by network devices, and no technically relevant details on the multiprocessing aspect is present

Messages being distributed over a network, i.e. e-mails, instant messaging

Special rules of classification

Rule 1
When a document qualifies for one of the groups in the table of rule 2 below, the group G06F 9/54 should not be assigned.

Rule 2
The following table specifies the group to be assigned:

<table>
<thead>
<tr>
<th>Technical details on</th>
<th>Group to be assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter mechanisms e.g. between incompatible applications</td>
<td>G06F 9/541</td>
</tr>
<tr>
<td>Communication between tasks, either on the same machine or on different ones, by subscribing to events and issuing event notifications when certain events happen, e.g. Event Management Systems, Unix alarms; communication aspects related to the broadcasting of the notifications</td>
<td>G06F 9/542</td>
</tr>
<tr>
<td>User-generated data transfer from the process / application point of view, e.g. clipboards, dynamic data exchange (DDE), object linking and embedding (OLE)</td>
<td>G06F 9/543</td>
</tr>
<tr>
<td>Communication of processes via buffers, shared memory, pipes, sockets and the like</td>
<td>G06F 9/544</td>
</tr>
<tr>
<td>Communication between tasks residing in different layers e.g. user- and kernel-space</td>
<td>G06F 9/545</td>
</tr>
<tr>
<td>Communication of processes via a message passing system, i.e. messaging middleware, and the inherent technicalities, e.g. message structure or queue handling; delivery of messages according to preferences of the recipients (which have to be processes)</td>
<td>G06F 9/546</td>
</tr>
<tr>
<td>Implementation of Remote Procedure Calls, e.g. stubs, (un-)marshalling of parameters, namely invocation of a procedure at a remote location; lightweight RPC, i.e. procedure call between protection domains / different address spaces on a single machine</td>
<td>G06F 9/547</td>
</tr>
<tr>
<td>Implementation of Remote Method Invocations, i.e. details which are peculiar to RPC between (mainly Java and COM) objects, e.g. object serialization, stub / proxy download. This group takes precedence over G06F 9/547.</td>
<td>G06F 9/548</td>
</tr>
</tbody>
</table>
Rule 3

The following text specifies the groups which could be assigned in addition to the groups of rule 2 above, to cover further technical details:

Further technical details on:

Communication aspects related to task execution in a client-server system
• Context information: All groups belonging to G06F 9/54

Interception of communications between tasks / layers
• Context information: All groups belonging to G06F 9/54

Handling of events within a single system, e.g. Unix alarms
• Context information: G06F 9/542

Distributed event management systems or handling of events produced in a distributed system
• Context information: G06F 9/542

Event handling related to the execution of a GUI and as long as the event handling aspect is technically relevant
• Context information: G06F 9/542

Broadcasting / multicasting and sequence related problems of event related messages and as long as the network aspect, if any, is not predominant
• Context information: G06F 9/542

Exchange of messages between processes by using a Message Oriented Middleware, e.g. Java Messaging Services
• Context information: G06F 9/546

Particular techniques for handling message queues (or similar structures)
• Context information: G06F 9/546

Remote execution techniques whereby program code is executed remotely from the client that initiated the execution and the client provides the code to the remote machine
• Context information: All groups belonging to G06F 9/54

G06F 11/00

Error detection; Error correction; Monitoring (error detection, correction or monitoring in information storage based on relative movement between record carrier and transducer G11B 20/18; monitoring, i.e. supervising the progress of recording or reproducing G11B 27/36; in static stores G11C 29/00)

Definition statement

This place covers:
• Error avoidance (G06F 11/004)
• Identification related to error detection / correction or monitoring (G06F 11/006)
• Reliability and availability analysis of computing systems (G06F 11/008)
• Error detection and/or correction (G06F 11/07 and subgroups)
• Detection or location of defective computer hardware by testing at a time outside of "normal operating mode", e.g. during standby, idle time or at power on (G06F 11/22 and subgroups)
• Checking the correct order of processing (G06F 11/28)
• Monitoring on computing systems (G06F 11/30 and subgroups)
• Preventing errors by analysing, debugging and testing software (G06F 11/36 and subgroups)

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error detection, correction or monitoring in information storage based on</td>
<td>G11B 20/18,</td>
</tr>
<tr>
<td>relative movement between record carrier and transducer</td>
<td></td>
</tr>
<tr>
<td>Supervising the progress of recording or reproducing</td>
<td>G11B 27/36</td>
</tr>
<tr>
<td>Error detection, correction or monitoring in static stores</td>
<td>G11C 29/00</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing of digital circuits</td>
<td>G01R 31/00</td>
</tr>
<tr>
<td>Error detection, correction or monitoring in control mechanisms</td>
<td>G05B</td>
</tr>
<tr>
<td>Methods or arrangements for verifying the correctness of marking on a</td>
<td>G06K 5/00</td>
</tr>
<tr>
<td>record carrier</td>
<td></td>
</tr>
<tr>
<td>Monitoring patterns of pulse trains</td>
<td>H03K 5/19</td>
</tr>
<tr>
<td>Coding, decoding or code conversion, for error detection or error correction; Coding theory basic assumptions; Coding bounds; Error probability evaluation methods; Channel models; Simulation or testing of codes</td>
<td>H03M 13/00</td>
</tr>
<tr>
<td>Digital transmission of data</td>
<td>H04L</td>
</tr>
<tr>
<td>Counter-measures to a fault</td>
<td>H04L 29/14</td>
</tr>
</tbody>
</table>

Special rules of classification

Implementation details of particular digital data processing techniques applied to error detection, error correction or monitoring are classified in the relevant subgroups of G06F 11/00.

The error detection/correction process in neural networks is also covered (G06F 11/1476).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>Physical defect, imperfection, or flaw that occurs within some hardware component, or logical defect of a piece of software. Essentially, the definition of a fault, as used in the fault tolerance community, agrees with the definition found in the dictionary. Faults may be permanent, transient or intermittent.</td>
</tr>
<tr>
<td>Error</td>
<td>The logical manifestation of a fault, observable in terms of incorrect instructions of or corrupted data in a (computer) system. E.g. a fault in a DRAM cell will never be observed if the memory location is never accessed. Specifically, an error is a deviation from accuracy or correctness.</td>
</tr>
<tr>
<td>Failure</td>
<td>The incorrect functioning of a system as perceivable by a user or the system's environment as a consequence of an error. A failure is the non-performance, the untimely performance or the performance in a subnormal quantity or quality of some action that is due or expected.</td>
</tr>
<tr>
<td>Redundant hardware</td>
<td>Additional hardware for performing the same function as another hardware part, provided that in faultless operation you could renounce on either hardware parts of the system without loosing functionality.</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Data representation</td>
<td>A physical or logical encoding (scheme) for data, which allows the latter to be processed, stored or transmitted by a machine.</td>
</tr>
<tr>
<td>Redundancy in data representation</td>
<td>A representation of data using more resources than strictly necessary to encode the desired information such that in the error free situation one could renounce to some of said resources without loosing information.</td>
</tr>
<tr>
<td>Redundancy in operation</td>
<td>Performing (a set of) operations more than once, or performing sequentially different implementations of a particular function, or performing additional operations which (allow to) restore a system in a state from which its correct operation can be resumed after a failure.</td>
</tr>
<tr>
<td>Time diversity</td>
<td>The concept to have an redundant system in which one of the redundant components operates with a delay with respect to the other in order to avoid common mode failures that would affect both redundant components in the same way at the same time, thereby not being detectable/correctable.</td>
</tr>
<tr>
<td>Master-checker setup</td>
<td>A redundant configuration in which a master CPU drives the system. The checker CPU is synchronized (often at clock level) with the master. It processes the input data stream as the master (and often also the very same program). Whenever the master drives an output signal, the checker compares its own value with the data written by the master. A mismatch triggers an error signal. The master-checker mode is supported in many modern microprocessors by a comparator integrated into the pin driver circuitry, thus reducing the external logic to a few chips for interfacing the error signals. The master-checker system generally gives more accurate answers by ensuring that the answer is correct before passing it on to the application requesting the algorithm being completed. It also allows for error handling if the results are inconsistent. Depending on the merit of a correct answer, a checker-CPU may or may not be warranted. In order to alleviate some of the cost in these situations, the checker-CPU may be used to calculate something else in the same algorithm, increasing the speed and processing output of the CPU system. There are two possible configurations: Master-Listener and Cross-Coupled. The Master-Listener lock step configuration pairs two processors, with one as a complete Master and the other as a complete Listener, the latter having disabled output drivers. In the Cross-Coupled configuration, one of the processors, the SI-Master, drives the system interface bus, while the other processor, the SC-Master, drives the secondary cache bus. The SI-Master has disabled output drivers for the secondary cache interface bus while the SC-Master has disabled output drivers for the system interface bus.</td>
</tr>
<tr>
<td>Normal operating mode</td>
<td>The operation of a system or software once it is deployed and provides the desired service as opposed to its development, maintenance, test or idle time.</td>
</tr>
<tr>
<td>Fault masking</td>
<td>Hiding the presence of an fault to the user or the environment of a (computer system by means of some sort of redundancy such that the perceived system functionality is not affected.</td>
</tr>
<tr>
<td>Active fault masking</td>
<td>Taking particular actions (e.g. reconfiguration, failover) not performed in the error free situation to mask a fault.</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Passive fault masking</td>
<td>When a system operates such that no particular action is necessary to mask a fault because all necessary operations are constantly performed independently of the presence of a fault (e.g. majority voting).</td>
</tr>
<tr>
<td>Normal operating mode</td>
<td>the operation of a system or software once it is deployed and provides the desired service as opposed to its development, maintenance, test or idle time.</td>
</tr>
<tr>
<td>Interconnections</td>
<td>are physical media and may be of point-to-point type or of bus type. Two interconnections are only considered redundant if: they both physically connect the same nodes, wherein nodes are the source producing or the final destination consuming the data to be transmitted, and are configured to perform the same data transmissions.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>monitoring refers to an extra functionality for observing properties of a running computing system in its normal operating condition without inputting test data</td>
</tr>
<tr>
<td>Mirrored data</td>
<td>Two copies of the data where it is supposed that both copies contain the same data at any moment.</td>
</tr>
<tr>
<td>Backed up data</td>
<td>The second copy of the data reflects the data of the first copy at a particular moment.</td>
</tr>
</tbody>
</table>

**G06F 11/002**

{protecting against parasitic influences, e.g. noise, temperatures}

**Special rules of classification**

In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

**G06F 11/004**

{Error avoidance (G06F 11/07 and subgroups take precedence)}

**Definition statement**

*This place covers:*

All measures taken to prevent an error from happening. This can either be by preventing the fault from being present or by ensuring that the presence of the fault will not lead to an error.

**References**

*Limiting references*

*This place does not cover:*

| Measures in response to the occurrence of a fault, e.g. measures designed to limit the impact of the error | G06F 11/07 |

**Special rules of classification**

In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.
This subgroup is only to be used for subject-matter for which no other technique (like fault-masking based on redundancy) to respond to the occurrence of a fault applies. If techniques corresponding to G06F 11/07 and subgroups apply, the subject-matter must be classified there instead.

**G06F 11/006**

*Identification (G06F 11/2289 takes precedence)*

**Special rules of classification**

In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

**G06F 11/008**

*Reliability or availability analysis*

**Definition statement**

This place covers:

Reliability theory describes the probability of a system completing its expected function during an interval of time. In reliability theory availability is the degree to which a system is in a specified functioning condition. In the literature various definitions can be found. One well established defines availability as "the probability that a system is operating at a specified time t", Barlow and Proschan: Mathematical Theory of Reliability (1975). A simple representation of availability is a ratio of the expected value of the uptime of a system to the aggregate of the expected values of up and down time. For example in the case of systems having a MTBF (Mean Time Between Failure) and MTTR (Mean Time to Recovery), availability = MTBF/(MTBF + MTTR). Typical terminology that the group contains: error prediction, failure rate, predictive maintenance, longevity, etc. A lot of documents deal with pure theory and propose new formula for better assessing a system in terms of reliability.

**References**

*Limiting references*

This place does not cover:

| Forecasting, planning | G06Q 10/00 |

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>The term refers to the ability of a system or component to perform its required functions under stated conditions for a specified period of time.</td>
</tr>
<tr>
<td>Availability</td>
<td>The ratio of the total time a functional unit is capable of being used during a given interval to the length of the interval.</td>
</tr>
<tr>
<td>Downtime</td>
<td>The term downtime is used to refer to periods when a system is unavailable.</td>
</tr>
<tr>
<td>Uptime</td>
<td>Part of active time during which an equipment, machine, or system is either fully operational or is ready to perform its intended function.</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between failure is the predicted elapsed time between inherent failures of a system during operation.</td>
</tr>
<tr>
<td>MTTF</td>
<td>Mean Time to Failure is the time taken for a part or system to fail for the first time.</td>
</tr>
</tbody>
</table>
Mean Time To Repair (MTTR) is a basic measure of the maintainability of repairable items. It represents the average time required to repair a failed component or device.

Mean Time To Recovery (MTTR) is the average time that a device will take to recover from any failure.

**G06F 11/07**

**Responding to the occurrence of a fault, e.g. fault tolerance**

**Definition statement**

*This place covers:*

- Error detection/correction on computing systems using redundancy in data representation (also includes RAID systems involving parity) ([G06F 11/08](#) and subgroups).
- Error detection/correction on computing systems using redundancy in operations ([G06F 11/14](#) and subgroups).
- Error detection/correction on computing systems using redundancy in hardware ([G06F 11/16](#) and subgroups).
- Error or fault processing without redundancy ([G06F 11/0703](#) and subgroups).
- Safety measures ([G06F 11/0796](#))

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

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<th>Definition</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
### Redundancy in operation
Performing (a set of) operations more than once, or performing sequentially different implementations of a particular function, or performing additional operations which (allow to) restore a system in a state from which its correct operation can be resumed after a failure.

### Normal operating mode
The operation of a system or software once it is deployed and provides the desired service as opposed to its development, maintenance, test or idle time.

### Fault masking
Hiding the presence of an fault to the user or the environment of a (computer system by means of some sort of redundancy such that the perceived system functionality is not affected.

### Active fault masking
Taking particular actions (e.g. reconfiguration, failover) not performed in the error free situation to mask a fault.

### Passive fault masking
When a system operates such that no particular action is necessary to mask a fault because all necessary operations are constantly performed independently of the presence of a fault (e.g. majority voting).

### Mirrored data
Two copies of the data where it is supposed that both copies contain the same data at any moment.

### Backed up data
The second copy of the data reflects the data of the first copy at a particular moment.

---

**G06F 11/0703**

*{Error or fault processing not based on redundancy, i.e. by taking additional measures to deal with the error or fault not making use of redundancy in operation, in hardware, or in data representation}*

**Definition statement**

*This place covers:*
The methods for error/fault processing on computing systems in normal operating mode that do not imply the use of any redundancy techniques. The error/fault processing, as it is defined in the subgroup, comprises one or more of the following steps:

- the error detection step ([G06F 11/0751](#) and subgroups)
- the error/fault reporting/storing step ([G06F 11/0766](#) and subgroups)
- the root cause analysis step of the error/fault ([G06F 11/079](#))
- the remedying step ([G06F 11/0793](#)), wherein:
  - the error/fault reporting/storing refers to collecting/storing of information related to the error/fault (e.g. a performing a memory dump after detecting an error).
  - the root cause analysis of an error aims at identifying the initial cause of an error/fault.
  - the remedying step refers to the actions taken on the computing system in order to overcome an error/fault.

**References**

**Application-oriented references**

*Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:*

| Monitoring power failures | G06F 1/28 |
Responding to power failures | G06F 1/30
---|---
Error/fault processing in manufacturing/control systems/environment | G05B 23/02
Error detection, correction or monitoring in information storage based on relative movement between record carrier and transducer | G11B 20/18, G11B 27/36
Error in transmission systems (error detection/correction in data transmission) | H04L 1/00

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exception handling during concurrent execution</td>
<td>G06F 9/3861</td>
</tr>
<tr>
<td>Error/fault detection or recovery by retry</td>
<td>G06F 11/14</td>
</tr>
<tr>
<td>Error/fault detection by checking the correct order of processing of a system or a program</td>
<td>G06F 11/28</td>
</tr>
<tr>
<td>Monitoring per se, reporting or storing of non-error data</td>
<td>G06F 11/30, G06F 11/34</td>
</tr>
<tr>
<td>Protection against unauthorized use of memory</td>
<td>G06F 12/14</td>
</tr>
<tr>
<td>Computer security, e.g. detection of attacks, malware, unauthorised accesses</td>
<td>G06F 21/00</td>
</tr>
<tr>
<td>Network security detection/protection against malicious traffic</td>
<td>H04L 29/06877</td>
</tr>
<tr>
<td>Fault management in networks wherein the error/fault is related to the data exchange protocols or to the network equipments (e.g. routers or switches)</td>
<td>H04L 41/06</td>
</tr>
<tr>
<td>Monitoring of traffic in a network or of network components (e.g. routers or switches)</td>
<td>H04L 43/00</td>
</tr>
<tr>
<td>Monitoring testing in wireless networks</td>
<td>H04W 24/00</td>
</tr>
</tbody>
</table>

**Special rules of classification**

A document classified in G06F 11/0703 - G06F 11/0793 must receive at least one classification for the "functional aspect" and at least one classification for the "architectural context" according to the two following actions.

**Action 1 – Classifying the functional aspect (see groups G06F 11/0751 - G06F 11/0793):**

- Classifying the document in a subgroup corresponding to the most relevant functional aspect of the error/fault processing described in the document;
- G06F 11/0751 and its subgroups for the function of error/fault detection, e.g. comparing data to an error threshold;
- G06F 11/0766 and its subgroups for the function of error/fault reporting/storing, e.g. performing a memory dump after detecting an error;
- G06F 11/079 for the function of root cause analysis, e.g. determining the first error event causing the others;
- G06F 11/0793 for the function of error/fault remedying, e.g. executing a specific interrupt handler to clear the error/fault;
- A document can be classified in more than one group of the list defined above based on details of different functional aspects disclosed in the document.

**Action 2 – Classifying the architectural context (see groups G06F 11/0706 - G06F 11/0748):**

- Classifying the document in a subgroup corresponding to the most relevant architectural context described in the document;
• A document can be classified in more than one group under G06F 11/0706 based on details of different architectural contexts disclosed in the document;
• In case the document does not disclose any specific architectural context details or only refers to a general computer, the generic head group, G06F 11/0706, should be used.

G06F 11/0796
{Safety measures, i.e. ensuring safe condition in the event of error, e.g. for controlling element}

Definition statement
This place covers:
A safe computer system protects its user(s) and/or environment from hazards whether its intended function is performed correctly or not. This group deals with measures taken to ensure that a computer-based system stays safe (i.e. does not present a danger to persons or its environment) when it is no longer able to provide its normal functionality due to the presence of an error. This requirement typically occurs in many real-time control systems. The subject-matter of is group is different from fault-masking since the latter attempts to maintain the desired functionality of a system in the presence of faults whereas this group relates to ensuring a safe condition when faults cannot be masked, thereby degrading the desired system functionality.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

If such a system continues to operate albeit with degraded hardware or software functionality, additional classification symbols in the appropriate subgroups may be necessary.

Special rules of classification
In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

G06F 11/08
Error detection or correction by redundancy in data representation, e.g. by using checking codes

Definition statement
This place covers:
Documents where the error detection/correction in a computer system is done by redundancy in the representation of the data.

Most often this redundancy arises from the fact that more bits are used to represent the data than strictly necessary. However, these groups cover as well cases where the data is stored twice, but in different formats (e.g. the second time using inverse logic).

However, subject-matter where 2 (or more) identical copies of the data are stored, is not treated here (see informative references)
References

Limiting references

This place does not cover:

Data with redundancy of data representation stored on storage with movable components G11B 20/18
Error detection or correction codes per se H03M 13/00
Transmission of data using redundancy of data representation H04L 1/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Redundant storage of data G06F 11/1666, G06F 11/2053

Special rules of classification

Generally only 1 class is given. Only invention information is classified.

G06F 11/10

Adding special bits or symbols to the coded information, e.g. parity check, casting out 9's or 11's

Definition statement

This place covers:

Subject matter where more bits are used to represent the data than strictly necessary, however without representing the data twice (or more often).

Subject-matter dealing with host-to-memory or host-to-host transfers is classified in this group per se, except when the protection is on the level of blocks of data (which is in G06F 11/1004).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Protecting a block of data words G06F 11/1004

Special rules of classification

As soon as the redundant representation is stored on storage, the subject-matter should be classified in G06F 11/1076 and subgroups and not in other subgroups. This is independent of how the redundant representation is determined or what representation is used. Group is not used for classification.
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| **Memory** | solid state devices used as main memory which are either directly addressable by the associated CPU (meaning that they are located on the high speed bus), or are not addressable internal memories (such as registers and buffers). As such, memory is different from storage. |
| **Storage** | media from which data needs first to be loaded before it can be used for computing. |

G06F 11/1004

{to protect a block of data words, e.g. CRC or checksum (G06F 11/1076 takes precedence; security arrangements for protecting computers or computer systems against unauthorized activity G06F 21/00)}

Definition statement

This place covers:

The use of checking codes on bigger units of data than a single word to detect the presence of errors in the data.

This group does not cover correction of data.

In this group, it is irrelevant for what purpose the checking is being used (e.g. for storing the data in memory, for transmission of the data to another component in the computing system, ...) as long as it is related to error detection.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Security arrangements for protecting computers or computer systems against unauthorized activity | G06F 21/00 |
| Computer virus detection or handling | G06F 21/00 |
| Using checking codes for detecting unauthorised modifications | G06F 21/00 |
| Using checking codes in data communication | H04L 1/00 |

G06F 11/1008

{in individual solid state devices (G06F 11/1004 takes precedence)}

Definition statement

This place covers:

That subject-matter where the error detection and/or correction is done on data stored in a single solid state device (i.e. the detection/correction is done when reading data from or writing data into the memory). It is independent of what function the solid state device has in the system. The relevant criterium is the type of component on which the data is stored (i.e. solid state devices in contrast to disks, tapes or other storage devices with moving components).
References

Limiting references

This place does not cover:

To protect a block of data words  G06F 11/1004

Informative references

Attention is drawn to the following places, which may be of interest for search:

Protection of blocks of data being transferred (from memory to memory or between host and memory)  G06F 11/10
Parity RAID in storage  G06F 11/1076

Special rules of classification

G06F 11/1004 takes precedence.

G06F 11/1012

{using codes or arrangements adapted for a specific type of error (G06F 11/1048 takes precedence)}

Definition statement

This place covers:

This group and its subgroups cover specific code arrangements, i.e. documents describing how the ECC codes to be applied to the data are determined. As an example, documents describing row and column parity are classified here

Special rules of classification

G06F 11/1048 takes precedence.

G06F 11/1016

{Error in accessing a memory location, i.e. addressing error}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Protection against unauthorized access to memory  G06F 12/14

G06F 11/1024

{Identification of the type of error}

Special rules of classification

Not used for classification.
G06F 11/1032

{Simple parity}

Special rules of classification
Not used for classification

G06F 11/1036

{Unidirectional errors}

Special rules of classification
Not used for classification.

G06F 11/1044

{with specific ECC/EDC distribution}

Definition statement
This place covers:
ECC codes where different bits of a data word are stored in different memory modules. Documents classified here, do not deal with calculation of ECC/EDC but only on where the data with the corresponding code is stored in the device (e.g. on different modules of the same device).

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Parity distribution in a Redundant Array of Independent storage devices | G06F 11/108 |

Special rules of classification
Only classify here when no other group applies.

G06F 11/1012 (code arrangements) takes precedence.

G06F 11/1048 (hardware arrangements) takes precedence.

G06F 11/1048

{using arrangements adapted for a specific error detection or correction feature}

Definition statement
This place covers:
This group and its subgroups cover coding where the hardware plays a role, e.g. to make the error correction or detection faster, to reduce the power consumption for detecting/correcting errors, ...

The hardware involved must be described.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity in RAID systems</td>
<td>G06F 11/1076</td>
</tr>
</tbody>
</table>

G06F 11/1052

{Bypassing or disabling error detection or correction}

Definition statement

This place covers:

This group covers documents in which no error detection/correction by redundant coding is performed at all in the normal situation.

Relationships with other classification places

Subject-matter covering circuits where ECC/EDC codes are calculated in parallel during operation are to be classified in G06F 11/1048.

G06F 11/1056

{Updating check bits on partial write, i.e. read/modify/write}

Special rules of classification

Not used for classification.

G06F 11/106

{Correcting systematically all correctable errors, i.e. scrubbing}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory refresh techniques</td>
<td>G11C</td>
</tr>
</tbody>
</table>

G06F 11/1064

{in cache or content addressable memories}

Definition statement

This place covers:

This group covers ECC when it concerns a feature which is specific to caches or content addressable memories.

For instance if an additional ECC is used for the cache with respect to the memory.
G06F 11/1068
{in sector programmable memories, e.g. flash disk (G06F 11/1072 takes precedence)}

References
Limiting references
This place does not cover:
G06F 11/1072 takes precedence

Special rules of classification
G06F 11/1072 takes precedence
Documents classified in this group should be sent to G11C 29/00 as well.

G06F 11/1072
{in multilevel memories}

Definition statement
This place covers:
Covers all subject-matter related to memories of which the cells can store more than 2 values.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Architectural details of multilevel memories | G11C |

Special rules of classification
Documents classified in this group should be sent to G11C 29/00 as well.

G06F 11/1076
{Parity data used in redundant arrays of independent storages, e.g. in RAID systems}

Definition statement
This place covers:
Redundancy using parity calculation and stripping in redundant arrays of storage devices such as:
• Hard Drives (e.g. RAID)
• Semiconductor memories (e.g. RAID of SSD/Flash disks)
• Optical Drives (e.g. RAID in ODD archives)
• Tape (e.g. RAIT)

Relationships with other classification places
Mirroring in RAID: G06F 11/2053
Use of parity in memories which do not constitute a redundant array and are close to the processor (e.g. ECC or arithmetic code in a semiconductor memory on the high speed bus): **G06F 11/1008**

**References**

**Limiting references**

*This place does not cover:*

| Control as such of RAID system | G06F 3/0604 |
| Mirroring                     | G06F 11/2053 |
| Redundancy on a disk used for reproduction | G11B 20/1833 |

**Special rules of classification**

If the document can be classified in a subgroup of the **G06F 11/1076**, then it should not appear in the head subgroup. Only those documents which cannot be classified in one or several subgroups (e.g. **G06F 11/108, G06F 11/1084** etc) have to be classified in the head subgroup.

It is important to evaluate whether the parity calculation aspect is present and if specifics about fault recovery / rebuilding are present in the document. If such topic is not present of if the document talks about general parity aspects mixed with other topics, the Indexing Code groups should be used.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| RAID | Redundant Array of Independent Disks is a technique for implementing fault tolerance in storage devices. |
| Rebuild | Action of regenerating lost data from redundant data present in available drives / memories. |
| JBOD | Just a Bunch Of Disks represent a group of disks without particular redundant scheme implemented. |

**G06F 11/1084**

*{Degraded mode, e.g. caused by single or multiple storage removals or disk failures}*

**Definition statement**

*This place covers:*

Using the parity to reconstruct data which would otherwise have been lost when a storage device is failing or is removed.

When the reconstruction takes place once a new disk is available, **G06F 11/1092** subgroup is used.

When the reconstruction takes place on a spare disk that was available, **G06F 11/1088** subgroup is used.

**References**

**Limiting references**

*This place does not cover:*

| Actual replacement of a failing disk | G06F 11/16 |
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| RAID | Redundant Array of Independent Disks is a technique for implementing fault tolerance in storage devices. |

G06F 11/14

Error detection or correction of the data by redundancy in operation

(G06F 11/16 takes precedence)

Definition statement

This place covers:

Although not fully consistent with the title of this group we consider that prophylactic additional saving-related measures like check-pointing, backing-up or state copying, which are performed before the occurrence of a fault in order to be able to recover or restore (at least partially) in case a fault occurs in the future, and which do not rely on hardware redundancy, are to be classified under this group.

The corresponding reverse operations of restoring and/or recovering and/or rolling back fit in naturally, since these are performed after the occurrence of a fault. The same holds for any type of redoing. All these activities are considered particular cases of error correction.

Retrying an operation may be part of an error detection mechanism when used in conjunction with a counting or time-out scheme. It may constitute an error correction when it is used to overcome a transient error. In both cases it is a mechanism used after the occurrence of a fault.

Special rules of classification

In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

G06F 11/1402

{Saving, restoring, recovering or retrying}

Definition statement

This place covers:

The techniques covered by G06F 11/1402 imply at least an attempt to correct an error. They do not cover the detection as such, which may be found in G06F 11/1497 or G06F 11/1479.

Special rules of classification

Classification of documents relating to snapshots is done as follows:

- documents describing the use or creation of snapshots to deal with the detection or correction of errors are classified in G06F 11/00, and normally in subgroups of G06F 11/1402.
- documents describing other uses of snapshots (or creation of snapshots for such purposes) are not classified in G06F 11/00. They are classified in G06F 16/00 or G06F 3/06 unless the specific use is provided for in another classification place.
- General-purpose treatment of snapshots (e.g. management of valid snapshots, determining not needed snapshots, storage optimisation, ...) is dealt with in G06F 16/00 if the snapshots are on file level. If the snapshots are volume-based snapshots, they are dealt with in G06F 3/00 since they concern the management of storage space in this case.
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Persistent data | Data which are still relevant after a normal power off/power on cycle or a logoff/logon procedure. Typically, the user determines when such data should be modified or destroyed (since they are not relevant anymore). Thus, persistent data is not equivalent to data that is stored in a non-volatile manner, the latter merely giving an indication of the type of memory/storage used to save the data. Non-volatile data does not need to be persistent, but persistent data is always non-volatile. |

G06F 11/1405

{at machine instruction level}

Definition statement

This place covers:

Measures taken inside the processor or relating to individual processor instructions. To implement these measures, additional hardware (such as registers) can be used. A necessary condition to classify here, is that the operating system is unaware of the measures taken.

G06F 11/1415

{at system level}

Definition statement

This place covers:

The solution of a specific problem related to the functioning of the computer system(s) as a whole in contrast to a particular application functionality. It is intended to cover firmware level (e.g. BIOS), OS level, file system level and/or utilities.

Relationships with other classification places

This group is NOT intended to include database specific techniques. Note that if the solutions in these groups involve the use of particular software techniques covered in G06F 11/1479/low, the documents should be classified there as well. See e.g. the comment under G06F 11/1438 relating to additional classification in G06F 11/1479.

G06F 11/1417

{Boot up procedures}

Definition statement

This place covers:

Restricted to correction (attempt) of errors during or using the boot process.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Booting in general | G06F 9/4401 |
Reboot as part of upgrading to verify the successful upgrade

G06F 11/142

{Reconfiguring to eliminate the error (group management mechanisms in a peer-to-peer network H04L 67/1044)}

Definition statement

This place covers:

Reconfiguration meaning that the system undergoes modification of the components that make up the system or their arrangement in response to an error being detected. The components can be either hardware or software components.

Example:

• The system switches to a minimal video driver in case the normally used video driver does not give any image anymore.

Counterexamples:

• redistributing the load on individual processors of a multiprocessor system in an overload condition
• masking faults by reconfiguring redundant hardware (e.g. making a standby component primary, changing the role of disks in a mirrored pair, ...)

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Software update in general</th>
<th>G06F 8/65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking for a new version of software when a failure occurs with the current version</td>
<td>G06F 11/0793</td>
</tr>
</tbody>
</table>

G06F 11/1423

{by reconfiguration of paths}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Isolating a faulty entity in a communication network | H04L 41/0659 |

G06F 11/1433

{during software upgrading}

Definition statement

This place covers:

Potential to recover from errors during or after software update or upgrade or installation processes. Also applies when this process is performed by a specific update/install software or even by the application itself.
G06F 11/1435
{using file system or storage system metadata}

Definition statement

This place covers:
There is redundancy in the metadata used to access a given stored data item.

Examples are:
• File systems having redundant FATs or redundant tuples
• Redundant CMOS/BIOS data defining the disk layout

Counterexamples are:
• Retry a read from a disk sector by the disk controller when the read fails. This should be classified G11B 20/00
• Retrying the disk I/O request by the CPU. This should be classified in G06F 11/1443.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| File management in general | G06F 16/14 |

G06F 11/1438
{Restarting or rejuvenating}

Definition statement

This place covers:
The act of restarting a software module (e.g. an application, but not the complete OS, because this would imply a boot process which is covered in G06F 11/1417) either to recover from an error or in order to prevent an error (the latter being rejuvenation). The restarting or rejuvenating may be based on a previous state saving of the software module. Usually, this is based on a previously saved dynamic state of the software module. The dynamic state of a software application or process or task includes at least some of stack, heap, open files, etc. information, from which the application can later continue processing. Continuing from a previously saved state without full application restart is also covered by this group.

Special rules of classification

If the application restart or rejuvenation mechanism is implemented in an OS or middleware layer outside the application, this aspect is to be additionally classified in G06F 11/1482.

G06F 11/1441
{Resetting or repowering}

Definition statement

This place covers:
Measures taken out of a normal operating mode (after boot) but before abnormal termination of the system to enable a machine to continue processing from a defined state after a re-initialisation (reset
or re-powering) of the machine. Example: power is monitored, when voltage drop is detected, the RAM is saved to disk. After power restore, RAM is reloaded from disk. Or, battery used to temporarily backup the RAM during a (short) power outage.

Without error see G06F 1/3203.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Means for saving power | G06F 1/3203 |

Special rules of classification

If a spare power supply is used, additionally G06F 11/2015 must be given (either as additional or invention, depending on the circumstances)

G06F 11/1443

{Transmit or communication errors}

Definition statement

This place covers:

Examples :

- printer or disk I/O retry by the Operating System.
- Repeated requests by a client to the server

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Detecting errors in the information received | H04L 1/00 |
| Error detection mechanisms part of a communication protocol | H04L 12/00, H04L 29/00 |

Special rules of classification

Documents should only be classified here when they concern transmit or communication errors and where the mechanisms used are not part of a communication protocol and no other group of G06F 11/14 and subgroups or G06F 11/16 and subgroups applies.

G06F 11/1446

{Point-in-time backing up or restoration of persistent data}

Definition statement

This place covers:

Backup done either on file or data block level. Covers, backing up of any type of file, independent of the data it contains.

Note: Due to considerable overlap in technology, backups and data backup systems frequently are confused with archives and fault-tolerant systems. However:
• Backups differ from archives in the sense that archives are the primary copy of data whereas backups are a secondary copy of data.
• Data backup systems differ from fault-tolerant systems in the sense that data backup systems assume that a fault will cause a data loss event, whereas fault-tolerant systems do not.

The scope of this group also covers ensuring that the data to be saved (as backup copy) is consistent (i.e. represents a meaningful state), especially if the copy is made of data within a distributed system.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Data replication</th>
<th>G06F 11/1658, G06F 11/2094, G06F 11/2097, G06F 16/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirroring</td>
<td>G06F 11/2056</td>
</tr>
<tr>
<td>Data archiving</td>
<td>G06F 16/10</td>
</tr>
</tbody>
</table>

G06F 11/1448

{Management of the data involved in backup or backup restore}

Definition statement

This place covers:

All operations related to data management which are used for the backup data.

Examples of management of the data that is backed up:
• managing versions of backups
• formatting for compatibility with different systems
• consolidation of backed up data

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| File management in general         | G06F 16/14                                            |

Special rules of classification

Documents relating to authorisation control or data security of the backups should also be sent to G06F 21/00 for classification

G06F 11/1451

{by selection of backup contents}

Definition statement

This place covers:

• any determination of what data should be subjected to backup (e.g. what type of data, which origin of data, according to criticality of the data, ...)
• determining the necessity to include particular data (e.g. based on whether the data has changed)
• in what form the data should be backed up (e.g. incremental backup, full backup, differential
   backup, ...)

G06F 11/1453

{using de-duplication of the data}

Definition statement

This place covers:

all techniques that are used to detect multiple copies of data items (e.g. files, data blocks, strings of
data, ...) and to use this knowledge to optimize the backup (e.g. by not retransmitting the detected
item, by not storing the detected item twice,...).

This is irrespective of whether the multiple copies are between (backups of) data at different times
or between (backups of) different data items having a part in common or between (backups from)
different hosts.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Redundancy elimination in general | G06F 16/174 |

G06F 11/1456

{Hardware arrangements for backup}

Definition statement

This place covers:

subject-matter where the hardware arrangement is affected by its use as backup system or where a
particular system arrangement is proposed for backup. However, this does not imply that a particular
hardware component must be physically modified for backup purposes

The following are some examples:
• additional (temporary) memory or storage is used to enable efficient writing on the backup medium
• storage which is configured to automatically perform a backup, when connected to a system to be
backed up.
• A specific type of hardware being used for backup

A distributed architecture where some processing nodes are dedicated to particular backup functions

G06F 11/1458

{Management of the backup or restore process}

Definition statement

This place covers:

All operations related to the management of the backup process.

Examples are:

management of backup process:
• how to make the backup process faster
• avoiding data restoration by unauthorized persons

Special rules of classification
In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

Documents relating to authorisation control or data security of the backups should also be sent to G06F 21/00 for classification

G06F 11/1464
{for networked environments}

Definition statement
This place covers:
Everything relating to arrangements in which the distributed architecture is of importance for the backup. Examples: Optimizing bandwidth, selecting machines (source or target) for backup, time multiplexed scheduling of backup clients, hierarchical distribution of backup control functionality to different networked machines.

G06F 11/1466
{to make the backup process non-disruptive}

Definition statement
This place covers:
All subject-matter dealing with techniques of limiting the impact of the backup process on normal operations, e.g. by minimizing the backup window.

G06F 11/1469
{Backup restoration techniques}

Definition statement
This place covers:
Problems relating to restoring data from a backup using a backup/restore application (in contrast to data movement services of an OS). Examples: Finding and ordering the necessary tapes, handling a target format that is no longer the same as the original one, target system configuration has changed and new locations must be determined, improving restore efficiency.

Relationships with other classification places
| Data migration from one machine to another one | G06F 3/0646, G06F 16/00 |

G06F 11/1471
{involving logging of persistent data for recovery}

Definition statement
This place covers:
Logging techniques or the usage thereof for the purpose of attempting to recover from errors.
Ensuring that a log contains all necessary data to enable a restore.

Maintenance of the logged data (e.g. pruning obsolete entries to reduce the recovery time).

References

Limiting references

This place does not cover:

| Journaling used as a data transmission mechanism for asynchronous mirroring Creating a consistent baseline of stored data for recovery to avoid long log processing at restore time is to be classified in other parts of | G06F 11/14, G06F 11/2074 |
| Journaling for asynchronous mirroring | G06F 11/2074 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

- Logging in general G06F 16/00
- Logging in database systems G06F 16/20

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Logging | recording physical or logical changes to stored persistent data to allow a system to recover from crashes or other errors and maintain the stored persistent data in a consistent state. |
| Journal | is a chronological record of data processing operations. It is considered equivalent to logical logging. |

G06F 11/1474

{in transactions (G06F 16/20 takes precedence)}

Definition statement

This place covers:

- general recovery techniques of transactional systems; detailed techniques of transaction processing in database systems (e.g. ensuring ACID properties of updates in database systems) are not classified here.

- Attempting to recover from errors within transactions that create/update/modify data. The term transaction is understood broadly.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

- Error recovery for (main) memory accesses implemented as transactions G06F 11/141
- Transactional file systems G06F 16/10
- Making database transactions atomic G06F 16/20
Special rules of classification
Documents being classified here that concern transactions in database management systems should be sent to G06F 16/20 for classification as well.

G06F 11/1479
{Generic software techniques for error detection or fault masking}

Definition statement
This place covers:
All techniques implemented by software means, i.e. where the fault tolerance does not result from the hardware and is not bound to a particular redundant hardware architecture.

Software architectures and structural approaches independent of the particular problem solved or function that is achieved. As a consequence, documents describing such technique for a particular purpose or hardware architecture as covered by the subgroups of G06F 11/14 and G06F 11/16 should be classified there as well. As a particular example for this see the comments under G06F 11/1482 relating to additional classification in G06F 11/1438.

Documents where the kind of fault tolerance used (active-active, voting, active-passive, ...) is fixed by the hardware architecture and cannot be influenced by the software, should not be classified in this group.

Examples are: Fault-tolerance using data-diversity (e.g. by using different equivalent input data sets for each retry of a function), corrective actions e.g. following a plausibility check. Other examples include measures taken before run time (e.g. duplication of instructions for comparison at compile time) or robust data structures (see XP745785).

Counterexample: the operating system for a Tandem Himalaya system will not be classified here, because it is bound to a hardware architecture that provides the fault tolerance and it does not employ any of the generic techniques covered by G06F 11/1479.

G06F 11/1482
{by means of middleware or OS functionality}

Definition statement
This place covers:
There is a software layer (on top of the operating system or integrated in the operating system) which makes applications which are not fault-tolerant run in a fault tolerant way. Typically, this is done by scheduling requests of the application more than once.

A typical example of this is fault tolerant cluster software.

Another example is an OS that detects a faulty process and creates a further copy of the same process on the same processor (but potentially in another memory area).

Special rules of classification
If the layer implements an application restart or rejuvenation mechanism, this feature is to be additionally classified in G06F 11/1438.

Documents where there is necessarily some hardware redundancy, get an Indexing Code as well in the HW redundancy groups.

Documents which describe said middleware/OS technique in combination with only one redundant hardware architecture always go into the G06F 11/16 and subgroups, but where said technique is
explicitly suitable for other redundant hardware architectures, they are classified in G06F 11/1482 as well.

The restart related aspect of the second example is to be classified additionally in G06F 11/1438. Note that G06F 11/1482 as such does not imply failover mechanisms, although the underlying hardware becomes redundant because of the software layer. Hence, this hardware redundancy aspect requires classification as well, in this particular case in G06F 11/2023 (example docs: US2003018927, US2003105852).

G06F 11/1487
{using N-version programming}

Definition statement
This place covers:
For error detection the output of multiple versions (typically based on different source codes) of the application code or portions thereof are compared or voted (note that this is different from an acceptance test as defined in G06F 11/1489). This can be in different programming languages, different compilers or implementation of alternative algorithms. The versions may be executed sequentially, concurrently or in parallel on different hardware (thereby making the latter redundant).

G06F 11/1489
{through recovery blocks}

Definition statement
This place covers:
For error detection an acceptance test (mostly a plausibility check or a limit on execution time) is performed on critical code blocks. If the test is not passed, the output of another execution of the same or an alternative version of the block is used for recovery. The executions may be sequential or parallel. Note that an acceptance test is performed using the output of only one of the executions.

Special rules of classification
If the other execution is systematically performed on the same hardware, this has to be additionally classified in G06F 11/1497.

G06F 11/1492
{by run-time replication performed by the application software}

Definition statement
This place covers:
In contrast with G06F 11/1482, here the redundancy is inherent in the application itself. Thus, the application does not rely on any other layer to be fault-tolerant. The redundant portions are necessarily identical, since otherwise the redundancy is not realized at runtime, but is hard coded.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Replication implemented at OS- or middleware level is covered by</th>
<th>G06F 11/1482</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-modular type</td>
<td>G06F 11/1494</td>
</tr>
</tbody>
</table>
G06F 11/1494

{N-modular type}

Definition statement

This place covers:

Using comparison or voting for the concurrently running replicas of the application software.

G06F 11/1497

{Details of time redundant execution on a single processing unit}

Definition statement

This place covers:

A piece of software (module, function, complete application, ...) is always executed two or more times sequentially or concurrently (e.g. as threads) on a single processing unit in order to address transient faults. In particular, this groups covers those aspects relating to the provision of the identical input to all executions of the software. When more than two execution are foreseen this can be used for error correction (not only detection). In particular, this group covers the techniques used to instantiate multiple executions of redundant software, the temporary storage of intermediary results or the duplication of contexts for each instance, as well as the measures taken for the subsequent error detection or fault masking. Note that this group also covers (non-redundant) hardware support for time redundant execution and, thus, cannot be a subgroup of G06F 11/1479.

G06F 11/16

Error detection or correction of the data by redundancy in hardware

Definition statement

This place covers:

- Systems where hardware redundancy is used to detect errors or to correct errors based on the output produced by the redundant components.

Relationships with other classification places

There are three types of hardware redundancy that can be found here:

The hardware redundancy is used for error detection only: such systems imply that there are at least (and normally only) two redundant components, which are both active, the output of which is compared (G06F 11/1608, G06F 11/1629). Disagreement indicates an error.

The hardware redundancy is used for error detection and correction: such systems imply that there are at least three redundant components, which are all active, the output of which is voted. In the presence of an error the majority of correct outputs is used to correct the error. Since this is done without reconfiguration of the system, i.e. by ignoring the erroneous component(s), this is called passive fault masking (G06F 11/18).

The hardware redundancy is used for error correction only: such systems imply that there are at least one active component and at least one passive component suited to replace the active one in case the latter is failing. The detection of the failure is not (necessarily) based on hardware redundancy, however the correction of the error is. It requires a reconfiguration of the system as a result of which...
the functionality of the failing component is switched over to a spare (failover, takeover). This is called active fault masking (G06F 11/20).

In this context, voting and comparing are decision processes as to the correctness of the output of the system. This is in contrast to membership determination processes (which may also use majority building), which concern decisions on what the configuration of a system should be.

Testing of redundant computer hardware justifies an Indexing Code in appropriate subgroups of G06F 11/16. Testing of non-redundant but identical computer hardware (e.g. on a wafer) using comparison or voting techniques is G06F 11/22 only. Verifying components against a "golden master" is neither run-time nor fault-masking, this it is not G06F 11/16 but G06F 11/22 or G01R 31/00.

The subgroups fall apart in 2 types:

- "architectural groups", i.e. groups that specify constructional elements (i.e. G06F 11/1608 and G06F 11/1629)
- "functional groups", i.e. groups that define a particular functionality that is independent of the architecture (i.e. G06F 11/1666 and G06F 11/1675). These groups may be relevant for any type of hardware redundancy or fault masking.

Redundant hardware is a prerequisite to correct permanent (hardware) faults, but is equally successful with transient faults. Thus, G06F 11/18 and G06F 11/20 provide mechanisms that can successfully deal with both types of faults.

- Active fault masking implies a reconfiguration and, thus, a retry in the new configuration for the operation (or set of operations) that encountered the error. Otherwise there would not be error correction. Hence, to avoid double classification of (at least) all documents in G06F 11/20 there is the precedence rule under G06F 11/14.

Examples:

- Not every (symmetric) multiprocessor is redundant per se, because criteria (A) is not necessarily true. However, additional error detection and reconfiguration functionality typically implemented in software (OS or application level) could be used to make processors operate redundantly.
- A point-to-point connection that initialises to use as many parallel lanes as possible and automatically reconfigures itself to use less lanes following an error implies redundant communication media, because criteria (A) and (B) are both true.

See definitions in G06F 11/2002 and subgroups regarding redundancy in communications.

### Special rules of classification

In this group the use of the Indexing Codes G06F 2201/00 and lower is mandatory.

Documents dealing with replication are classified in G06F 11/16 and subgroups (in particular in G06F 11/2094 and (G06F 11/2097 or G06F 11/1658) only when the purpose of the replication is for error handling or error detection. If the use is another one (e.g. performance or load balancing) or is not disclosed, the document should be classified in G06F 16/10 instead.

Some systems having a set of equivalent/similar hardware resources all used under normal conditions may be reconfigured in response to an error to use only a subset of these resources while still providing the same full logical functionality, however possibly with degraded performance.

In order to decide where such documents are to be classified, the following criteria are used:

- (A) If a reconfiguration mechanism is used following the error detection, we are in the presence of error correction using active fault masking.
- (B) If said mechanism is able to correct permanent hardware faults, this implies the presence of some form of redundancy in hardware.

If both criteria apply, the subject-matter is for G06F 11/20: A AND B => G06F 11/20.

Note in particular that:
**G06F 11/14** (redundancy in operation) provides mechanisms that can ONLY deal successfully with transient faults.

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundant hardware</td>
<td>additional hardware for performing the same function as another hardware part, provided that in faultless operation you could renounce on either hardware parts of the system without loosing functionality.</td>
</tr>
</tbody>
</table>

**G06F 11/1604**

{where the fault affects the clock signals of a processing unit and the redundancy is at or within the level of clock signal generation hardware}

**Definition statement**

This place covers:

- Systems with multiple clock generating components with active or passive fault masking, i.e. where the system is continuously clocked even in the presence of failing clock generators.
- Single clock generators that are fault tolerant in themselves, e.g. by comprising multiple oscillators.
- Arrangements that only detect clock faults based on redundancy at or in the clock generating level (typically by comparing signals output by two clock generators).
- The symbols **G06F 11/1608, G06F 11/18** and **G06F 11/20** are to be used where appropriate to capture the type of mechanism implementing the clock fault tolerance, if no EC symbol in the respective field is already given.

Note that this group does not require, that the clocked system itself is fault-tolerant.

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock signal generation circuits/techniques as such even when redundancy is involved within such circuits</td>
<td><strong>G06F 1/04</strong></td>
</tr>
<tr>
<td>Appropriate clock signal distribution on ICs or between discrete components</td>
<td><strong>G06F 1/10</strong></td>
</tr>
<tr>
<td>Clock (phase) synchronisation in general, even when used to ensure the synchronous operation of multiple processors</td>
<td><strong>G06F 1/12</strong></td>
</tr>
<tr>
<td>Measures taken at clock level to achieve lockstep operation of redundant processing components</td>
<td><strong>G06F 11/1679</strong></td>
</tr>
<tr>
<td>Time of day; time pieces</td>
<td><strong>G04G</strong></td>
</tr>
<tr>
<td>Oscillators, pulse generators or clock synthesizers</td>
<td><strong>H03K</strong></td>
</tr>
<tr>
<td>Oscillators, pulse generators or clock synthesizers if a loop in involved</td>
<td><strong>H03L 7/00</strong></td>
</tr>
<tr>
<td>Synchronisation of processor clocks representing time (time of day, logical/virtual time, real time clocks; NTP, PTP, UTC)</td>
<td><strong>H04J 3/0635</strong></td>
</tr>
</tbody>
</table>
Informative references

Attention is drawn to the following places, which may be of interest for search:

| Fault-tolerant synchronisation of clocks representing time | G06F 11/1479 |
| Error detection by comparing the output signals of redundant hardware | G06F 11/1608 |
| Checking static stores for correct operation | G11C 29/00 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Clock signal | designates the common periodic square-waved signal on which synchronous digital components base their operations. This signal does not represent any absolute or relative real, logical or virtual time value (although such time may be derived therefrom by counting periods of this clock signal). |

Computing-related hardware the run-time behaviour of which is not controlled by software (e.g. ALUs, counters, decoders, ...). As soon as the redundant hardware under consideration, the output of which is compared, comprises a software programmable processor ((micro-)controller, CPU, microprocessor, ...), this should go to the G06F 11/1629.

Comparing is understood largely, i.e. it encompasses coherency checks (are the compared results similar enough to be considered the same or equivalent?) not only identity tests.

Processor(s) comparing the input from redundant sources (like buffers) are G06F 11/1608 as long as they do not compare their own results. The latter would have to be additionally classified in G06F 11/1629.

G06F 11/1629

{Error detection by comparing the output of redundant processing systems}

Definition statement

This place covers:

This group is intended to contain systems in which the redundant components are programmable (hardware) processors, the runtime behaviour of which is defined by software/firmware.

Comparing is understood largely, i.e. it encompasses coherency checks (are the compared results similar enough to be considered the same or equivalent?), not only identity tests.

Relationships with other classification places

FPGAs are programmable in respect of their configuration only. In general, the resulting run-time functionality thereof does not constitute a software controllable processor, thus systems comprising redundant FPGAs, the functionality of which is not run-time programmable, should be in 16B, as long as they form part of computer hardware.

Comparisons of input values are not to be classified here. They may, however, be for G06F 11/1608 as long as said input is produced by redundant sources. If such a comparison is used to detect errors in the transmission of data, this should be H04L 1/00. Redundant sources like sensors may be G05B rather than G06F (see also comments of G06F 11/1616).
G06F 11/1633
{using mutual exchange of the output between the redundant processing components}

Definition statement

This place covers:

This group is intended to comprise systems in which there is no comparator hardware. Instead, all redundant components send their respective output results to each other and each perform the comparison (in software) between their own output and the one(s) received from the other redundant components. This would cover processors exchanging results via a local (processor) bus as well as distributed system which communicate the results via LAN or other type of network.

Relationships with other classification places

• If there are more than 2 redundant units, this group applies only as far as there is no fault masking (this would be G06F 11/18).
• Redundant hardware comparators distinct from but directly associated with the redundant processing components go into G06F 11/1645.

G06F 11/1637
{using additional compare functionality in one or some but not all of the redundant processing components}

Definition statement

This place covers:

• Consists of systems often denoted as master/checker in which there is no separate comparator unit. Instead, one or some of the redundant unit(s) (the checker(s)) do(es) additional work to perform the comparison, thereby detecting erroneous behaviour and checking the system for correct operation. The additional compare functionality may be implemented in hardware on the corresponding processing component(s), or in software executed by the corresponding processing component(s).
• Master/checker type architectures in which two processors operate in clock lockstep, where the checker compares the values driven by the master with its own corresponding internally present by otherwise disabled outputs. If a discrepancy is detected, the checker produces an error signal. See the glossary for citations of example master-checker structures. Note that this type of architectures also falls in the G06F 11/1654.
• Master/checker architectures where the checker is limited in processing functionality with respect to the master, even though this is not absolutely in line with our definition of hardware redundancy.

G06F 11/1641
{where the comparison is not performed by the redundant processing components}

Definition statement

This place covers:

Here one or more hardware units separate from the redundant components are used to compare the results produced by the redundant components. Further details of subgroups G06F 11/1645 and the comparison itself uses redundant hardware.
This covers architectures in which there are comparator units (typically but not necessarily respectively associated with but) distinct from each one of the redundant processing components. The comparators are considered redundant when they perform the same comparison on (copies of) the same signals/data.

G06F 11/165

{with continued operation after detection of the error}

Definition statement

This place covers:
Documents in which an additional mechanism is provided to determine which one(s) of the redundant component(s) shall survive after the detection of the error. This may (but need not) involve a determination of which component is correct, in which case this redundant component can be used to correct the error in the other one(s) such that all redundant processing components can finally continue their operation.

Relationships with other classification places

However, since they are not based on a majority decision, (otherwise they would be G06F 11/18, see in particular G06F 11/181), the determination of the surviving component(s) is usually not done using redundancy in hardware. Rather, some diagnostics or simple priority rules, possibly based on prior behaviour are used.

Special rules of classification

Techniques in this group may use active fault masking, passive fault masking (i.e. ignoring the faulty component), or other techniques like retry. If these are described they should get an Indexing Code in the respective field as well.

G06F 11/1654

{where the output of only one of the redundant processing components can drive the attached hardware, e.g. memory or I/O}

Definition statement

This place covers:
• Here one of the processing components is usually called the “master”, the other(s) may be denoted as slave(s), checker(s), or shadow(s). The master's outputs drive the system. The slave's outputs are used for comparison but are otherwise disabled from reaching other components of the system.
• Architectures in which both processors have a master and a slave role but for distinct parts of the system, i.e. for different types of output.

Relationships with other classification places

There may be an overlap of this group with G06F 11/1637 when the slave itself also performs the comparison, thereby making it a checker as well.

Special rules of classification

This group should only be used when there effectively is an asymmetry in the role of the redundant processors. On the contrary, the mere statement that a comparator or bridge or the like selects the outputs of one the processors to drive the attached components does not suffice to justify a different role of the processors.
G06F 11/1658

{Data re-synchronization of a redundant component, or initial sync of replacement, additional or spare unit}

Definition statement

This place covers:

The following types of data transfer activities (possibly using data replication) from a memory, the content of which is assumed to be good, to a one that is not yet current (note that the concerned memories do not need to be themselves redundant):

- sporadic resynchronisation processes used to reintegrate a redundant component into an active/active system, such process being started in an attempt to correct a fault for instance by rebooting a failing component or by replacing it.
- synchronisation processes occurring at start-up of some redundant active/active systems in which the redundant components have to negotiate when they are all ready to enter the lockstep mode of operation.
- initialisation processes used to make a redundant component ready to work as a stand-by in active/passive systems.

Special rules of classification

Documents in this group describing techniques in the context of active/passive systems should additionally have at least one Indexing Code in the G06F 11/20 (see also the comments in G06F 11/2097).

G06F 11/1662

{the resynchronized component or unit being a persistent storage device (re-synchronization of failed mirror storage G06F 11/2082; rebuild or reconstruction of parity RAID storage G06F 11/1008)}

Definition statement

This place covers:

- Initialising data of a (newly activated) spare disk, provided this is not a mirror disk (the latter being in G06F 11/2082).
- Typical examples for this are the preparation of file system or database replica.
- G06F 11/1666

G06F 11/1666

{where the redundant component is memory or memory area}

Definition statement

This place covers:

- The term memory is meant to comprise solid state devices used as main memory which is directly addressable by the associated CPU, as well as non addressable solid state internal memories (e.g. registers, buffers). It does however not need to be RAM.
- Redundant caches and main memory mirroring (in which case the Indexing Code G06F 11/20 should be given). One of the following Indexing Codes should be used where appropriate to better characterise the fault detection or correction mechanism involved: G06F 11/18, G06F 11/20.
- Error detection (or fault masking) using data replicated in different areas of the same memory device is also covered.
These documents differ significantly from the other mechanisms in G06F 11/1658 relating to (main) memory.

**G06F 11/167**

{Error detection by comparing the memory output}

**Definition statement**

*This place covers:*

This the appropriate place for comparisons performed on the output of redundant memory (areas).

**G06F 11/1675**

{Temporal synchronisation or re-synchronisation of redundant processing components}

**Definition statement**

*This place covers:*

The 16T groups address the problem of ensuring that corresponding outputs of redundant active components are simultaneously available for error detection or correction at a given time. This does not imply that these outputs are produced simultaneously (see e.g. US2002116662). Such system are frequently said to operate in lockstep (at least at some level of abstraction).

Some active/standby systems using active fault masking, where a standby unit is to be maintained in close time synchrony with its primary, the standby unit thereby effectively maintaining itself current to be ready for failover. Documents of this latter type shall also get at least an Indexing Code in G06F 11/2097.

**G06F 11/1679**

{at clock signal level}

**Definition statement**

*This place covers:*

Here systems either use a common clock (clock lockstep) or are otherwise synchronised to such an extend that they produce comparable outputs within the same clock cycle, although not necessarily exactly in phase. If not using a common clock, the synchronisation measures taken affect the clock signal.

**G06F 11/1683**

{at instruction level}

**Definition statement**

*This place covers:*

Here we have documents where the synchronisation occurs at statically predictable places in the code either after each instruction or after each instruction of a predetermined type (e.g. memory write or I/O operation) or by using explicit synchronisation instructions/operations.
**G06F 11/1687**

{at event level, e.g. by interrupt or result of polling}

**Definition statement**

*This place covers:*

- Synchronisation mechanisms that are triggered by events asynchronous to the main program. Typical example is synchronisation at the occurrence of an interrupt.
- Also cases in which the events are I/O operations performed in response to a polling mechanism.

**G06F 11/1691**

{using a quantum}

**Definition statement**

*This place covers:*

Here the synchronisation process is initiated when a predetermined count (>1) of units of work is achieved.

This could be clock cycles, (selected types of) instructions, interrupts, I/O-operations, elapsed time units or any other suitable countable unit.

**Special rules of classification**

In most cases documents should also be classified in one of the other lower subgroups of G06F 11/1675

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantum</td>
<td>A predetermined count (&gt;1) of units of work</td>
</tr>
</tbody>
</table>

**G06F 11/1695**

{which are operating with time diversity}

**Definition statement**

*This place covers:*

Time diversity is the concept to have an active/active system in which one of the redundant components operates with a delay with respect to the other in order to avoid common mode failures that would affect both redundant components in the same way at the same time, thereby not being detectable by comparison. Typically the time delay is a small odd multiple of the half clock period. It has to be taken into account when comparing the outputs in order to compare outputs resulting from the same logical steps, which by definition are not produced simultaneously. (Should time diversity turn out to be a concept useable for active/passive system as well, this group would have to be moved one level up).
**G06F 11/18**

using passive fault-masking of the redundant circuits {(error detection by comparing the output of redundant processing systems with continued operation after detection of the error G06F 11/165)}

**Definition statement**

*This place covers:

- Fault masking: hiding the presence of a fault to the user or the environment of a [computer system by means of some sort of redundancy such that the perceived system functionality is not affected.
- Passive fault masking: when a system operates such that no particular action is necessary to mask a fault because all necessary operations are constantly performed independently of the presence of a fault (e.g. majority voting).

In G06F 11/18 this is achieved by redundant active hardware components, the output of which is subjected to a (voting) process which ensures that only output considered correct is propagated in the system. Thereby, those redundant components which are in error are simply ignored, this resulting in a correction of the error(s) through the hardware redundancy.

Passive fault masking means that a system produces correct behaviour/outputs in the presence of faulty components.

Voting is a majority building process, by which the output agreed upon by a majority of the redundant components is selected as the correct one, thereby tolerating any minority number of erroneous outputs.

**Relationships with other classification places**

The subgroups fall apart in 2 types:

- "architectural groups", i.e. groups that specify constructional elements (i.e. G06F 11/182, G06F 11/183 and G06F 11/184, G06F 11/185)
- "functional groups", i.e. groups that define a particular functionality that is independent of the architecture (G06F 11/181, G06F 11/187, G06F 11/188).

**References**

*Limiting references*

*This place does not cover:

| With continued operation after detection of the error | G06F 11/165 |

**G06F 11/181**

{Eliminating the failing redundant component}

**Definition statement**

*This place covers:

Documents including an elimination of a faulty component based on the results of a passive fault masking process, through which those components being in the minority are assumed to be the erroneous ones. They can, thus, be eliminated without the need for a separate fault location process. Note that this group implies that the fault masking as such is passive i.e. the correct system output can be produced before the faulty component is eliminated.
G06F 11/182

{based on mutual exchange of the output between redundant processing components}

Definition statement

This place covers:

The voting process when it is performed in software by the redundant components themselves, based on their own output and the ones received from the other redundant components. There is no voter hardware.

Processors exchanging results via a local (processor) bus as well as distributed system which communicate the results via LAN or other type of network.

Redundant processing while the other groups at the same level are not.

A system having only a single redundant processing component performing the voting in software is covered as well.

References

Limiting references

This place does not cover:

Redundant voters distinct from but directly associated with the redundant processing components go into G06F 11/185.

G06F 11/183

{by voting, the voting not being performed by the redundant components}

Definition statement

This place covers:

Here one or more hardware units separate from the redundant components are used to vote the results produced by the redundant components.

G06F 11/184 where the redundant components implement processing functionality

Documents where the outputs of redundant processors / CPUs / microcontrollers are voted to perform the passive fault masking.

G06F 11/185 and the voting is itself performed redundantly

Documents where the voting process itself is implemented using redundant hardware, i.e. where the voter does not constitute a single point of failure. The voter does not need to be implemented in hardware, but could be realised as software processes on dedicated voting processors.

Counter-example: each redundant component has a voting module in software, which uses the outputs produced by the other redundant components. This is G06F 11/182.
**G06F 11/187**

*{Voting techniques}*

**Definition statement**

This place covers:

Specifics on how the voting process is performed in contrast to remaining G06F 11/18 groups which relate to architectural aspects of the systems.

**Relationships with other classification places**

This group is only used for voting for redundant hardware components. See G06F 11/1497 and G06F 11/1479 and subgroups for voting in the context of redundant software.

**G06F 11/188**

*{where exact match is not required}*  

**Definition statement**

This place covers:

Concerns documents where the majority is formed by outputs which are considered equivalent, although not identical. This is frequent in control applications where inputs of the redundant components do not originate from the same source of information, or where they are gained at (slightly) different times. Tolerances or other plausibility or coherence criteria may be used to determine which outputs form the majority.

**G06F 11/20**

using active fault-masking, e.g. by switching out faulty elements or by switching in spare elements

**Definition statement**

This place covers:

Head-group for all documents in which faults are masked actively, i.e. after the masking is done, the fault is not present anymore in the active part of the system. It is to be noted as well that we are talking exclusively about fault masking and not about error masking.

The subgroups fall apart in 2 types:

- "architectural groups", i.e. groups that specify the constructional element which is redundant (i.e. G06F 11/2002, G06F 11/202 and G06F 11/2053)
- "functional groups", i.e. groups that define a particular functionality that any active fault masking arrangement needs to implement (i.e. G06F 11/2097). This functionality is independent of the particular constructional element which is redundant.

**Special rules of classification**

A general concept in the field of active fault masking is that a surviving component takes over the load/work of failing one in addition to its own normal work. For such documents the symbol G06F 2201/85 should be used except for documents getting a dedicated group for this concept (e.g. G06F 11/2035).

In G06F 11/181 there are also documents dealing eliminating a faulty component. G06F 11/165 possibly uses active fault masking (to ensure the continued operation, some kind of decision is needed to identify one of both components as failed and this one may completely be removed from the system). However, since in those two groups the active fault masking is rather a consequence of the voting or compare, we decided to take this particular subject-matter out of the G06F 11/20.
Failover comprises one or more of the following activities:

- error detection: this is not a failover specific mechanism since there is no link between detection and failover => such docs to be classified according to the used mechanisms but not necessarily in 
  \text{G06F 11/20}
- determination of the spare to be used
- activation of the determined spare
- declaration of the activated spare as primary
- elimination of the faulty unit

There is failover taking place as soon as any functionality of a hardware component is taken over by another hardware component, whatever the functionality is.

\textbf{Glossary of terms}

\textit{In this place, the following terms or expressions are used with the meaning indicated:}

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault masking</td>
<td>hiding the presence of a fault to the user or the environment of a computer system by means of some sort of redundancy such that the perceived system functionality is not affected.</td>
</tr>
<tr>
<td>Active fault masking</td>
<td>taking particular actions (e.g. reconfiguration, failover) not performed in the error free situation to mask a fault.</td>
</tr>
</tbody>
</table>

\textbf{G06F 11/2002}

\textit{(where interconnections or communication control functionality are redundant (flexible arrangements for bus networks involving redundancy \text{H04L 12/40176})}

\textbf{Definition statement}

\textit{This place covers:}

All cases where architectural components involved in communication are redundant, as long as no communication protocol layer independent of a particular application is involved.

Examples pertaining to subgroups of \text{G06F 11/2002} are:

- Duplicate connection lines
- Redundant busses (serial or parallel)
- Redundant bus controllers (e.g. PCI)
- Network interface boards describing built-in redundancy
- A redundant setup of two network adapters which are not redundant in themselves

\textbf{Relationships with other classification places}

Fault tolerance in communications is for \text{H04L} rather than \text{G06F 11/00} if the mechanism described is implemented by a communication protocol layer that is independent of a particular application.

Examples that should be classified in \text{H04L}:

- fault tolerant FTP protocol.
- client having a session management layer, the layer independently maintaining connections with a server.
- operations relating to establishing or cancelling connections between nodes.
- message replication or retry by a routing algorithm (even fault-tolerant routing);
- dealing with transmission errors occurring on the interconnection media (\text{H04L 1/00})
Special rules of classification

The subgroups G06F 11/2005, G06F 11/2007 and G06F 11/2012 are to be used together in order to classify 9 different types of redundancy in this field. Regarding details of communication failover no subgroup is foreseen. This has to be searched using the other architectural criteria.

Example: Two PCs connected to a LAN by a respective LAN controller and additionally being connected to each other by a USB cable via respective USB controllers, where the USB connection can be used as alternative path to transmit the same data. This configurations gets all the three subclasses.

Remarks:
• A communication switch implements control logic to realise physical connections between a set of data input ports and a set of data output ports, thus, if not H04L 49/00 this is G06F 11/2005.
• Data transfer between processors and memories is not considered communication (rather it is addressing), hence redundant interconnects between processors and memories is G06F 11/2002 (not G06F 11/2007).

Examples below illustrate how the scheme should work in some typical situations:
G06F 11/2005

{using redundant communication controllers}

Definition statement

This place covers:

Communication controllers are nodes as defined under G06F 11/2007 dedicated to performing communication control logic.

G06F 11/2007

{using redundant communication media}

Definition statement

This place covers:

Interconnections are physical media and are of point-to-point type or of bus type. Two interconnections are only considered redundant if:

- they both physically connect the same nodes, wherein nodes are any components performing processing or control functionality (examples: computers, bridges, storage controllers, communication switches, counter-example: physical repeater has neither processing nor control logic), and
- are configured to perform the same data transmissions.

Only documents fulfilling these criteria are classified here.

This group covers as well redundant dedicated interconnection media for I/O functionality as long as it does not use general purpose communication interconnection media (like LAN or USB cables).

G06F 11/201

{between storage system components}

Definition statement

This place covers:

E.g. multiple IBM channels between controller and disk
G06F 11/2017
{where memory access, memory control or I/O control functionality is redundant (redundant communication control functionality G06F 11/2005; redundant storage control functionality G06F 11/2089)}

Definition statement
This place covers:
All cases where memory access, memory control or I/O control functionality is redundant. An example would be redundant configurations having an active and a passive graphics adapter.

Special rules of classification
Redundant dedicated interconnection media for such I/O functionality are to be classified in G06F 11/2002 as long as it does not use general purpose communication interconnection media (like LAN or USB cables).

G06F 11/202
{where processing functionality is redundant (redundant communication control functionality G06F 11/2005, redundant storage control functionality G06F 11/2089)}

Definition statement
This place covers:
All subject-matter where the redundancy resides in components that perform processing, i.e. components the runtime functionality of which is controlled by software (or firmware), except for ones dedicated to storage control or communication control (see the precedence rule).

For subject-matter to be classified in this group, it is enough that a fault masking is tried when a failure occurs. It is not necessary to have a guarantee that resources will be available to successfully fail over.

Relationships with other classification places
Two types of subgroups can be identified
• "architectural groups", i.e. groups that specify the actual redundancy arrangement (i.e. G06F 11/2035-G06F 11/2048)
• "functional groups", i.e. groups that define a particular functionality (i.e. G06F 11/2023, G06F 11/2051). This functionality is independent of the particular redundancy arrangement used.

Special rules of classification
This group has 4 types of subgroups. A class in each of the types should be given (as far as disclosed in the document) systematically. Thus, a document classified in these subgroups will normally have 3 or 4 symbols (invention or additional). The four types are:
• G06F 11/2023 and subgroups
• G06F 11/2035 - G06F 11/2041
• G06F 11/2043 - G06F 11/2048
• G06F 11/2051
**G06F 11/2023**

**{Failover techniques}**

**Definition statement**

*This place covers:*

Details of the failover mechanism

Also includes documents describing failback, i.e. reverting to the original or replacement primary processing unit when it becomes operational again. Currently this also covers documents dealing with the determination/selection of the spare to be used for replacing the failing component. There is failover taking place as soon as any functionality of a processing component is taken over by another processing component, whatever the functionality is.

**G06F 11/2025**

**{using centralised failover control functionality}**

**Definition statement**

*This place covers:*

Where a single component implements the control functionality for failover. This may be a distinct hardware module or software implemented on a single one of the redundant processing components.

**G06F 11/2028**

**{eliminating a faulty processor or activating a spare}**

**Definition statement**

*This place covers:*

Documents describing how to ensure that a failing and formerly active processing component no longer participates in the system functionality. Similarly, documents describing how to activate a former standby processing component to replace the functionality of a failing one. Example: setting bits identifying a node as active in a configuration file.

**Special rules of classification**

On the contrary, eliminating a backup unit that is not active (i.e. not within a failover process) is not **G06F 11/20** since this is not error correction using redundancy in hardware. This is most likely **G06F 11/0793**.

"Eliminating a faulty processor" needs to be understood broadly. E.g. this includes as well:

- documents describing a complete reconfiguration of the system which results in eliminating not only the faulty processor, but also some functioning components if needed to come to a fault-free system and
- documents dealing with how to determine the fault-free system configuration which eliminates the minimum number of components.
**G06F 11/203**

**{using migration}**

**Definition statement**

*This place covers:*

Transferring runtime context of processes, tasks, jobs, threads etc... from a failing processing component to a replacing one.

**G06F 11/2033**

**{switching over of hardware resources}**

**Definition statement**

*This place covers:*

The process of placing resources (other than the redundant processing components) under control of a replacement processing unit instead of a failing one. Example: attaching a RAID or other I/O device to the spare.

**G06F 11/2035**

**{without idle spare hardware}**

**Definition statement**

*This place covers:*

There are no processing components left inactive in failure-free operation.

This group contains all subject-matter where the performance is degraded after a failure has occurred, since the same processing needs to be done on less hardware.

However, performance degradation is not a necessary condition for this group, since a safety margin can be used in the failure-free operation.

**Special rules of classification**

"Hot spare" architectures wherein the spares are maintained updated for immediate failover by performing the same processing as the primary (possibly in clock synchronisation with the latter) do not fall in this group, because such spares are considered inactive to the extent they do not perform system functionality beyond what is necessary to function as spare. The same applies to architectures where spares are not completely idle because they monitor the primary to detect whether it is failing. These examples would rather be classified in G06F 11/2038 or G06F 11/2041.

**G06F 11/2038**

**{with a single idle spare processing component}**

**Definition statement**

*This place covers:*

The spare component can be spare for a single one or for a plurality of active processing components. There may be multiple spares which, however, are each a single spare for distinct sets of active processing components.

Also covers the case where the spare component is a hot spare.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Without idle spare hardware

G06F 11/2035

G06F 11/2041

{with more than one idle spare processing component}

Definition statement

This place covers:
A processing component has more than one spare.
Also covers the case where at least one spare component is a hot spare.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Without idle spare hardware

G06F 11/2035

G06F 11/2043

{where the redundant components share a common memory address space}

Definition statement

This place covers:
Examples: symmetric multiprocessor; multicomputer with virtual shared memory based on message passing.

G06F 11/2046

{where the redundant components share persistent storage (G06F 11/2043 takes precedence)}

Definition statement

This place covers:
Any architecture where redundant components have (at least temporarily) access to common storage independent of whether or not the shared storage is used for or during failover.

References

Limiting references

This place does not cover:

Where the redundant components share a common memory address space

G06F 11/2043

323
G06F 11/2053

{where persistent mass storage functionality or persistent mass storage control functionality is redundant (error detection or correction in information storage based on relative movement between record carrier and transducer G11B 20/18)}

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Storage | persistent memory subsystems (typically involving disks), the contents of which are not directly physically addressable as data words by a CPU |

G06F 11/2056

{by mirroring}

Definition statement

This place covers:

All subject-matter related to mirroring.

Relationships with other classification places

Mirroring means that data replication is performed solely by the storage controller(s) or corresponding drivers without the involvement of higher software layers like file systems or databases. However, information provided by such higher layers within the blocks dealt with by the controllers (like sequence numbers or time stamps) may be used within the mirroring operation.

If a higher software layer is involved, this is not considered as mirroring but as backup (if point-in-time) or replication (if continuous) and should be classified in the appropriate places.

Mirroring implies, that the time at which a piece of data is transferred is determined solely by the mirroring functionality (disk controller, disk driver, ...). In contrast, for backup a trigger is necessary from another (typically higher level) software layer.

As a counter-example (i.e. which is not mirroring, but something in G06F 11/1402):

- periodic creation of snapshots and transfer of delta between successive snapshots to update a secondary storage.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Arrangements for replication or mirroring the data, e.g. data synchronisation between network nodes and/or user terminals | H04L 29/0854 |

324
G06F 11/2058
{using more than 2 mirrored copies}

Definition statement
This place covers:
Each of the more than 2 copies is a mirrored copy, the original (primary) data itself also being considered as one mirrored copy. An intermediate volume used as a buffer but not representing a full copy (suitable for failover) would not be considered a mirrored copy.

Special rules of classification
Subject-matter combining mirroring and backup should have double classification.

G06F 11/2064
{while ensuring consistency}

Definition statement
This place covers:
This covers distinct types of consistency problems like write order consistency, consistency between different volumes (broken links problem), consistency groups or writes.

G06F 11/2066
{Optimisation of the communication load}

Definition statement
This place covers:
Measures aiming at reducing the amount of data being transferred in the mirror system e.g. from the primary to the mirror site, or between the Host and the primary. Examples: "write coalescing", sending record logs instead of full blocks (journaling).

G06F 11/2079
{Bidirectional techniques}

Definition statement
This place covers:
Systems in which updates occur independently on different mirror copies and are simultaneously propagated to the respective other mirror copies.

G06F 11/2082
{Data synchronisation}

Definition statement
This place covers:
This covers resynchronisation of a failed or reconnected mirror as well as initial synchronisation to start mirroring.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| For non-mirroring related disk initialisation | G06F 11/1662 |

G06F 11/2089

{Redundant storage control functionality}

Relationships with other classification places

Mirroring with multiple controllers does not imply that the controllers are redundant. If one of the storage controllers would be faulty in such a system, either the host will not be able to access the storage anymore or the mirroring functionality will be lost. Thus some storage control functionality will be lost and there is no redundancy on this level.

G06F 11/2092

{Techniques of failing over between control units}

Definition statement

This place covers:

This group contains the details about how the faulty storage control element is taken out of operation or how storage control functionality is transferred to other elements.

Examples are:

• changing the system configuration
• shut down of the controller concerned

Counter-example:

Eliminating a backup unit that is not active (i.e. not within a failover process) is not G06F 11/20 since this is not error correction using redundancy in hardware. This is most likely G06F 11/0793.

G06F 11/2094

{Redundant storage or storage space (G06F 11/2056 takes precedence)}

Definition statement

This place covers:

Architectures and problems involving the use of additional storage (space) intended to be used instead of failing storage (space). Typical problems involve eliminating a failing active storage unit or activating spares (possibly storing replicated data).

Also to be used when it is not clear whether an eliminated disk has its data replicated elsewhere.

Relationships with other classification places

In the case of failing over, this group does not cover the data initialisation of an activated spare, because this is G06F 11/1662.

Note that because of the precedence rule failover in the context of mirroring is not dealt with in this group (see G06F 11/2069).
G06F 11/2097
{maintaining the standby controller/processing unit updated (initialisation or re-synchronisation thereof G06F 11/1658 and subgroups)}

Definition statement

This place covers:

This group contains details of the measures that are taken to keep the data in memory, and/or persistent storage of a spare/stand-by unit (processor or controller) current in order to be ready for take-over. This is a repetitive process (frequently involving data replication) used before the occurrence of the fault.

This group does not contain details of how a component's data is initially made ready to function as backup (this belongs to G06F 11/1658+).

Examples for the use of this group:

• replaying message log on standby node: transmission of log (before failure) is G06F 11/2097, replaying of log is failover (G06F 11/2023) if performed after the failure.
• very hot standby using running standby in lockstep without comparison. The lockstep aspect is to be classified in G06F 11/1675 (Indexing Code or EC according to importance). However, since it addresses the problem of maintaining the standby unit updated G06F 11/2097 (possibly Indexing Code) should be given.

Example: Two redundant disk controllers control a single disk. Host write requests received by one controller are transferred to the second one (including the data) for temporary buffering until the write is performed by the first one. Should the first one crash, the second one is able to perform incomplete writes. Hence, the second one is maintained updated by the first one for potential failover.

Special rules of classification

A symbol to indicate the type of redundancy in Hardware (e.g. G06F 11/2038) must be added as additional, when the type of redundancy is not otherwise classified.

G06F 11/22
Detection or location of defective computer hardware by testing during standby operation or during idle time, e.g. start-up testing

Definition statement

This place covers:

This group and its subgroups also cover testing at system level, i.e. testing of a combination of hardware and software.

This testing occurs at a time outside of "normal operating mode", e.g. during standby, idle time or at power on.

Next to the testing per se, this group and its subgroups also cover the equipment which is used to test the hardware concerned or to interpret the test results.

Relationships with other classification places

Subject-matter is classified here if programmable processing logic is part of the device under test. Else, the subject-matter belongs to G01R 31/317.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

- Testing of Software [G06F 11/36]
- Verification of a hardware design [G06F 17/50]
- Testing of digital circuits, e.g. of separate computer components [G01R 31/317]
- Testing of computer memories [G11C 29/00]

Special rules of classification

General rules for G06F 11/22 and subgroups

In G06F 11/22 and subgroups, generally only 1 symbol is allocated. The symbol allocated is the most relevant one for the invention information disclosed.

Only if the component being tested and the test itself are important, should the subject-matter be classified in one of the subgroups G06F 11/2205 together with another group in G06F 11/22.

Only invention information is classified.

If the software testing part is described and is important, the document should also be sent to G06F 11/36 for classification.

Rules specific to G06F 11/22 per se:

Documents are only classified in G06F 11/22 per se if it cannot be established whether the test is marginal checking (classified in G06F 11/24), testing of logical operation (classified in G06F 11/25) or functional testing (classified in G06F 11/26).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

- Computer hardware: a digital circuit which has programmable processing logic incorporated.
- Testing: an execution of the computer hardware which is dedicated to the detection of faults. Thus, the execution of the hardware during the test is not part of the "useful" processing which contributes to achievement of the intended purpose.

G06F 11/2247

{Verification or detection of system hardware configuration}

Special rules of classification

Group no longer used for classification. See G06F 11/2289 instead.
G06F 11/2252
{using fault dictionaries}

Definition statement
This place covers:
Subject-matter where the testing process or test analysis process is guided by a fault dictionary. This is the case when a lookup (based on the test results) is done directly from a list of entries, without any additional processing.

Although 90% of the documents use the fault dictionary to determine where the fault is located or what actions to take; the group also covers subject-matter where information is looked up in the fault dictionary to determine the next test.

G06F 11/2257
{using expert systems}

Definition statement
This place covers:
Subject-matter where an error message is correlated with other error messages or parameters.

Although 90% of the documents use expert systems to determine where the fault is located or what actions to take; the group also covers subject-matter where the expert system is used to determine the next test.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

| Expert system | A computer program that contains a knowledge base and a set of algorithms or rules that infer new facts from knowledge and from incoming data. |

G06F 11/2263
{using neural networks}

Definition statement
This place covers:
Although 90% of the documents use the neural network to determine where the fault is located or what actions to take; the group also covers subject-matter where the neural network is used to determine the next test.

G06F 11/2273
{Test methods}

Definition statement
This place covers:
Subject-matter where the focus is on how the test is done instead of on what test is done or what is tested.
In general, the documents classified in this subgroup are of a more theoretical nature.

**G06F 11/2284**

*{by power-on test, e.g. power-on self test [POST]}*

**Definition statement**

*This place covers:*

Subject-matter describing what tests are being done on power on. The tests concern the correct functioning of the system as a whole.

**Relationships with other classification places**

Documents describing the execution of tests are classified in G06F 11/26 and subgroups.

**G06F 11/2289**

*{by configuration test}*

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Detection of the configuration of a system | G06F 8/71 |

**G06F 11/25**

**Testing of logic operation, e.g. by logic analysers**

**Definition statement**

*This place covers:*

All testing where the level of the logical value (e.g. 0 or 1) of the signal is tested, independent of functionality.

**G06F 11/261**

*{by simulating additional hardware, e.g. fault simulation}*

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Debugging using additional hardware | G06F 11/3648 |
**G06F 11/263**

Generation of test inputs, e.g. test vectors, patterns or sequences {; with adaptation of the tested hardware for testability with external testers}

**Definition statement**

This place covers:

Subject-matter concerning the generation of test inputs, where this generation is done externally to the system being tested. It covers as well arrangements where both test input generation and test result processing are done externally to the system being tested.

**G06F 11/267**

Reconfiguring circuits for testing, e.g. LSSD, partitioning

**Definition statement**

This place covers:

All adaptations to the hardware being tested to make the hardware more testable.

**G06F 11/27**

Built-in tests

**Definition statement**

This place covers:

Those tests which are incorporated in the hardware component itself which is being tested.

**G06F 11/273**

Tester hardware, i.e. output processing circuits {((G06F 11/263 takes precedence))}

**References**

**Limiting references**

This place does not cover:

G06F 11/263 takes precedence.

**G06F 11/277**

with comparison between actual response and known fault-free response

**Special rules of classification**

Group no longer used for classification.
G06F 11/28

by checking the correct order of processing (G06F 11/08 - G06F 11/26 take precedence; monitoring patterns of pulse trains H03K 5/19)

Definition statement

This place covers:

Checking the correct order of processing. the word "order" implies the consideration of a sequence. It can be for example the sequence of instructions in a computer program, the sequence of steps to perform when installing a software on a computer, etc. Typically documents dealing with the verification of a system that is specified in terms of state machine (states and transitions between states) based on reachability analysis can be found in the group. Also documents dealing with the verification that a computer program is executing according to the expected sequence of instructions (i.e. there is no unexpected jump that could be the result of a malicious attack) can be found in the group. This can be done for example by computing a current signature while the program is executing and comparing it to a reference signature.

References

Limiting references

This place does not cover:

| Checking the correct execution order of instructions for security purposes | G06F 21/00 |
| Monitoring patterns of pulse trains | H03K 5/19 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| FSM, FSA | A finite state machine (FSM) or finite state automata (FSA) is a mathematical abstraction sometimes used to design digital logic or computer programs. It is a behaviour model composed of states and transitions between the states. |
| Signature | A signature is a value resulting from the application of a function to some computer data, for example a hash function. |

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

• "sequence", "FSM (Finite State Machine)" or "FSA (Finite State Automata)"

G06F 11/30

Monitoring

Definition statement

This place covers:

Monitoring refers to an extra functionality for observing properties of a running computing system in its normal operating conditions without inputting test data.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Thermal management in cooling means</th>
<th>G06F 1/206</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power management</td>
<td>G06F 1/3203</td>
</tr>
<tr>
<td>Monitoring for error detection</td>
<td>G06F 11/0751</td>
</tr>
<tr>
<td>Verification or detection of system hardware configuration</td>
<td>G06F 11/2002</td>
</tr>
<tr>
<td>Monitoring intrusion in a computer system</td>
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<td>Network security. Monitoring network traffic</td>
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<td>Network monitoring</td>
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</tr>
<tr>
<td>Monitoring testing in wireless networks</td>
<td>H04W 24/00</td>
</tr>
</tbody>
</table>

Special rules of classification

The classification process in the G06F 11/30 and its subgroups has to be carried out performing the following steps:

1. If the document contains interesting aspects about the observation of properties of a running computing system over time in its normal operating conditions without inputting test data, then proceed with ALL of the following steps 2, 3, 4.1, 4.2, 4.3, 4.3.1, 4.4, 4.5 and 5 in sequence, otherwise stop because the document is not to be understood to be about monitoring;

2. If the document contains interesting aspects about the (visual or acoustical) display of the monitored data, then classify the document in G06F 11/32 and its subgroups;

3. If the document contains interesting aspects about the monitoring of computer activity, then classify the document according to the FCRs of G06F 11/34 and subgroups;

4.1. If the document contains interesting aspects about monitoring the configuration of the computing system, then classify the document in G06F 11/3051;

4.2. If the document contains interesting aspects about monitoring the status of the computing system, then classify the document in G06F 11/3055;

4.3. If the document contains interesting aspects about the monitoring of environmental parameters of the computing system, then classify the document in G06F 11/3058 and subgroups;

4.3.1. If power consumption is evaluated through the monitoring of computer activity, then also classify the document in G06F 11/34 and subgroups according to the FCRs of G06F 11/34;

4.4. If the document contains interesting aspects about the reporting of the monitored data, then classify the document in G06F 11/3065 and its subgroups;

4.5. If the document contains interesting aspects about the sensing of the monitored data, then classify the document in G06F 11/3089 and its subgroups;

4.6. If the document has been classified at least once in G06F 11/3051, G06F 11/3055, G06F 11/3058, G06F 11/3065, G06F 11/3089 or their subgroups, then classify the document in G06F 11/3003 and its subgroups;

5. If none of the steps 2-4.6 apply, then classify the document in G06F 11/30.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Computer activity                        | For this group and its subgroups, computer activity covers the activities performed by the computer system that involve data (e.g. processing, data storage, data transfer). It also includes user activity. |
Monitoring system

A monitoring system is generally considered to be composed of observing or measuring entities (usually called monitors or observers) and interfaces/probes which link them to the system under observation.

Interfaces/probes

The interfaces/probes sense (or access) data relative to the system under observation and report them to the observing/measuring entities.

Probe effect

The probe effect is the undesired alteration of a system property caused by the fact that this property is being observed or measured.

Environmental parameters

Environmental parameters of a computing system are: power, currents, temperature, humidity, position, radiation, etc.

G06F 11/34

Recording or statistical evaluation of computer activity, e.g. of down time, of input/output operation {; Recording or statistical evaluation of user activity, e.g. usability assessment}

Definition statement

This place covers:

For this group and its subgroups, computer activity covers the activities performed by the computer system that involve data (e.g. processing, data storage, data transfer). It also includes user activity.

This group also includes the modeling of the system or its behaviour, or simulating the execution of the system for observing its properties on a theoretical level.

Special rules of classification

As criterion to decide whether G06F 11/34 and subgroups applies, it needs to be considered whether computer activity or user activity is being monitored or not.

If the monitoring is done purely to detect when an error occurs, G06F 11/0703 and subgroups apply instead of G06F 11/34 and subgroups.

Recording data during software testing or debugging is classified in G06F 11/36 and subgroups.

The subgroups of G06F 11/34 fall apart in 2 blocks:

- G06F 11/3404 - G06F 11/3442 and subgroups deal with what is being monitored.
- G06F 11/3447 - G06F 11/3466 and subgroups deal with how the monitoring is done.

If both aspects are relevant, classes should be given in both ranges. E.g. performance measurement (G06F 11/3409 or subgroups) where a particular monitoring hardware is used to perform the measurement (G06F 11/3466 or subgroups) is classified in both ranges.

Documents where the monitoring relates to the monitoring of user actions must be systematically classified in G06F 11/3438 (as invention or additional information), independent of any other classification.

Following Indexing Codes must be systematically given for documents classified in G06F 11/34 and subgroups:

- G06F 2201/80 if the monitoring is specific to databases
- G06F 2201/81 if a threshold influences the monitoring behaviour
- G06F 2201/815 if the monitoring concerns the effects of virtualisation
• **G06F 2201/86** for all event-based monitoring
• **G06F 2201/865** if software is being monitored
• **G06F 2201/87** if the monitored object is a transaction
• **G06F 2201/875** if the monitored system includes the internet
• **G06F 2201/88** if counts are used
• **G06F 2201/885** if the monitored object includes a cache

If the document does not describe what is being monitored, its subject-matter should not be classified in **G06F 11/34**, but in **G06F 11/30** or other subgroups of **G06F 11/30**.

### Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

<table>
<thead>
<tr>
<th>Monitoring</th>
<th>Extra functionality for observing properties of a running computing system over time in its normal operating conditions without inputting test data</th>
</tr>
</thead>
</table>

### G06F 11/3404

*{for parallel or distributed programming}*

#### Definition statement

*This place covers:*

The subject-matter of this group covers monitoring of parallel or distributed programming. Typical issues addressed are: determining the degree of parallelism, optimizing the degree of parallelism, performance of distribution algorithms.

### G06F 11/3409

*{for performance assessment}*

#### Definition statement

*This place covers:*

monitoring the performance of the computer system or its components.

This group covers not only the monitoring of time, but usage of any (physical or other) resource as well.

This group applies whatever the component (e.g. disk, processor, scheduler,...) of which the performance is being monitored is.

### References

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

| Monitoring of user actions | **G06F 11/3438** |
G06F 11/3433

{for load management (allocation of a server based on load conditions G06F 9/505; load rebalancing G06F 9/5083; redistributing the load in a network by a load balancer H04L 67/1029)}

Definition statement

This place covers:
Only the monitoring activities to determine the load of a computer system or the distribution of the load on the different components of the computer system. However it does not cover any actions that are performed in response to the determined load.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Adapting or redistributing the load in a computer system | G06F 9/00 |
| Adapting or planning the capacity required | G06F 11/3442 |
| Redistributing the load in a network by a load balancer | H04L 67/1029 |

Special rules of classification

If time measurement is used to be able to determine the load, documents should be classified as well in G06F 11/3419.

G06F 11/3438

{monitoring of user actions (checking the network activity of the user for network-specific applications H04L 67/22)}

Definition statement

This place covers:
all documents where actions of the user are monitored (e.g. for productivity or allocation of billable employee time).

This includes arrangements to evaluate the usability of a system or component.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Checking the network activity of the user for network-specific applications H04L 67/22

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Usability | Measure of the ease of use of a specific object or set of objects or of how easy the object or set of objects is to learn to use |
**G06F 11/3442**

{for planning or managing the needed capacity}

**Definition statement**

*This place covers:*

This group covers all subject-matter where monitoring is done to come to conclusions about the capacity required. It is necessary that this goal is explicit in the document.

Capacity should be understood here as relating to how much computer resources are needed. In general these are hardware resources (such as the amount of processing power, memory or storage space). However this can also be software resources emulating such hardware (such as an amount of virtual memory, a number of virtual machines, etc.).

In contrast to G06F 11/3433, here the load is taken as a given and the goal is to come to conclusions about the resources that need to be available. The actions taken in response will change the configuration of the system.

**Relationships with other classification places**

The actions per se performed to adapt the capacity are not classified here, but rather in G06F 9/00.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Measures to allocate resources | G06F 9/00 |

**G06F 11/3447**

{Performance evaluation by modeling}

**Definition statement**

*This place covers:*

This group deals with subject-matter where a model of the system to be monitored (or part of it) is made or modified. This group does not cover the use of the model as monitoring tool (which should be classified according to what is being monitored).

**E.g.:**

- This group covers the construction of a model to determine monitoring points in the system. However, it does not cover a concrete implementation of the monitoring points (which would be in G06F 11/3466).
- This group covers the construction of a model to be used in a simulation. However, the use of the model in a simulation is not covered (this would be in G06F 11/3457).

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Model | description of a system using mathematical concepts and language. It may help to explain a system and to study the effects of different components or parameters, and to make predictions about system behaviour |
G06F 11/3452

{Performance evaluation by statistical analysis}

Definition statement

This place covers:

Performance evaluation by statistical analysis means that statistics are used to come to a conclusion regarding a system parameter. This may be to evaluate system parameters or predict the future behaviour of the system.

It covers as well subject-matter where a relation between different parameter is modelled, based on measured values documenting the relationship (e.g. curve-fitting)

Typically, this would involve multiple executions or the analysis of time series observed.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Stochastic model development of the system for monitoring | G06F 11/3447 |

G06F 11/3457

{Performance evaluation by simulation}

Definition statement

This place covers:

Simulation means that execution characteristics of the system or component to be monitored are observed without actually executing the real system or without executing the system or component under real conditions.

Examples are:

• Monitoring the execution of the real system but with a fictive workload
• Applying a real workload to a model or a mockup of the system

G06F 11/3466

{Performance evaluation by tracing or monitoring}

Definition statement

This place covers:

The title of this groups should be read as “by tracing”. This group and its subgroups are also relevant if the tracing is not explicitly done to evaluate the performance (for instance if no specific purpose is stated for the tracing).

This group covers arrangements that describe how monitored data of the physical system is being collected or made available. These arrangements can be internal in the system (i.e. tracing) or external to the system (general monitoring arrangements used for monitoring computer activity).

Relationships with other classification places

Tracing for software testing or debugging purposes is classified in G06F 11/36 and subgroups.
Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracing</td>
<td>Observing or making available monitored data using additional hardware or software functionality in the monitored system or component</td>
</tr>
</tbody>
</table>

G06F 11/3471
{Address tracing}

Definition statement
This place covers:
Examples are:
• Observing the addresses circulating on a computer bus
• Monitoring memory accesses for certain address ranges

G06F 11/3476
{Data logging (G06F 11/14, G06F 11/22 take precedence)}

Definition statement
This place covers:
The scope of this group is not restricted to logging of monitoring data per se. It covers as well the determination of what monitoring data should be logged and how it should be logged (e.g. condensing the logged data, logging statistics, ...) and analysis of logged monitoring data.

G06F 11/3485
{for I/O devices}

Special rules of classification
Documents describing the monitoring of channels should additionally be classified in G06F 11/349.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>An independent hardware component that coordinates all I/O to a set of controllers or devices</td>
</tr>
</tbody>
</table>

G06F 11/349
{for interfaces, buses}

Special rules of classification
Documents describing the monitoring of channels should additionally be classified in G06F 11/3485.
**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Channel | An independent hardware component that coordinates all I/O to a set of controllers or devices |

**G06F 11/3495**

*{for systems}*

**Definition statement**

*This place covers:*

Applies when communication or interaction between the processing components influences the assessed properties of the whole system.

Thus, it is a necessary condition to have a communication medium involved, however not a sufficient condition. If the system which is observed is limited to the communication medium, it should not be classified here (but in H04L if the medium is a network or in G06F 11/349 if the medium is a bus).

Examples are:
- Monitoring arrangements for distributed systems
- Arrangements for application level response time measurement of web servers
- Monitoring arrangements in a multiprocessor system

**Relationships with other classification places**

If the communication protocol or the hardware characteristics of the network are relevant for the monitoring, this should be (additionally) classified in H04L.

**G06F 11/36**

**Preventing errors by testing or debugging software**

**Definition statement**

*This place covers:*

The methods used during software development in order to prevent errors:
- software Analysis (G06F 11/3604 and subgroups), which refers to verifying properties of a program (statically or dynamically)
- software testing (G06F 11/3668 and subgroups), which refers to the activity of detecting errors (using test inputs)
- software debugging (G06F 11/362 and subgroups), which refers to the activity of locating an error.

The class also covers the environments (e.g. GUI, simulators) helping a user to perform software debugging or testing (G06F 11/3664).

**Relationships with other classification places**

Tracing for performing performance analysis; G06F 11/3466
Emulators and simulators used for testing computer hardware; G06F 11/261
User interface programs; G06F 9/451
Generating or modifying source code; G06F 8/30
CASE, software engineering tools; G06F 8/30

Compiling; G06F9/45

Concurrent instruction execution; G06F 9/38

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Patching of programs</th>
<th>G06F 9/328</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte-code verification</td>
<td>G06F 9/44589</td>
</tr>
<tr>
<td>Fault-tolerant software</td>
<td>G06F 11/1479</td>
</tr>
<tr>
<td>Hardware testing</td>
<td>G06F 11/22</td>
</tr>
<tr>
<td>Checking correct execution order of instructions</td>
<td>G06F 11/28</td>
</tr>
<tr>
<td>Performance evaluation</td>
<td>G06F 11/34</td>
</tr>
<tr>
<td>Computer aided design using simulation, modelling</td>
<td>G06F 17/50</td>
</tr>
<tr>
<td>Security checking or analysis</td>
<td>G06F 21/00</td>
</tr>
</tbody>
</table>

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bug</td>
<td>A bug in a program produces an incorrect or unexpected result, or causes the program to behave in unintended ways.</td>
</tr>
<tr>
<td>Software analysis</td>
<td>Software Analysis aims at verifying that a program or its specification satisfies certain properties without involving testing (no test inputs are provided to the program under analysis). It can involve for example scanning the source code and analysing the dependencies between the various components, or the use of certain variables, etc. It can consist in the use of formal methods, like model checking or theorem proving which aim at formally guaranteeing certain properties, for example that the program is well-typed, or deadlock free etc. In principle Software analysis does not require the program to execute (static analysis), but in some cases it does, for example to verify runtime properties.</td>
</tr>
<tr>
<td>Software testing</td>
<td>Software testing is the process of executing a program, or a discrete program unit, with the intent of finding errors. Tests can only reveal the presence of errors, but cannot ensure the absence of errors. When errors are detected in a program, one might want to start debugging it, i.e. locating precisely the error and correcting it. In both cases (testing and debugging), the program is executed.</td>
</tr>
<tr>
<td>Software debugging</td>
<td>Software debugging refers to the activity of locating an error.</td>
</tr>
</tbody>
</table>
**G06F 11/3604**

{Software analysis for verifying properties of programs (byte-code verification G06F 9/44589)}

**Definition statement**

*This place covers:*

Software Analysis aims at verifying that a program or its specification satisfies certain properties without involving testing (no test inputs are provided to the program under analysis). It can involve for example scanning the source code and analysing the dependencies between the various components, or the use of certain variables, etc. It can consist in the use of formal methods, like model checking or theorem proving which aim at formally guaranteeing certain properties, for example that the program is well-typed, or deadlock free etc. In principle Software analysis does not require the program to execute (static analysis), but in some cases it does, for example to verify runtime properties.

**G06F 11/3608**

{using formal methods, e.g. model checking, abstract interpretation (theorem proving G06N 5/006)}

**Definition statement**

*This place covers:*

Mathematically-based techniques (model checking, abstract interpretation, formal proof) for the verification of a program.

**G06F 11/3612**

{by runtime analysis (performance monitoring G06F 11/3466)}

**Definition statement**

*This place covers:*

Analysing runtime behaviour to detect errors (e.g. performance bug or infinite loops).

**G06F 11/3616**

{using software metrics}

**Definition statement**

*This place covers:*

A software metric is a measure of some property of a piece of software or its specifications, e.g. number of lines in the code, cyclomatic complexity (number of linearly independent paths through a program's source code), or any measure which aims at evaluating the properties of a program.

**References**

**Limiting references**

*This place does not cover:*

| Software metrics used during software generation | G06F 8/77 |
G06F 11/362
{Software debugging}

Definition statement
This place covers:
Software debugging is the activity of locating and correcting an error.

References
Limiting references
This place does not cover:

| Patching of programs | G06F 9/328 |

G06F 11/3624
{by performing operations on the source code, e.g. via a compiler}

Definition statement
This place covers:
Manual or compiler assisted instrumentation or by any automatic tool of the source code according to an instrumentation policy.

G06F 11/3628
{of optimised code (optimisation G06F 8/443)}

Definition statement
This place covers:
Usually the debugging process is performed on an un-optimised version of a program, and the program is optimised (by the compiler) when fully debugged. However, in some cases one wants to debug the optimised version of a program: for example, some bugs might occur in the optimised version of the code only. An obvious problem that an optimised code will create is when a developer sets a breakpoint in a part of code that has been eliminated by the compiler during optimisation.

G06F 11/3632
{of specific synchronisation aspects}

Definition statement
This place covers:
- Methods and arrangements for dealing with the synchronisation issues involved with debugging operations (e.g. when inserting a breakpoint in a multithreaded or distributed program).
- Method and arrangements for investigating synchronisation problems in distributed or multithreaded programs.
G06F 11/3636
{by tracing the execution of the program}

Definition statement
This place covers:
Methods and arrangements for generating or analysing traces of a program execution.

G06F 11/364
{tracing values on a bus}

Definition statement
This place covers:
Methods and arrangements for gathering or analysing data exchanged on a computer bus (e.g. data bus, memory bus) during the execution of a program.

G06F 11/3644
{by instrumenting at runtime}

Definition statement
This place covers:
• Instrumenting operations performed on a compiled program directly before execution (e.g. Valgrind).
• Runtime injection: the code is modified at runtime.

References
Limiting references
This place does not cover:
Instrumentation of Bytecodes

G06F 11/3648
{using additional hardware}

Definition statement
This place covers:
Hardware arrangements contributing to the debugging process

G06F 11/3652
{in-circuit-emulation [ICE] arrangements}

Definition statement
This place covers:
The term "In-Circuit Emulator" in this group only refers to a device replacing the target microprocessor. The code under debug is not executed on the real target processor but rather on a specific hardware
that emulates the target processor and that comprises debug facilities for setting breakpoints or watchpoints.

**Special rules of classification**

Nowadays, the term "In-Circuit Emulator" refers also to a JTAG or BDM based device which provides access to the internal registers of the target microprocessor. Said device can take control of the target microprocessor, start, stop or resume the code execution. The code under debug is executed on the real target microprocessor, in that case. If the technical contribution of a document refers to such a JTAG/BDM based device, this document should be classified in **G06F 11/3656** group (Debug interfaces).

**G06F 11/3656**

{using a specific debug interface}

**Definition statement**

*This place covers:*

Aspects related to communication between a host and a target (e.g. JTAG/BDM based "In-Circuit Emulator").

**Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTAG</td>
<td>Joint Test Action Group (JTAG) is the common name for what was later standardized as the IEEE 1149.1 Standard Test Access Port and Boundary-Scan Architecture. JTAG refers nowadays to a bus for transferring debug commands from a host to a target and debug data from the target to the host.</td>
</tr>
<tr>
<td>BDM</td>
<td>Background Debug Mode (BDM) interface is an electronic interface that allows debugging of embedded systems. BDM interface allows a Host to manage and query a target.</td>
</tr>
</tbody>
</table>

**G06F 11/366**

{using diagnostics (**G06F 11/0703** takes precedence)}

**Definition statement**

*This place covers:*

The aim of this group is to be able for example, to classify documents which have to do with software bugs, but not at the software development phase, afterwards. For example, if a system crashes during operation, it might be caused by a software bug. The system is diagnosed after the crash (or the failure) to find out where the bug was. This group might have overlap with the **G06F11/07P** and subgroups... e.g. analysis of core dumps, post-mortem debugging, memory leaks, and failure analysis.

**G06F 11/3664**

{Environments for testing or debugging software}

**Definition statement**

*This place covers:*

Environment, frameworks, Graphical User Interfaces or simulators that aim at supporting or facilitating the task of a user during the various phases of software testing or software debugging (e.g. to
navigate into the code, to or remove breakpoints, to visualize execution traces, to edit/maintain/archive test suites).

The environment may be comparable to a Software Development Environment but it contains features that are specific to the phases of software testing or debugging.

G06F 11/3668

{Software testing (software testing in telephone exchanges H04M 3/242, testing of hardware G06F 11/22)}

Definition statement

This place covers:

Software testing is the process of executing a program, or a discrete program unit, with the intent of finding errors.

References

Limiting references

This place does not cover:

| Software testing in telephone exchanges | H04M 3/242 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Testing of hardware | G06F 11/22 |

G06F 11/3672

{Test management}

Definition statement

This place covers:

The different activities of software testing:
• test case/script/scenario design (G06F 11/3684)
• test coverage analysis (G06F 11/3676)
• execution of the test cases/scripts/scenarii (G06F 11/3688)
• analysis of the test results (G06F 11/3692)
• maintenance and updates of the test cases/scripts/scenarii in parallel to the software evolution during software development (G06F 11/368)

Special rules of classification

The document should be classified according to the most relevant information concerning one activity of the software testing.
• if it is possible to identify one relevant piece of information related to one of the identified software testing activities, the document should be in classified in one of the corresponding subgroups: G06F 11/3676, G06F 11/368, G06F 11/3684, G06F 11/3688, G06F 11/3692.
• If it is not possible to extract any relevant information concerning any of the identified software testing activities, the document should be classified in the test management subgroup (G06F 11/3672)
G06F 11/3676
{for coverage analysis}

Definition statement
This place covers:
Coverage analysis is concerned with the degree to which test cases exercise or cover the logic of the program. Because testing is a time consuming activity that cannot be exhaustive, the key issue is to apply a subset of all possible test cases which has the highest probability of detecting errors. Coverage analysis is therefore an issue at the design stage (strategy for generating test inputs that are effective in terms of coverage) as well as at the execution stage (how to measure coverage).

Test coverage can refer to different aspects:
• path coverage
• data coverage
• line coverage

G06F 11/368
{for test version control, e.g. updating test cases to a new software version}

Definition statement
This place covers:
Maintenance and updates of test scripts in parallel to the evolution of the software during software development.

References
Limiting references
This place does not cover:
Version control; configuration management for creation of software

G06F 11/3684
{for test design, e.g. generating new test cases}

Definition statement
This place covers:
Generation or updates of test cases, scenarios, scripts. Specific languages for writing tests.

G06F 11/3688
{for test execution, e.g. scheduling of test suites}

Definition statement
This place covers:
Scheduling of the tests; recording of test results; regression testing; mutation testing.
G06F 11/3692
{for test results analysis}

Definition statement
This place covers:
Comparing the results of the tests with an oracle (assertions, mathematical models, simulations and the like).

G06F 11/3696
{Methods or tools to render software testable}

Definition statement
This place covers:
Arrangements for facilitating the testing of a software unit:
• Arrangement can be an interface to provide test inputs.
• Arrangement for simulating missing part of software or hardware that are necessary for performing the execution and the testing of the software unit.
• Arrangement for performing a time compression in order to simulate a long term execution of a software program in a short time frame
• Arrangement for performing the test execution on a different platform

G06F 12/00
Accessing, addressing or allocating within memory systems or architectures (digital input from, or digital output to record carriers, e.g. to disk storage units, **G06F 3/06**)

References

Limiting references
This place does not cover:

Accessing, addressing or allocation of record carriers, e.g. disk storage  **G06F 3/06**

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Memory management specially adapted to image processing</th>
<th><strong>G06T 1/60</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Static stores</td>
<td><strong>G11C</strong></td>
</tr>
</tbody>
</table>

Special rules of classification
Any classification rules applicable to a specific group also apply to any sub-groups thereof unless overruled by more specific rules.

When one or more sub-group definitions are listed in the definition statement of a group no further description of these sub-groups are provided in this FCR.

The group **G06F 12/00** contains no material and should not be used for classification.

Use of Indexing Codes:
All groups have corresponding G06F 12/00 Indexing Code-codes, which should be used for secondary aspects (non-invention information).

Indexing Scheme G06F 2212/00:

In November 2011 a new indexing scheme relating to G06F 12/00 has been introduced. The Indexing Codes from the range G06F 2212/20 - G06F 2212/7211 are mandatory when applicable. The code range G06F 2212/10 - G06F 2212/178 is not mandatory but should preferably be used for documents characterized by specific technical effects or applications.

Warning: The G06F 2212/00 indexing scheme is new and has not yet been systematically applied to the existing documentation except when explicitly indicated in this document.

G06F 12/00

Addressing or allocation; Relocation (program address sequencing G06F 9/00; arrangements for selecting an address in a digital store G11C 8/00)

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program address sequencing.</td>
<td>G06F 9/00</td>
</tr>
<tr>
<td>Low-level arrangements for selecting an address in a memory device.</td>
<td>G11C 8/00</td>
</tr>
</tbody>
</table>

Special rules of classification

G06F 12/02 should be used only for material not provided for in any of the sub-groups.

G06F 12/0207

{with multidimensional access, e.g. row/column, matrix}

Definition statement

This place covers:
Addressing or accessing memory in two or more dimensions, e.g. for transposing of data.
Addressing of rectangular blocks of data.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory systems specially adapted to graphics processing or display.</td>
<td>G06T, G09G</td>
</tr>
<tr>
<td>Memory systems specially adapted to video processing.</td>
<td>H04N</td>
</tr>
</tbody>
</table>
G06F 12/0215
{with look ahead addressing means}

Definition statement
This place covers:
Page mode addressing of DRAM.
Speculative addressing of a memory in general.

References

Limiting references
This place does not cover:
Prefetching to cache memory or use of dedicated prefetch buffers

Informative references
Attention is drawn to the following places, which may be of interest for search:
Memory controllers

G06F 12/0223
{User address space allocation, e.g. contiguous or non contiguous base addressing}

References

Limiting references
This place does not cover:
Module addressing

Informative references
Attention is drawn to the following places, which may be of interest for search:
Resource allocation

G06F 12/023
{Free address space management}

Definition statement
This place covers:
Dynamic memory allocation.
Explicit memory de-allocation.
Free space management.
**G06F 12/0238**

**{Memory management in non-volatile memory, e.g. resistive RAM or ferroelectric memory}**

**Definition statement**

*This place covers:*

Memory management in non-volatile memory that is not specific to flash memory, e.g. in emerging memory types such as resistive RAM or ferroelectric memory.

**G06F 12/0246**

**{in block erasable memory, e.g. flash memory}**

**Definition statement**

*This place covers:*

Addressing of flash memory, e.g. logical to physical address mapping;

Allocation within flash memory;

Management, e.g. cleaning, compacting, erasing, wear levelling;

Temporary storage of data, e.g. within volatile buffers or in buffer blocks.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Details</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Details of block management in an interface arrangement to a storage system</td>
<td>G06F 3/064</td>
</tr>
<tr>
<td>Details of file management in an interface arrangement to a storage system</td>
<td>G06F 3/0643</td>
</tr>
<tr>
<td>Details of the controller in an interface arrangement to a storage system making use of vertical data movement</td>
<td>G06F 3/0658</td>
</tr>
<tr>
<td>Details of the protocol conversion in an interface arrangement to a storage system making use of vertical data movement</td>
<td>G06F 3/0661</td>
</tr>
<tr>
<td>Interface arrangements for single solid-state devices</td>
<td>G06F 3/0679</td>
</tr>
<tr>
<td>Interface arrangements for hybrid storage devices, e.g. magnetic and semiconductor mediums sharing the same controller</td>
<td>G06F 3/068</td>
</tr>
<tr>
<td>Interface arrangements for storage system comprising multiple controllers and multiple storage medium types, e.g. SSD, HDD and tapes combined</td>
<td>G06F 3/0685</td>
</tr>
<tr>
<td>Interface arrangements for storage system comprising multiple controllers and multiple semiconductor storage devices, e.g. Hybrid storage array</td>
<td>G06F 3/0688</td>
</tr>
<tr>
<td>Write caching</td>
<td>G06F 12/0804, G06F 12/0866</td>
</tr>
<tr>
<td>Non-volatile memories</td>
<td>G11C 16/00</td>
</tr>
</tbody>
</table>
Special rules of classification

Indexing Codes G06F 2212/7201 - G06F 2212/7211 are used in this group. The coding of the existing documentation is mostly complete.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Page | The smallest data unit of read or write access in a NAND flash memory. |

G06F 12/0253

{Garbage collection, i.e. reclamation of unreferenced memory}

Definition statement

This place covers:

Automatic reclamation of heap-allocated memory after last use by a program, i.e. where the allocated memory is not explicitly freed by the program.

References

Limiting references

This place does not cover:

| Explicit freeing of memory | G06F 12/023 |
| Compaction and cleaning within flash memory | G06F 12/0246 |

Special rules of classification

The Indexing Code G06F 2212/702 should be used for conservative garbage collection. The coding of the existing documentation is mostly complete.

G06F 12/0284

{Multiple user address space allocation, e.g. using different base addresses (interprocessor communication G06F 15/163)}

Definition statement

This place covers:

Multi-user or multiprocessor address space allocation.

Mapping arrangements therefore, e.g. local to global address space mapping.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Virtual address translation | G06F 12/10 |
| Interprocessor communication | G06F 15/163 |
G06F 12/0292
{using tables or multilevel address translation means (G06F 12/023 takes precedence; address translation in virtual memory systems G06F 12/10)}

References

Limiting references
This place does not cover:

| Free address space management               | G06F 12/023 |
| Multiple user address space allocation      | G06F 12/0284 |
| Virtual memory address translation.         | G06F 12/10  |

G06F 12/04
Addressing variable-length words or parts of words

Definition statement
This place covers:
Addressing variable length words.
Addressing parts of a word, e.g. bit fields.
Addressing unaligned words.

References

Limiting references
This place does not cover:

| Address generation within processors        | G06F 9/34  |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Information transfer on a bus                | G06F 13/38 |

G06F 12/06
Addressing a physical block of locations, e.g. base addressing, module addressing, memory dedication (G06F 12/08 takes precedence)

Definition statement
This place covers:
Addressing or allocation of physical memory modules or banks.
Module selection, e.g. using chip selects.
References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addressing or allocation within a memory module.</td>
<td>G06F 12/0223</td>
</tr>
<tr>
<td>Hierarchical memory arrangements</td>
<td>G06F 12/08</td>
</tr>
</tbody>
</table>

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory controller.</td>
<td>G06F 13/16</td>
</tr>
<tr>
<td>Bank or array addressing within individual memory devices.</td>
<td>G11C 8/00, G11C 11/00</td>
</tr>
</tbody>
</table>

G06F 12/08
in hierarchically structured memory systems, e.g. virtual memory systems

Definition statement
This place covers:
Hierarchical memory systems.
Virtual memory.
Paging.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchically organised storage systems</td>
<td>G06F 3/06</td>
</tr>
<tr>
<td>Virtual address translation</td>
<td>G06F 12/10</td>
</tr>
<tr>
<td>Replacement control</td>
<td>G06F 12/12</td>
</tr>
</tbody>
</table>

G06F 12/0802
Addressing of a memory level in which the access to the desired data or data block requires associative addressing means, e.g. caches

Definition statement
This place covers:
Cache memories being part of a memory hierarchy. Information not provided for in the sub-groups is classified in this group, e.g. aspects relating to cache configuration, error handling or testing.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register cache (for register file).</td>
<td>G06F 9/30</td>
</tr>
</tbody>
</table>
Special rules of classification

Indexing Code groups G06F 2212/27, G06F 2212/30, G06F 2212/45, G06F 2212/60 are mandatory in this group when applicable.

G06F 12/0804

with main memory updating (G06F 12/0806 takes precedence)

Definition statement

This place covers:
Write-back of dirty data to main memory.
Saving or preservation of dirty data in case of errors or power failure
Write-back policies, e.g. selective write-through / write-back.

References

Limiting references

This place does not cover:
Multiuser, multiprocessor, multiprocessing cache systems e.g. write-back due to coherency protocol transactions.

Informative references

Attention is drawn to the following places, which may be of interest for search:

Data backup to prevent data loss.
Replacement policies

G06F 12/0806

Multiuser, multiprocessor or multiprocessing cache systems

Special rules of classification

Indexing Codes G06F 2212/62 are mandatory in this group.

G06F 12/0815

Cache consistency protocols

Definition statement

This place covers:
Cache coherency protocols, e.g. snooping, directory based or software controlled. Further details of subgroups

G06F 12/0833: this group is not used for classification of new material, use G06F 12/0831.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Memory consistency not specific to cache coherency. | G06F 9/46 |
| Locking for the purpose of program synchronization | G06F 9/52 |

Special rules of classification

The group G06F 12/0815 should only be used for material not provided for in any of the subgroups G06F 12/0817-G06F 12/0837.

**G06F 12/0844**

Multiple simultaneous or quasi-simultaneous cache accessing

Definition statement

This place covers:

Simultaneous processing of two or more accesses.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Pipeline techniques within processors | G06F 9/38 |
| Module addressing in general | G06F 12/06 |

**G06F 12/0862**

with prefetch

Definition statement

This place covers:

Prefetching in cache memory using fixed or adaptive prefetch strategies.

Software controlled prefetching using prefetch instructions.

Use of dedicated prefetch buffer or prefetch cache.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Compiling techniques to reduce cache misses | G06F 8/4442 |
| Instruction or operand prefetching within processors | G06F 9/38 |

Special rules of classification

For prefetching in disk caches this class should be combined with Indexing Code G06F 12/0866.
Indexing Code group **G06F 2212/602** is mandatory in this group. The coding of the existing documentation is mostly complete.

**G06F 12/0864**

using pseudo-associative means, e.g. set-associative or hashing

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

| Page mode accessing of cache | G06F 12/0882 |

**Special rules of classification**

Indexing Code **G06F 2212/6032** is mandatory for material dealing with way prediction. The coding of the existing documentation is mostly complete.

**G06F 12/0866**

for peripheral storage systems, e.g. disk cache

**Definition statement**

This place covers:

- Dedicated cache memory within storage controller or storage device;
- Caching of network attached storage or remote server content;
- Disk caching in main memory of host computer, e.g. by operating system.

**References**

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

| Storage adapters, disk storage management | G06F 3/06 |
| Data buffering arrangements for data transfers within storage systems | G06F 3/0656 |
| Caching of dynamically generated data content, e.g. web caching, database query results | G06F 16/00 |
| Temporary data storage in networks | H04L 67/2842 |

**Special rules of classification**

Indexing Code groups **G06F 2212/21, G06F 2212/22, G06F 2212/26, G06F 2212/28, G06F 2212/31** and **G06F 2212/46** are mandatory in this group.

If the invention information can be fully classified in other group(s) it is recommended to add only Indexing Code **G06F 12/0866**.
G06F 12/0868
Data transfer between cache memory and other subsystems, e.g. storage devices or host systems

Definition statement
This place covers:
Data transfer control within the cache system, between the cache and the storage devices or between the cache and the host system.
E.g. concurrent transfers, internal buffering arrangements, pipelining.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write back control</td>
<td>G06F 12/0804</td>
</tr>
<tr>
<td>Replacement control</td>
<td>G06F 12/12</td>
</tr>
</tbody>
</table>

G06F 12/0871
Allocation or management of cache space

Definition statement
This place covers:
Allocation of cache space.
Organisation of cache data, data structures therefore.
Free space management within cache.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement control</td>
<td>G06F 12/12</td>
</tr>
</tbody>
</table>

G06F 12/0873
Mapping of cache memory to specific storage devices or parts thereof

Definition statement
This place covers:
Selective allocation of (parts of) cache memory space to specific storage devices or parts of such devices.
This group is limited to large granularity mapping of cache areas to portions of a storage system, e.g. allocating cache partitions to individual storage devices.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

- Set-associative or similar mappings of individual cache entries to storage device locations.

G06F 12/0875

with dedicated cache, e.g. instruction or stack

Definition statement

This place covers:
Cache memories adapted for particular applications or specific types of data, e.g. stack caches, instruction caches, caches for graphics information.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

- Branch history cache, branch target cache

Special rules of classification

Indexing Code group G06F 2212/45 is used in this group.

Warning: Except for G06F 2212/451 these codes have not yet been allocated to the existing documentation.

G06F 12/0877

Cache access modes

Definition statement

This place covers:
Special access modes to cache memory, e.g. burst mode access, partial line accessing.

G06F 12/0888

using selective caching, e.g. bypass

Definition statement

This place covers:
Selective or conditional caching of data, e.g. based on expected usefulness of caching;
Bypassing of cache.
**G06F 12/0891**

**using clearing, invalidating or resetting means**

**Definition statement**

*This place covers:*

Invalidation of the entire cache memory content or parts of the cache memory content, e.g. upon initialization or task switching;

Hardware techniques for cache memory invalidation.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Indexing Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main memory updating, e.g. flushing of cache content</td>
<td>G06F 12/0804</td>
</tr>
<tr>
<td>Invalidation forming part of a cache coherency protocol</td>
<td>G06F 12/0815</td>
</tr>
<tr>
<td>Initialisation circuits for static stores</td>
<td>G11C 7/20, G11C 11/40</td>
</tr>
</tbody>
</table>

**G06F 12/0893**

**Caches characterised by their organisation or structure**

**Definition statement**

*This place covers:*

Cache topology;

Cache structurally integrated within a memory device, e.g. DRAM row cache;

Cache employing DRAM or other technology than SRAM.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Indexing Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static stores in general</td>
<td>G11C</td>
</tr>
</tbody>
</table>

**Special rules of classification**

Indexing Code **G06F 2212/305** is mandatory for memory with integrated cache memory, e.g. cache DRAM. The coding of the existing documentation is mostly complete.

Indexing Code groups **G06F 2212/22** and **G06F 2212/27** are used in this group.

**G06F 12/10**

**Address translation**

**Definition statement**

*This place covers:*

Virtual to physical address translation;
Translation fault handling;

Virtual address space management, see provisionally also G06F 12/0284.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Term</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual machines.</td>
<td>G06F 9/455</td>
</tr>
<tr>
<td>Logical partitioning</td>
<td>G06F 9/50</td>
</tr>
<tr>
<td>Address mapping within flash memory</td>
<td>G06F 12/0246</td>
</tr>
<tr>
<td>Multi-user or multiprocessor address space allocation</td>
<td>G06F 12/0284</td>
</tr>
<tr>
<td>Address mapping or translation in general, not specific to virtual memory</td>
<td>G06F 12/0292</td>
</tr>
</tbody>
</table>

Special rules of classification

Indexing Codes G06F 2212/65-G06F 2212/657 are used in this group. The coding of the existing documentation is mostly complete.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page</td>
<td>The unit of paging in virtual memory</td>
</tr>
</tbody>
</table>

G06F 12/1027

using associative or pseudo-associative address translation means, e.g. translation look-aside buffer [TLB]

Definition statement

This place covers:

Caching of address translations;

TLB miss handling.

Special rules of classification

Indexing Code group G06F 2212/681-G06F 2212/684 is used in this group. The coding of the existing documentation is mostly complete.

Replacement control for TLB’s is classified in G06F 12/12-G06F 12/128. An Indexing Code G06F 12/1027 should be allocated in such cases.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLB</td>
<td>Translation Look-aside Buffer</td>
</tr>
<tr>
<td>MMU</td>
<td>Memory Management Unit</td>
</tr>
</tbody>
</table>
**G06F 12/1081**

for peripheral access to main memory, e.g. direct memory access [DMA]

**Definition statement**

*This place covers:*

Address translation for peripheral devices, channels, I/O adapters, network adapters, DMA controllers etc.

Memory management units within such devices or interfaces.

**G06F 12/109**

for multiple virtual address spaces, e.g. segmentation (G06F 12/1036 takes precedence)

**Definition statement**

*This place covers:*

Translation for multiple virtual address spaces, e.g. identified by an address space identifier;

Segmentation based on a segment identifier;

Guest address space to host address space translation.

**Special rules of classification**

Indexing Codes G06F 2212/656 and G06F 2212/657 are particularly relevant in this group.

**G06F 12/12**

Replacement control

**Definition statement**

*This place covers:*

Replacement control in virtual memory, cache memory or TLB.

Replacement algorithms.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Write back control in cache | G06F 12/0804 |

**Synonyms and Keywords**

*In patent documents, the following abbreviations are often used:*

<table>
<thead>
<tr>
<th>LFU</th>
<th>Least Frequently Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRU</td>
<td>Least Recently Used</td>
</tr>
<tr>
<td>MRU</td>
<td>Most Recently Used</td>
</tr>
<tr>
<td>FIFO</td>
<td>First In First Out</td>
</tr>
</tbody>
</table>
G06F 12/14

Protection against unauthorised use of memory {or access to memory}

Definition statement

This place covers:
Preventing unauthorized access to memory content.

Virtual memory access control.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Multiprogramming arrangements</th>
<th>G06F 9/46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program synchronization, e.g. using locks; mutual exclusion</td>
<td>G06F 9/52</td>
</tr>
<tr>
<td>Security arrangements in computers</td>
<td>G06F 21/00</td>
</tr>
<tr>
<td>Coded identity card or credit card</td>
<td>G07F 7/08</td>
</tr>
<tr>
<td>Secure communication</td>
<td>H04L 9/00</td>
</tr>
</tbody>
</table>

G06F 12/1408

{by using cryptography (for digital transmission H04L 9/00)}

Definition statement

This place covers:
Address scrambling;
Data encryption within a memory, e.g. being dependent on the memory location.

References

Limiting references

This place does not cover:

| Data encryption being independent of the memory location | G06F 21/00 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Secure communication | H04L 9/00 |
G06F 12/1416
{by checking the object accessibility, e.g. type of access defined by the memory independently of subject rights (G06F 12/1458 takes precedence)}

Definition statement
This place covers:
Memory protection being independent of the subject identity, e.g. physical write protection of a memory.

References

Limiting references
This place does not cover:

| By checking the subject access rights | G06F 12/1458 |

G06F 12/1458
{by checking the subject access rights}

Definition statement
This place covers:
Memory protection in which the protection depends on the subject identity, e.g. using an access list.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Access list protection in general | G06F 21/00 |

G06F 12/16
Protection against loss of memory contents {contains no material, see G06F 11/00}

Relationships with other classification places
This group is not used for classification and contains no material. Documents relating to protection against loss of memory content are classified within main group G06F 11/00, in particular in the groups G06F 11/14 or G06F 11/16.

References

Limiting references
This place does not cover:

| Protection against loss of memory contents | G06F 11/00 |
G06F 13/00

Interconnection of, or transfer of information or other signals between, memories, input/output devices or central processing units (interface circuits for specific input/output devices G06F 3/00; multiprocessor systems G06F 15/16 (multiprogram control therefor G06F 9/46))

Definition statement

This place covers:
Interconnection of, or transfer of information or other signals between, memories, input/output devices or central processing units.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface circuits for specific input/output devices</td>
<td>G06F 3/00</td>
</tr>
<tr>
<td>Multiprogram control therefor</td>
<td>G06F 9/46</td>
</tr>
<tr>
<td>Multi-processor systems</td>
<td>G06F 15/16</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission of digital information in general</td>
<td>H04L</td>
</tr>
<tr>
<td>Synchronisation in transmission of digital information in general</td>
<td>H04L 7/00</td>
</tr>
<tr>
<td>Bus networks</td>
<td>H04L 12/40</td>
</tr>
<tr>
<td>Selecting</td>
<td>H04Q</td>
</tr>
</tbody>
</table>

G06F 13/28

using burst mode transfer, e.g. direct memory access (DMA), cycle steal (G06F 13/32 takes precedence)

Definition statement

This place covers:
Handling requests for interconnection or transfer using burst mode transfer, e.g. direct memory access.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to input/output bus using combination of interrupt and burst mode transfer</td>
<td>G06F 13/32</td>
</tr>
</tbody>
</table>
Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote DMA</td>
<td>H04L 12/06</td>
</tr>
</tbody>
</table>

G06F 13/38
Information transfer, e.g. on bus (G06F 13/14 takes precedence)

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling requests for interconnection or transfer</td>
<td>G06F 13/14</td>
</tr>
</tbody>
</table>

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus networks</td>
<td>H04L 12/40</td>
</tr>
</tbody>
</table>

G06F 13/382
{using universal interface adapter}

Definition statement
This place covers:
Information transfer, e.g. on bus using universal interface adapter.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital I/O from or to direct access storage devices</td>
<td>G06F 3/0689</td>
</tr>
<tr>
<td>Wireless network data management</td>
<td>H04W</td>
</tr>
</tbody>
</table>

Special rules of classification
The information transfer is between components in a computer. Therefore, documents classified in this subgroup should relate to a data transfer in, to or from a computer.

G06F 13/4004
{Coupling between buses}

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network bridges</td>
<td>H04L 12/46</td>
</tr>
</tbody>
</table>
G06F 13/4063
{Device-to-bus coupling}

Relationships with other classification places
Documents classified in this subgroup can also be related to some pins configuration, and more also to system configuration.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Booting configuration | G06F 9/445 |

G06F 13/4081
{Live connection to bus, e.g. hot-plugging (current or voltage limitation during live insertion H02H 9/004)}

Definition statement
This place covers:
Bus structure electrical coupling between device and bus; Live connection to bus, e.g. hot plugging.

References
Limiting references
This place does not cover:

| Current or voltage limitation during live insertion | H02H 9/004 |

Special rules of classification
Documents related to detection of presence and/or type of connected peripheral can be classified in this subgroup.

G06F 13/409
{Mechanical coupling (back panels H05K 7/1438)}

Definition statement
This place covers:
Bus structure based on a mechanical coupling between device and bus.

References
Limiting references
This place does not cover:

| Back panels | H05K 7/1438 |
**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Computer enclosure</th>
<th>G06F 1/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical connector</td>
<td>H01R 13/00</td>
</tr>
</tbody>
</table>

**Special rules of classification**

Documents related to mechanical coupling between a computer component and a bus can be classified in this subgroup, e.g. coupling of connectors or boards to a computer bus.

**G06F 13/42**

Bus transfer protocol, e.g. handshake; Synchronisation

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Characterised by a protocol | H04L 29/06 |

**G06F 15/00**

Digital computers in general (details G06F 1/00 – G06F 13/00); Data processing equipment in general

**References**

**Limiting references**

This place does not cover:

| Details of digital computers | G06F 1/00- G06F 13/00 |
| Neural networks for image data processing | G06T |

**G06F 15/02**

manually operated with input through keyboard and computation using a built-in program, e.g. pocket calculators

**Definition statement**

This place covers:

Pocket calculators, e-books, PDA.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Constructional details or arrangements for portable computers | G06F 1/1613 |
| Input arrangements or combined input and output arrangements for interaction between user and computer | G06F 3/01 |
Special rules of classification

When a document qualifies for one of the groups below, **G06F 15/02** should not be assigned:

For combination with other devices having a different main function, e.g. watches, pens: **G06F 15/0208**

Constructional details or arrangements: **G06F 15/0216**

User interface arrangements, e.g. keyboard, display; Interfaces to other computer systems: **G06F 15/0225**

With printing provisions: **G06F 15/0233**

Of the IC-card-like type: **G06F 15/0241**

Adapted to a specific application: **G06F 15/025**

For unit conversion: **G06F 15/0258**

For time management, e.g. calendars, diaries: **G06F 15/0266**

For measuring: **G06F 15/0275**

For data storage and retrieval: **G06F 15/0283**

For reading: **G06F 15/0291**

**G06F 15/16**

**Combinations of two or more digital computers each having at least an arithmetic unit, a program unit and a register, e.g. for a simultaneous processing of several programs {coordinating program control therefor G06F 9/52; in regulating and control system G05B}**

Definition statement

This place covers:

MIMD, SPMD Architectures.

Relationships with other classification places

Documents classified in this subgroup can also be related to digital computers for regulating and control system (**G05B**).

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Coordinating program control therefor</th>
<th>G06F 9/52</th>
</tr>
</thead>
<tbody>
<tr>
<td>In regulating and control system</td>
<td>G05B</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Constructional details on portable computers, PDAs</th>
<th>G06F 1/1613</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initialization of multiprocessor systems.</td>
<td>G06F 9/4405</td>
</tr>
</tbody>
</table>
### Special rules of classification

When a document qualifies for one of the groups below, none of the groups above should be assigned:

- Computing Infrastructure, e.g. cluster racks: **G06F 15/161**
- Inter-processor communication: **G06F 15/163**
- Using a common memory e.g. mailbox, dual port memory, UMA, NUMA architectures: **G06F 15/167**
- Using an interconnection network e.g. message passing architectures: **G06F 15/173**
- Direct connection machines e.g. point to point topologies, buses, (partial) crossbars: **G06F 15/17337**
- Being dynamically configurable e.g. loosely coupled nearest neighbour architecture: **G06F 15/17343**
- Indirect interconnection networks (one or several nodes are traversed before reaching destination): **G06F 15/17356**
- Hierarchical e.g. trees, pyramids: **G06F 15/17362**
Non-hierarchical: G06F 15/17368

On one dimension e.g. linear arrays, rings: G06F 15/17375

On two dimensions e.g. mesh, torus: G06F 15/17381

Topologies not covered by groups G06F 15/17375 or G06F 15/17381: G06F 15/17387

Intercommunication techniques specific to parallel machines: G06F 15/17306

Routing: G06F 15/17312

Collective communications e.g. gather/scatter, broadcast, multicast, all to all: G06F 15/17318

Synchronization, hardware support therefore: G06F 15/17325

Distributed shared memory, hardware support therefore e.g. RDMA: G06F 15/17331

Details on network interfaces: G06F 15/1735

Initialisation or configuration control: G06F 15/177

**G06F 15/163**

**Interprocessor communication**

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Interconnection of, or transfer of information or other signals between, memories, input/output devices or central processing units | G06F 13/00 |

**G06F 15/76**

**Architectures of general purpose stored program computers (with program plugboard G06F 15/08; multicomputers G06F 15/16)**

**Definition statement**

This place covers:

System on Board, System on Chip, Reconfigurable Architectures, Data-Parallel Architectures (Vector Architectures, SIMD, Systolic Arrays), Dataflow Architectures, Demand Driven Architectures.

**Relationships with other classification places**

Documents classified in this subgroup can also be related to general purpose image data processing (G06T).

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Digital computers with program plugboard</th>
<th>G06F 15/08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multicomputers</td>
<td>G06F 15/16</td>
</tr>
</tbody>
</table>
Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

| Processor architectures; Processor configuration for image data processing | G06T 1/20 |

Special rules of classification

Comprising a single central processing unit: G06F 15/78

System on Board: computer system on one or more PCB e.g. motherboards, daughterboards, blades: G06F 15/7803

System on Chip: computer system on a single chip: G06F 15/7807

System in Package: computer system on a number of chips in a single package: G06F 15/7807

On-chip cache, off-chip memory: G06F 15/781

Specially adapted for real time processing e.g. comprising hardware timers: G06F 15/7814

Specially adapted for signal processing e.g. Harvard Architectures: G06F 15/7817

Tightly coupled to memory e.g. computational memory, smart memory, processor in memory: G06F 15/7821

Globally asynchronous, locally synchronous e.g. Network on Chip: G06F 15/7825

Reconfigurable architectures: G06F 15/7867

Reconfiguration support e.g. configuration loading, configuration switching (hardware OS): G06F 15/7871

Self reconfiguration: G06F 15/7882

Multiple Contexts: G06F 15/7875

Pipeline reconfiguration: G06F 15/7878

Runtime Interface e.g. data exchange, runtime control: G06F 15/7885

Embedded in CPU as a functional unit: G06F 15/7892

As a coprocessor: G06F 15/7889

Modular architectures e.g. assembled from a number of identical packages: G06F 15/7896

Comprising an array of processing units with common control, e.g. single instruction multiple data processors: G06F 15/80

SIMD multiprocessors: G06F 15/8007

One dimensional arrays e.g. rings, linear arrays, buses: G06F 15/8015

Two dimensional arrays, i.e. mesh, torus: G06F 15/8023

Other topologies e.g. hypercubes: G06F 15/803

Associative processors: G06F 15/8038
Systolic arrays: G06F 15/8046

Vector Processors: G06F 15/8053

Details on exchanging data with memory: G06F 15/8061

Using a cache: G06F 15/8069

Details on exchanging data with registers: G06F 15/8076

Special arrangements thereof, e.g. mask, switch: G06F 15/8084

Array of vector units: G06F 15/8092

Data or demand driven: G06F 15/82

Dataflow computers: G06F 15/825

Here are specified the places which could be assigned in addition to the places above to cover further technical details:

Indexing Code G06F 3/0604 finite state machines: controlled by or implementing FSM

**G06F 17/10**

**Complex mathematical operations** {(function generation by table look-up G06F 1/03; evaluation of elementary functions by calculation G06F 7/544)}

**Definition statement**

*This place covers:*

Algorithms for:

- performing complex mathematical operations (e.g. matrix-vector multiplication G06F 17/16, discrete Fourier transform G06F 17/141);
- solving generic mathematical problems (e.g. system of linear equations G06F 17/12);
- manipulating mathematical objects (e.g. matrix factorization G06F 17/16);

evaluating complex mathematical functions (e.g. by interpolation of known function values G06F 17/17);

- computing statistical descriptions of data sets (e.g. histogram computation G06F 17/18)
- mathematical analysis of data not provided elsewhere (e.g. mathematical spectral analysis algorithms based on the discrete Fourier transform G06F 17/141) and the implementation of such algorithms
- as computer programs (for general-purpose digital processors), eventually with specially adapted data structures for storing the mathematical objects upon which the operations are performed (e.g. specific matrix storage formats), or
- as dedicated digital hardware circuits, described on the level of adders, subtractors, multiplexers, etc.

The groups in G06F 17/10 are function-oriented and are intended to cover mathematical methods and devices which are in principle not tied to a particular application field.

To be classified in G06F 17/10 and subgroups, a document should not merely disclose how a (technical) problem in an application field is reduced to a particular mathematical problem (e.g. a particular set of equations) but it must also disclose details of the mathematical algorithm used to solve this particular mathematical problem. Furthermore, the mathematical problem and/or the mathematical algorithm used to solve it should also be sufficiently generic in the sense that they may
be relevant outside the particular application field (even if this fact is not mentioned in the document itself).

Subject-matter classified in group G06F 17/10 itself (because it does not fall in any of the subgroups) includes among others:

- Numerical computation of the derivative of a function;
- Numerical integration of a function, e.g. Using monte-carlo methodology;
- Methods enabling symbolic mathematical calculations, e.g. In computer algebra systems;
- Graph algorithms not classified elsewhere.

Relationships with other classification places
When a document discloses a mathematical algorithm applied in a particular application field, classification in the relevant application-related group(s) should also be considered.

References

Limiting references
This place does not cover:

| Function generation working, at least partially, by table look-up | G06F 1/03 |
| Computational arithmetic, e.g.number representation systems (e.g. conversion between number formats, rounding issues in fixed-point / floating-point arithmetic) implementation of arithmetic operations (addition, subtraction, multiplication, division), also for complex numbers (e.g. using CORDIC) | G06F 7/00 |
| Evaluation of elementary functions (e.g. trigonometric functions, power, roots, logarithmic and exponential functions) by calculation | G06F 7/544 |
| Arithmetic circuits for sum of products per se, e.g. multiply-accumulators (MACs) | G06F 7/5443 |
| Arithmetic logic units (ALUs) | G06F 7/57 |
| Generation of random or pseudo-random numbers | G06F 7/58 |
| Digital differential analysers | G06F 7/64 |
| Computational residue arithmetic, e.g. modular inversion or exponentiation;computational elliptic curve arithmetic | G06F 7/72 |
| Basic logic circuits (e.g. AND, NAND, OR) | H03K 19/00 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Computer-aided design and simulation | G06F 17/50 |
| Reservoir modelling | E21B 49/00 |
| Geophysics, seismic data analysis | G01V 1/28 |
| Pattern recognition, e.g. classification algorithms | G06K 9/00 |
| Neural networks | G06N 3/02 |
| Genetic algorithms | G06N 3/128 |
| Computer systems using knowledge base models | G06N 5/00 |
| Computer systems based on specific mathematical models | G06N 7/00 |
| Probabilistic networks, e.g. Bayesian networks | G06N 7/005 |
Using fuzzy logic: G06N 7/02
Image processing: G06T
Digital filters: H03H 17/00
Data compression in general: H03M 7/30
Coding/decoding in general: H03M 13/00
Decoding based on Viterbi algorithm: H03M 13/41

**Special rules of classification**

A document disclosing a device which is configurable to perform several complex mathematical operations (e.g. a circuit configurable to perform either a DFT or a convolution operation) is to be classified in the relevant groups (G06F 17/141 and G06F 17/15) if the document discloses details of the computations which are specific to the different mathematical operations. However, if no such details are provided, the document is to be classified only in the broadest group covering these operations. For example, a document disclosing a circuit able to perform any linear transform, including DFT and DCT, without providing details specific to the DFT or DCT computations, is to be classified only in G06F 17/14.

**G06F 17/11**

for solving equations {, e.g. nonlinear equations, general mathematical optimization problems (optimization specially adapted for a specific administrative, business or logistic context G06Q 10/04)}

**Definition statement**

*This place covers:*

- Solving non-linear equations (e.g. By iterative methods)
- Mathematical algorithms for solving general mathematical optimization problems (e.g. Linear, non-linear, mixed-integer or combinatorial optimization problems)

**Relationships with other classification places**

The use of mathematical optimization to solve a problem in an administrative, business or logistic context is usually classified in G06Q 10/04. However, if the document provides also details regarding the mathematical algorithm used for solving the resulting mathematical optimization problem and if the mathematical optimization problem and/or the mathematical algorithm are sufficiently generic (i.e. if they may be relevant outside the particular application context), the document should also be classified in G06F 17/11.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Computer-aided design, e.g. circuit design, network design | G06F 17/50 |
| Dynamic search techniques, heuristics, branch-and-bound used in computer systems utilising knowledge based models | G06N 5/003 |
| Optimization specially adapted for a specific administrative, business or logistic context | G06Q 10/04 |
**G06F 17/12**

Simultaneous equations {, e.g. systems of linear equations}

**Definition statement**

*This place covers:*

Methods for solving systems of linear equations $Ax=b$, e.g. by direct or iterative methods.

**Special rules of classification**

Details of matrix factorization algorithms or matrix storage formats used in the context of a specific method for solving a system of linear equations are additionally classified in G06F 17/16 if they are per se relevant.

---

**G06F 17/13**

Differential equations (using digital differential analysers G06F 7/64)

**Definition statement**

*This place covers:*

• Solving ordinary or partial differential equations.

• Qualitative analysis of dynamical systems, e.g. Determining attractors.

**References**

*Limiting references*

*This place does not cover:*

| Solving differential equations using digital differential analysers | G06F 7/64 |

*Informative references*

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Computer-aided design</th>
<th>G06F 17/50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation using finite difference or finite element methods</td>
<td>G06F 17/5018</td>
</tr>
<tr>
<td>Adaptive control systems</td>
<td>G05B 13/00</td>
</tr>
<tr>
<td>Creation and adaptation of a mathematical model used to control a system</td>
<td>G05B 17/00</td>
</tr>
</tbody>
</table>

---

**G06F 17/14**

Fourier, Walsh or analogous domain transformations {, e.g. Laplace, Hilbert, Karhunen-Loeve, transforms (for correlation function computation G06F 17/156; spectrum analysers G01R 23/16)}

**Definition statement**

*This place covers:*

• Efficient computation of domain transforms

• By extension, G06F 17/14 and its subgroups (in particular G06F 17/141 and G06F 17/148) do also include
• General mathematical algorithms for spectral analysis based on a domain transform (e.g. a method for DFT resolution enhancement by zero-padding is classified in G06F 17/141)
• Domain transforms not covered by its subgroups, e.g. Laplace, Hilbert or Karhunen-Loève transforms. It does also cover devices enabling computation of broad classes of domain transforms.

References

Limiting references

This place does not cover:

| Correlation function computation using a domain transform | G06F 17/156 |
| Spectral and Fourier analysis devices, e.g. digital spectrum analysers, in which the focus is on the electrical signal measurement apparatus and not on a mathematical spectral analysis algorithm | G01R 23/16 |
| Frequency selective networks using specific transformation algorithms | H03H 17/0211 |

G06F 17/141

{Discrete Fourier transforms}

Definition statement

This place covers:

• Discrete Fourier Transform (DFT) computation, e.g. partial DFT, Goerzel method, recursive DFT computation, short-time DFT

Fast Fourier Transform (FFT) and Prime Factor algorithms for computing the DFT and corresponding devices are classified in subgroups.

By extension, G06F 17/141 also includes:

• general mathematical algorithms for spectral analysis based on the DFT, e.g. DFT resolution enhancement by zero-padding

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Multi-carrier modulation systems | H04L 27/2601 |
| Inverse Fourier transform modulators | H04L 27/2628 |
| IFFT/IDFT in combination with other circuits for modulation | H04L 27/2634 |
| Fourier transform demodulators | H04L 27/265 |

G06F 17/142

{Fast Fourier transforms, e.g. using a Cooley-Tukey type algorithm}

Definition statement

This place covers:

• DFT computation by means of a Fast Fourier Transform (FFT) algorithm, e.g. Cooley-Tukey or mixed-radix type
• processing elements specially adapted for FFT butterfly operations
• memory addressing schemes specially adapted for FFT computation

G06F 17/144

{Prime factor Fourier transforms, e.g. Winograd transforms, number theoretic transforms}

Definition statement

This place covers:
• prime factor algorithm (PFA) or Good-Thomas algorithm
• Winograd Fourier transform algorithm (WFTA)

G06F 17/145

{Square transforms, e.g. Hadamard, Walsh, Haar, Hough, Slant transforms}

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Direct-sequence spread-spectrum techniques, e.g. CDMA | H04B 1/707 |

G06F 17/147

{Discrete orthonormal transforms, e.g. discrete cosine transform, discrete sine transform, and variations therefrom, e.g. modified discrete cosine transform, integer transforms approximating the discrete cosine transform (G06F 17/145 takes precedence)}

Definition statement

This place covers:
• Discrete Cosine Transform (DCT)
• Discrete Sine Transform (DST)
• Modified Discrete Cosine Transform (MDCT)
• Integer transforms approximating the DCT, e.g. IntDCT

References

Limiting references
Attention is drawn to the following places, which may be of interest for search:

| Square transforms, e.g. Hadamard transform | G06F 17/145 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Coding or decoding of speech or audio signals | G10L 19/00 |
| Discrete cosine transform modulators in multi-carrier modulation systems | H04L 27/2639 |
| Transform-based video coding | H04N 19/60 |
| The transform being DCT | H04N 19/625 |
**G06F 17/148**

**{Wavelet transforms}**

**Definition statement**

*This place covers:*
- Fast Wavelet Transform.
- Integer Wavelet Transform.

**References**

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Transform-based video coding, the transform being sub-band based, e.g. wavelets | H04N 19/63 |

**G06F 17/15**

**Correlation function computation {including computation of convolution operations (arithmetic circuits for sum of products per se, e.g. multiply-accumulators G06F 7/5443; digital filters, e.g. FIR, IIR, adaptive filters H03H 17/00)}**

**Definition statement**

*This place covers:*
- Correlation computations, e.g. Sliding correlation, cross-correlation, auto-correlation
- Convolution operations

**References**

**Limiting references**

*This place does not cover:*

| Arithmetic circuits for sum of products per se, e.g. multiply-accumulators (MACs) | G06F 7/5443 |

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Pattern recognition | G06K 9/00 |
| Convolution neural network | G06N 3/02 |
| Digital filters, e.g. FIR, IIR, adaptive filters | H03H 17/00 |
| Direct-sequence spread-spectrum techniques, e.g. CDMA | H04B 1/707 |
G06F 17/153

{Multidimensional correlation or convolution}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Convolution neural network                          | G06N 3/02 |
| Image enhancement, e.g. noise filtering, using multidimensional convolution operations | G06T 5/00 |

G06F 17/156

{using a domain transform, e.g. Fourier transform, polynomial transform, number theoretic transform}

Definition statement

This place covers:

FFT-based correlation and convolution.

G06F 17/16

Matrix or vector computation {, e.g. matrix-matrix or matrix-vector multiplication, matrix factorization (matrix transposition G06F 7/78)}

Definition statement

This place covers:

• Matrix-matrix multiplication
• Matrix-vector multiplication
• Vector product, dot product computation
• Matrix inversion
• Matrix factorization, e.g. Svd, lu, qr, cholesky decompositions
• Matrix storage formats, e.g. For sparse matrices
• Software and hardware implementations thereof, e.g. a systolic array specially adapted for QR decomposition.

References

Limiting references

This place does not cover:

| Matrix transposition                         | G06F 7/78 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Arrangements for executing machine-instructions | G06F 9/30 |
| To perform operations on data operands, e.g. arithmetic instructions | G06F 9/30007 |
Concurrent instruction execution using a plurality of independent parallel functional units, e.g. SIMD, MIMD | G06F 9/3885
---
Architecture of general-purpose stored program computer | G06F 15/76
---
Reconfigurable architectures | G06F 15/7867
---
Architectures comprising an array of processing units, e.g. single instruction multiple data (SIMD) processors | G06F 15/80
---
Systolic arrays | G06F 15/8046
---
Vector processors | G06F 15/8053
---
Solving simultaneous equations, e.g. systems of linear equations | G06F 17/12

### G06F 17/17

Function evaluation by approximation methods, e.g. inter- or extrapolation, smoothing, least mean square method (G06F 17/18 takes precedence) ; interpolation for numerical control G05B 19/18

### References

#### Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating statistical data, e.g. function fitting based on least-mean squares method</td>
<td>G06F 17/18</td>
</tr>
<tr>
<td>Interpolation for numerical control</td>
<td>G05B 19/18</td>
</tr>
</tbody>
</table>

#### Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital function generation working, at least partially, by table look-up; reduction of look-up table size</td>
<td>G06F 1/03</td>
</tr>
</tbody>
</table>

### G06F 17/175

{of multidimensional data}

#### References

#### Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometric Image transformation, e.g. interpolation-based scaling</td>
<td>G06T 3/00</td>
</tr>
</tbody>
</table>
**G06F 17/18**

for evaluating statistical data {e.g. average values, frequency distributions, probability functions, regression analysis (forecasting specially adapted for a specific administrative, business or logistic context G06Q 10/04)}

**Definition statement**

*This place covers:*

- Computing the (running) average of a set of data.
- Computation of confidence intervals.
- Computing a probability density function, e.g. An histogram, for a set of data.
- Regression analysis, e.g. Least-mean square methods for fitting a function to statistical data.
- General statistical analysis methods not covered elsewhere.

**References**

**Limiting references**

*This place does not cover:*

| Computing the maximum, minimum or median value of a set of data | G06F 7/22 |

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Pattern recognition using clustering techniques | G06K 9/6217 |
| Forecasting specially adapted for a specific administrative, business or logistic context | G06Q 10/04 |
| Bioinformatics | G16B |
| Healthcare informatics | G16H |

**G06F 17/20**

Handling natural language data (speech analysis or synthesis G10L)

**Definition statement**

*This place covers:*

- Text and natural language processing,
- Natural language understanding and translation,
- Processing of markup language,
- Spreadsheets.

**Relationships with other classification places**

The mere use of XML or other markup language, e.g. as a file format for functional data such as configuration files, should not be classified here, but rather in the field in which the data is actually used.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parser generation for computer code</td>
<td>G06F 8/37</td>
</tr>
<tr>
<td>Parsing of computer code</td>
<td>G06F9/45</td>
</tr>
<tr>
<td>Translation, e.g. compilation, of computer code</td>
<td>G06F9/45</td>
</tr>
<tr>
<td>Tape / Label printers (hardware)</td>
<td>B41J 3/4075</td>
</tr>
<tr>
<td>Translation to/from Braille or sign language</td>
<td>G09B 21/00</td>
</tr>
<tr>
<td>Text-to-speech</td>
<td>G10L 13/00</td>
</tr>
<tr>
<td>Speech-to-text</td>
<td>G10L 15/00</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input/output for Oriental characters</td>
<td>G06F 3/018</td>
</tr>
<tr>
<td>Predictive input</td>
<td>G06F 3/0237</td>
</tr>
<tr>
<td>Digital ink, low-level/hardware aspects thereof</td>
<td>G06F 3/04883</td>
</tr>
<tr>
<td>Printing (job control, etc.)</td>
<td>G06F 3/12</td>
</tr>
<tr>
<td>Multilingual user interfaces</td>
<td>G06F 9/454</td>
</tr>
<tr>
<td>Text retrieval, creation of semantic tools</td>
<td>G06F 16/30</td>
</tr>
<tr>
<td>Thesaurus (creation for retrieval)</td>
<td>G06F 16/374</td>
</tr>
<tr>
<td>Retrieval of semistructured data</td>
<td>G06F 16/80</td>
</tr>
<tr>
<td>Website content management</td>
<td>G06F 16/958</td>
</tr>
<tr>
<td>Character generators for displays</td>
<td>G09G 5/22</td>
</tr>
<tr>
<td>Compression/encoding of unstructured text</td>
<td>H03M 7/30</td>
</tr>
</tbody>
</table>

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
</tbody>
</table>

G06F 17/22

Manipulating or registering by use of codes, e.g. in sequence of text characters (compression H03M 7/30)

Definition statement

This place covers:

Manipulation of document(s) content or structure where the visual appearance or natural-language content does not play a role.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>H03M 7/30</td>
</tr>
</tbody>
</table>

Special rules of classification

Documents should not be classified in this group, but only in its subgroups. This group has merely a tree structure function.

G06F 17/2247

{Tree structured documents; Markup, e.g. Standard Generalized Markup Language [SGML], Document Type Definition [DTD] (validation and parsing G06F 17/2705; data retrieval G06F 16/00; coding and compression H03M 7/30)}

Definition statement

This place covers:

Processing of tree-structured text documents, where the tree structure and the textual nature are both significant.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data retrieval</td>
<td>G06F 16/00</td>
</tr>
<tr>
<td>Natural language data validation and parsing</td>
<td>G06F 17/2705</td>
</tr>
<tr>
<td>Compression</td>
<td>H03M 7/30</td>
</tr>
</tbody>
</table>

G06F 17/40

Data acquisition and logging (for input to computer G06F 3/00 {; displays as computer output G06F 3/14; for image data processing G06T 9/00; compression in general H03M 7/30; for transmission H04B 1/66; for pictorial communication H04N; arrangements in telecontrol or telemetry systems for selectively calling a substation from a main station H04Q 9/00})

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays as computer output</td>
<td>G06F 3/14</td>
</tr>
<tr>
<td>For image data processing</td>
<td>G06T 9/00</td>
</tr>
<tr>
<td>Compression in general</td>
<td>H03M 7/30</td>
</tr>
<tr>
<td>For transmission</td>
<td>H04B 1/66</td>
</tr>
<tr>
<td>For pictorial communication</td>
<td>H04N</td>
</tr>
</tbody>
</table>
Special rules of classification

This group is no longer used for the classification of new documents. Documents about data acquisition and logging should be classified in the application field according to the limiting references above.

G06F 17/50

Computer-aided design

Definition statement

This place covers:

• Arrangements and methods, specially adapted for automated execution, for design and simulation of technical entities.
• The application field of the entity designed or simulated takes precedence.
• Methods, lacking adaptations for automated execution, can also be classified here unless provided otherwise.

References

Limiting references

This place does not cover:

| Virtual reality, interaction with human body | G06F 3/011 |
| Software engineering | G06F 8/00 |
| Software tools | G06F 9/44, G06F9/45 |
| Testing, monitoring and debugging | G06F 11/00 |
| Complex mathematical operations not limited to technical design purpose | G06F 17/10 |
| Design of implants and prosthetic devices | A61C 13/0004, A61F 2/30942 |
| Factory automation (CAM) | G05B 19/00 |
| Three dimensional graphical modelling and manipulation | G06T 17/00, G06T 19/00 |
| Electronic editing of audio or video signals | G11B 27/031 |
| Computer-aided design of test circuits for static stores | G11C 29/54 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Design | description of technical parameters or a virtual model of a technical arrangement; does not cover aesthetic aspects; not to be confused with the physical object |
| Verification | determining the correct functioning of a design; not to be confused with testing of a physical object |
**G06F 17/5009**

**Definition statement**

*This place covers:*

Determining technical properties and behaviour by virtual simulation in a computer.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation of seismic phenomena and design of earth reservoirs</td>
<td>G01V 1/00</td>
</tr>
<tr>
<td>Adaptive control using simulation</td>
<td>G05B 13/00</td>
</tr>
<tr>
<td>Simulation for teaching or training purposes</td>
<td>G09B 9/10</td>
</tr>
</tbody>
</table>

**G06F 17/5018**

**Definition statement**

*This place covers:*

Co-simulation, HW-SW simulation and other computer-implemented simulations for verifying circuit design.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing prostheses using FEM</td>
<td>A61F 2002/30955</td>
</tr>
<tr>
<td>Picture mesh generation</td>
<td>G06T 17/20</td>
</tr>
</tbody>
</table>

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection moulding using FEM</td>
<td>B29C 45/7693</td>
</tr>
</tbody>
</table>

**G06F 17/5022**

**Definition statement**

*This place covers:*

Co-simulation, HW-SW simulation and other computer-implemented simulations for verifying circuit design.

**References**

**Limiting references**

*This place does not cover:*

Fault simulation                                                        | G06F 11/261 |
G06F 17/5022 (continued)

<table>
<thead>
<tr>
<th>Test pattern generation</th>
<th>G01R 31/28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit testing</td>
<td>G01R 31/317</td>
</tr>
<tr>
<td>Testing simulation</td>
<td>G01R 31/318357</td>
</tr>
</tbody>
</table>

G06F 17/5027

{Logic emulation using reprogrammable logic devices, e.g. field programmable gate arrays [FPGA]}

**Definition statement**

*This place covers:*

Using a programmable device (FPGA) for accelerating the simulation.

**References**

*Limiting references*

*This place does not cover:*

Reprogrammable logic devices as such H03K 19/177

G06F 17/5031

{Timing analysis}

**Definition statement**

*This place covers:*

Simulation of digital circuits focusing on the timing.

G06F 17/5036

{for analog modelling, e.g. for circuits, spice programme, direct methods, relaxation methods}

**Definition statement**

*This place covers:*

Simulation of circuits (digital and analog) for determining analog (continuous) electrical properties.

G06F 17/504

{Formal methods}

**Definition statement**

*This place covers:*

Using formal method for design verification as well as for specification verification.
G06F 17/5045

{Circuit design (G06F 17/5068 takes precedence; logic circuits H03K 19/00)}

Definition statement

This place covers:
• Design of electrical circuits at behavioural or functional level of abstraction.
• High-level synthesis.
• Design of a system-on-chip (SoC).
• Co-synthesis or WH-SW synthesis and partitioning.
• HDL, behavioural silicon compilers.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Physical circuit design</th>
<th>G06F 17/5068</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic circuits</td>
<td>H03K 19/00</td>
</tr>
</tbody>
</table>

G06F 17/505

{Logic synthesis, e.g. technology mapping, optimisation}

Definition statement

This place covers:
• Low-level synthesis.
• Netlist optimization.

G06F 17/5054

{for user-programmable logic devices, e.g. field programmable gate arrays [FPGA]}

References

Limiting references

This place does not cover:

| Programmable devices as such | H03K 19/177 |

G06F 17/5081

{Layout analysis, e.g. layout verification, design rule check}

References

Limiting references

This place does not cover:

| Assist features and mask correction | G03F 1/144 |

388
G06F 17/5086

{Mechanical design, e.g. parametric or variational design}

**Definition statement**

*This place covers:*

Design of mechanical systems in regard to moving parts, dimension tolerances etc.

G06F 17/509

{Network design, e.g. positioning, routing, graphs (circuit design G06F 17/5068)}

**Definition statement**

*This place covers:*

Using network design techniques or graph theories for determining the position of elements in a design.

**References**

**Limiting references**

*This place does not cover:*

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit design</td>
<td>G06F 17/5068</td>
</tr>
<tr>
<td>Computer networks design</td>
<td>H04L 41/145</td>
</tr>
</tbody>
</table>

G06F 19/00

Digital computing or data processing equipment or methods, specially adapted for specific applications (specially adapted for specific functions G06F 17/00; data processing systems or methods specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes G06Q; healthcare informatics G16H)

**Definition statement**

*This place covers:*

Digital computing or data processing equipment or methods specially adapted for the fields of healthcare or life sciences: Bioinformatics, Chemoinformatics and Medical Informatics

No document should be classified in this main group, but only in its subgroups. This main group has merely a tree structure function.

**Relationships with other classification places**

Digital computing or data processing equipments or methods specially adapted to other areas than healthcare or life sciences are not covered by this group.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital computing or data processing equipment or methods, specially</td>
<td>G06F 17/00</td>
</tr>
<tr>
<td>adapted for specific functions</td>
<td></td>
</tr>
<tr>
<td>Data processing systems or methods specially adapted for administrative,</td>
<td>G06Q</td>
</tr>
<tr>
<td>commercial, financial, managerial, supervisory or forecasting purposes</td>
<td></td>
</tr>
<tr>
<td>Healthcare informatics</td>
<td>G16H</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical or veterinary science</td>
<td>A61</td>
</tr>
<tr>
<td>Physical training (fitness)</td>
<td>A63B</td>
</tr>
<tr>
<td>Peptides</td>
<td>G07K</td>
</tr>
<tr>
<td>Measuring or testing involving enzymes or microorganisms</td>
<td>C12Q</td>
</tr>
<tr>
<td>Combinatorial chemistry</td>
<td>C40B</td>
</tr>
<tr>
<td>Investigating or analysing materials by determining their chemical or</td>
<td>G01N</td>
</tr>
<tr>
<td>physical properties</td>
<td></td>
</tr>
<tr>
<td>Pattern recognition</td>
<td>G06K 9/00</td>
</tr>
<tr>
<td>Computer systems based on specific computational models</td>
<td>G06N</td>
</tr>
<tr>
<td>Business methods</td>
<td>G06Q</td>
</tr>
<tr>
<td>Image data processing</td>
<td>G06T</td>
</tr>
</tbody>
</table>

G06F 19/00 (continued)

G06F 19/30

{Medical informatics, i.e. computer-based analysis or dissemination of patient or disease data (measuring for diagnostic purposes A61B 5/00; recognising patterns in biomedical signals G06K 9/00496; data processing systems or methods specially adapted for administrative or managerial aspects of healthcare or welfare G06Q 50/22)}

Definition statement

This place covers:

Medical Informatics, also called Healthcare Informatics, Health Informatics, Clinical Informatics or Biomedical Informatics.

Medical Informatics is a discipline at the intersection of information science, computer science and health care.

It deals with the resources, devices, and methods required to optimise the acquisition, storage, retrieval, and use of information in healthcare and biomedicine. Medical Informatics tools include not only computers but also clinical guidelines, formal medical terminologies, and information and communication systems.

It is applied to the areas of nursing, clinical care, dentistry, pharmacy, public health, occupational therapy, and (bio)medical research.
No document should be classified in this group, but only in its lower subgroups. This group has merely a tree structure function.

**Relationships with other classification places**

In order to differentiate Medical Informatics from Bioinformatics or Chemoinformatics, we highlight that the focus of Medical Informatics is on patients or diseases (e.g. diagnosis or treatments), whereas the focus of Bioinformatics and Chemoinformatics is on proteins, molecules or DNA.

Documents dealing with analogue electrical medical signals (ECG, EKG, etc) are classified under A61 for acquisition (measuring), and under G06K 9/00 for analysis (pattern recognition).

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Category</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical or veterinary science</td>
<td>A61</td>
</tr>
<tr>
<td>Detecting, measuring or recording for diagnostic purposes</td>
<td>A61B 5/00</td>
</tr>
<tr>
<td>Surgical instruments, devices or methods</td>
<td>A61B 17/00</td>
</tr>
<tr>
<td>Physical training (fitness)</td>
<td>A63B</td>
</tr>
<tr>
<td>Investigating biological material</td>
<td>G01N 33/48</td>
</tr>
<tr>
<td>Recognising patterns in biomedical signals</td>
<td>G06K 9/00496</td>
</tr>
<tr>
<td>Business methods</td>
<td>G06Q</td>
</tr>
<tr>
<td>Biomedical image inspection</td>
<td>G06T 7/0012</td>
</tr>
<tr>
<td>Biomedical image modelling</td>
<td>G06T 17/00</td>
</tr>
</tbody>
</table>

**Special rules of classification**

Multiple places no priority - for all the lower subgroups of this group, unless exceptionally specified different in the particular subgroup(s).

**G06F 19/32**

{Medical data management, e.g. systems or protocols for archival or communication of medical images, computerised patient records or computerised general medical references (information retrieval or databases per se G06F 16/00; data security aspects G06F 21/00)}

**Definition statement**

*This place covers:*

Normally no document should be classified in this group, but only in its lower subgroups. This group has merely a tree structure function.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Category</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security aspects per se</td>
<td>G06F 21/00</td>
</tr>
</tbody>
</table>
G06F 19/321

{Management of medical image data, e.g. communication or archiving systems such as picture archiving and communication systems [PACS] or related medical protocols such as digital imaging and communications in medicine protocol [DICOM]; Editing of medical image data, e.g. adding diagnosis information (image data processing in general G06T, image data processing related to 3D objects G06F 17/00; biomedical image inspection G06T 7/0012)}

**Definition statement**

This place covers:

Systems dealing with medical image transmission and archiving, and related protocols. Usually called Picture Archiving and Communication Systems (PACS), Digital Imaging and Communications in Medicine protocol (DICOM).

This subgroup also covers editing of medical image data, for example adding the doctor's diagnosis to the image.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Image analysis</th>
<th>G06T 7/0012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editing figures and text; Combining figures or text per se</td>
<td>G06T 11/60</td>
</tr>
<tr>
<td>Edit video signals</td>
<td>G11B 27/00</td>
</tr>
<tr>
<td>Image enhancement</td>
<td>H04N 5/325</td>
</tr>
<tr>
<td>Transmission of medical images</td>
<td>H04N 7/00</td>
</tr>
</tbody>
</table>

**Synonyms and Keywords**

In patent documents, the following abbreviations are often used:

<table>
<thead>
<tr>
<th>PACS</th>
<th>Picture Archiving and Communication System</th>
</tr>
</thead>
<tbody>
<tr>
<td>DICOM</td>
<td>Digital Imaging and Communications in Medicine</td>
</tr>
<tr>
<td>HL7</td>
<td>Health Level Seven</td>
</tr>
</tbody>
</table>

In patent documents, the following words/expressions are often used as synonyms:

- "image" and "picture"

G06F 19/324

{Management of patient independent data, e.g. medical references in digital format}

**Definition statement**

This place covers:

Management of medical data not linked to a specific individual, for professional or educational usage.
Special rules of classification
Documents will be classified in this group only if not possible to classify them in its lower subgroups.

G06F 19/325
{Medical practices, e.g. general treatment protocols}

Definition statement
This place covers:
Systems dealing with general medical protocols, not for a particular patient.

G06F 19/326
{Medication information, e.g. drug reference databases}

Definition statement
This place covers:
Systems dealing with general drug information (usage, side effects).

G06F 19/328
{Health insurance management, e.g. payments or protection against fraud}

Definition statement
This place covers:
Documents dealing with insurances and payments.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| Payment schemes | G06Q 20/00 |

G06F 19/34
{Computer-assisted medical diagnosis or treatment, e.g. computerised prescription or delivery of medication or diets, computerised local control of medical devices, medical expert systems or telemedicine}

Definition statement
This place covers:
Computerised diagnosis or treatment.

Normally no document should be classified in this group, but only in its lower subgroups. This group has merely a tree structure function.
G06F 19/3418
{Telemedicine, e.g. remote diagnosis, remote control of instruments or remote monitoring of patient carried devices}

Definition statement
This place covers:
Remote medical diagnosis and medical care - monitoring, testing, controlling and communicating.

Observation: The medical professional can also be an expert system running on a server.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Computer networks, wireless applications | H04L 29/00 |

Special rules of classification

A doctor controlling an operation arm using a wireless joystick located in the same room will not be classified here but in the Local monitoring or local control of medical devices subgroup (G16H 40/63).

Documents comprising remote testing where data is sent to a server and the result is sent back to the patient belong here. However, if a specimen itself is sent, the application should be classified in the Acquisition of data related to laboratory tests subgroup (G16H 10/40).

G06F 19/3456
{Computer-assisted prescription or delivery of medication, e.g. prescription filling or compliance checking}

Definition statement
This place covers:
Prescription, dispensing, management, controlling and administration of medication.

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Medicinal preparations | A61K 9/00 |

Special rules of classification

General drug reference databases are classified in the Medication information subgroup (G06F 19/326).

Computer-assisted distribution of medication from dispensers, i.e. making sure that medication is correctly delivered to patients, is classified in the subgroup G06F 19/3462.

Computer-assisted delivery of medication via infusion or injection is classified in the subgroup G06F 19/3468.
**G06F 19/3462**

{Computer-assisted distribution of medication from dispensers, i.e. making sure that medication is correctly delivered to patients (medication containers A61J 1/00; dispensers activated by money or the like G07F)}

**Definition statement**

*This place covers:*

Computer-managed delivery of medication from dispensers, i.e. making sure that the correct medication is delivered to the correct patient.

Documents dealing with RFID tags for drugs are classified here.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Medication (drug) containers</th>
<th>A61J 1/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispensers activated by money or the like</td>
<td>G07F</td>
</tr>
</tbody>
</table>

**G06F 19/3468**

{Computer-assisted delivery of medication via infusion or injection (infusion devices per se A61M 5/14)}

**Definition statement**

*This place covers:*

Computer-managed delivery of medication via infusion or injection.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Infusion devices per se</th>
<th>A61M 5/14</th>
</tr>
</thead>
</table>

**G06F 19/3475**

{Computer-assisted prescription or delivery of diets, e.g. prescription filling or compliance checking}

**Definition statement**

*This place covers:*

Prescription or control of nutrition or diet, treatment by diet.
G06F 19/3481

{Computer-assisted prescription or delivery of treatment by physical action, e.g. surgery or physical exercise (surgical instruments, devices or methods A61B 17/00; apparatuses for physical training A63B)}

Definition statement

This place covers:

Systems for defining a treatment for an individual after diagnosis. Treatment should involve a physical action on a patient (is not mere medication or nutrition).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Radiation therapy</th>
<th>A61B 6/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>A61B 17/00</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>A61M 16/00</td>
</tr>
<tr>
<td>Fitness</td>
<td>A63B</td>
</tr>
<tr>
<td>Magnetic resonance per se</td>
<td>G01R 33/00</td>
</tr>
</tbody>
</table>

G06F 19/36

{Computer-assisted acquisition of medical data, e.g. computerised clinical trials or questionnaires (measuring analogue medical signals A61B 5/00)}

Definition statement

This place covers:

Computerised acquisition of medical data.

Normally no document should be classified in this group, but only in its lower subgroups. This group has merely a tree structure function.

Relationships with other classification places

This subgroup does not deal with measuring analogue electrical medical signals, which is the topic of A61B 5/00.

G06F 21/00

Security arrangements for protecting computers, components thereof, programs or data against unauthorised activity

Definition statement

This place covers:

Security arrangements for protecting computers or their components, programs and data against unauthorised activity, e.g. intrusion into a computer, computer malware detection and handling, authentication, unauthorised use of data, dishonest alteration of data, theft of secret data.

In particular, the following subjects are covered:
• Protecting specific internal or peripheral components in which the protection of a component leads to protection of the entire computer;
• Monitoring users, programs or devices to maintain the integrity of platforms;
• Authenticating users, programs or devices;
• Protecting distributed programs or content, e.g. vending or licensing of copyright material;
• Protecting data used within a computer.

Relationships with other classification places
This group covers security arrangements for local platforms.

Classification should be directed to groups **H04L 9/00** - **H04L 9/32** when the subject is secret or secure communication involving the use of encryption.

Furthermore, classification should be directed to group **H04L 29/06** when network involvement or protocols are of relevance.

Finally, classification should be directed to group **H04W 12/00** when security or authentication arrangements in wireless communication networks are of relevance.

References

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Program control, executing machine-instructions, program loading or initiating in general, task interaction, specific resource access rights | G06F 9/00 |
| Multiprogramming | G06F 9/46 |
| Error detection, error correction, monitoring | G06F 11/00 |
| Electric safety arrangements in control or regulating systems | G05B 9/02 |
| Electric program-control in control or regulating systems | G05B 19/02 |
| Record carriers for use with machines and with at least a part designed to carry digital markings | G06K 19/00 |
| Protecting identification code in record carriers | G06K 19/073 |
| Data processing adapted for administrative, commercial, managerial, supervisory or forecasting purposes | G06Q |
| Complete banking systems | G07F 19/00 |
| Alarms or alarm systems | G08B 13/00 - G08B 31/00 |
| Equipment anti-theft monitoring by a central station | G08B 26/00 |
| Ciphering apparatus | G09C |
| Information storage based on relative movement between record carrier and transducer | G11B |
| Arrangements for conditional access to broadcast information using cryptography | H04H 60/23 |
| Secret or secure communication, e.g. including authentication means | H04L 9/00 - H04L 9/32 |
| Key distribution in cryptographic systems | H04L 9/08 |
| Algorithms, certificates, signatures, hash functions, encryption | H04L 9/32 |
| Data switching networks | H04L 12/00 |
| Scanning, transmission or reproduction of documents | H04N 1/00 |
Selective content distribution, e.g. interactive television, video on demand

Security arrangements, e.g. access security or fraud detection; authentication in wireless communication networks

Special rules of classification
The general rule is to limit to the best-suited group but there could be a plurality of groups for a document if that document discloses many relevant aspects when taken separately (e.g. a document having isolated disclosures) or in combination, in particular when a combination of groups is more suited to reflect the disclosure.

Glossary of terms
In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>means any intellectually created work whose copyright is to be safeguarded</td>
</tr>
</tbody>
</table>

G06F 21/10
Protecting distributed programs or content, e.g. vending or licensing of copyrighted material

Definition statement
This place covers:
Protecting software against unauthorised usage in a vending or licensing environment, e.g. protecting the software provider's copyright. The protection is generic, i.e. not specific to the type of content.

Protecting data in an environment substantially outside the data owner's control (or in a hostile environment). The term "hostile environment" means data and operational environment of the data are controlled by different entities.

Example: hostile environment: FT(Financial Times) has a server where users who pay get a key that enables locally stored encrypted FT-newspaper-articles to be decrypted and read. The articles are in a hostile environment, the computer of the user, where FT has limited or no influence, therefore the article needs to be protected from the user, in this case by encryption

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection Issue</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>If protection is restricted to techniques specific to executables</td>
<td>G06F 21/12</td>
</tr>
<tr>
<td>Protecting data in an environment substantially within the data owner's control (or in a non-hostile environment)</td>
<td>G06F 21/60</td>
</tr>
<tr>
<td>Preventing unauthorized non-electronic copying</td>
<td>G03G 21/04</td>
</tr>
<tr>
<td>Image watermarking when the watermarking itself is concerned</td>
<td>G06T 1/0021</td>
</tr>
<tr>
<td>Usage of faulty sectors for copy protection</td>
<td>G11B 20/00086</td>
</tr>
<tr>
<td>Preventing unauthorized electronic reproduction of physical documents</td>
<td>H04N 1/00838</td>
</tr>
<tr>
<td>Digital watermarking on images when the watermarking itself is concerned</td>
<td>H04N 1/32144</td>
</tr>
</tbody>
</table>
Protection in video systems, games, pay television when the protection is dependent on the format of the audio/video data e.g. adding security frames in a MPEG signal

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

<table>
<thead>
<tr>
<th>Protection in video systems, games, pay television when the protection is dependent on the format of the audio/video data e.g. adding security frames in a MPEG signal</th>
<th>H04N 21/00</th>
</tr>
</thead>
</table>

| Games systems, i.e. specific solutions for security of games | G06F 2221/2109 |
| Chip on media | G06F 2221/2121 |
| Commerce, e.g. marketing, shopping, billing, auctions or e-commerce | G06Q 30/00 |
| Preventing of unauthorized reproduction or copying of media | G11B 20/00086 |
| Protecting content in television systems | H04N 21/00 |

**Special rules of classification**

*G06F 2221/07* and subgroups are used in combination with this group.

**G06F 21/105**

{Tools for software license management or administration, e.g. managing licenses at corporate level}

**Definition statement**

*This place covers:*

Examples: Managing floating licenses.

**G06F 21/12**

Protecting executable software

**Definition statement**

*This place covers:*

Protection is restricted to techniques specific to executables.

**References**

**Limiting references**

*This place does not cover:*

If the protection is suitable for generic content, although claiming being adapted for protection of an executable | G06F 21/10 |
G06F 21/123
{by using dedicated hardware, e.g. dongles, smart cards, cryptographic processors, global positioning systems [GPS] devices}

Definition statement
This place covers:
Dedicated hardware is used for authorizing access to an executable program using techniques specific to executable programs (e.g. manipulation of the code, manipulation of the instruction flow or data flow, security routine in the program to verify a code in a dongle).

References
Limiting references
This place does not cover:

| If a security procedure contained in a dongle is used to check a code in the content, no need for code attached to content | G06F 21/10, G06F 2221/0797 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Authenticating in combination with an additional device | G06F 21/34 |
| If the program contains security routines acting after initial authorization | G06F 21/54 |
| Location-sensitive | G06F 2221/2111 |

G06F 21/14
against software analysis or reverse engineering, e.g. by obfuscation

Definition statement
This place covers:
Be aware that the software generally stays unlocked. Obfuscation is primarily used to prevent reverse engineering but not to prevent copying.

Examples: Program code is altered at each execution, program flow is changed to mask calls to sensitive routines, data flow is changed, compiling techniques normally performed by code optimizers rolled back.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

| If similar techniques as the ones used for obfuscation are used to restrict unauthorized usage and thus copy protection | G06F 21/125 |
G06F 21/16
Program or content traceability, e.g. by watermarking

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Digital watermarking on images | H04N 1/32 |

G06F 21/30
Authentication, i.e. establishing the identity or authorisation of security principals

References

Limiting references

This place does not cover:

If the network plays a role, e.g. secure socket layer, IPsec, Internet Key Exchange, or Extensive Authentication Protocol | H04L 29/06755 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Authentication using challenge-response | G06F 2221/2103 |
| Bluffing e.g. pretending to have connected a user to a real node when in fact the connection is to a dummy node | G06F 2221/2127 |
| Lost password, i.e. recovery of lost of forgotten passwords | G06F 2221/2131 |
| Verifying human interaction, e.g. Captcha | G06F 2221/2133 |
| Metering, i.e. counting events for security purposes | G06F 2221/2135 |
| Time limited access e.g. to a computer | G06F 2221/2137 |
| Recurrent verification | G06F 2221/2139 |
| Clearing memory or data when detecting an attack e.g. to prevent the data from being stolen | G06F 2221/2143 |
| Time stamp | G06F 2221/2151 |
| One-time-passwords | H04L 29/06789 |
| Time-dependent-passwords, e.g. periodically changing passwords | H04L 29/06795 |

G06F 21/305
{by remotely controlling device operation}

Definition statement

This place covers:

Authentication is not triggered by a user but imposed/initiated by a third party.
References

Limiting references

This place does not cover:

If re-authentication is triggered after an intrusion

G06F 21/31

User authentication

Definition statement

This place covers:

Specific authentication aspect (e.g. initial authentication, regular authentications at predetermined time intervals, or re-authentication after logout or locking) or password design.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Authentication mechanisms

G06F 21/313

{using a call-back technique via a telephone network}

Definition statement

This place covers:

Using characteristics specific to telephone lines.

Examples: Call-back to user phone number derived from phone network provider.

Particular cases: Authentication request triggered by server (no call-back) using phone number derived from phone network provider.

G06F 21/316

{by observing the pattern of computer usage, e.g. typical user behaviour}

Definition statement

This place covers:

Authentication succeeds only when secondary user-specific authorization criteria are fulfilled at login time.

Examples: An example of secondary user-specific authorization criteria is the typing speed of the user; admit user only if this typing-speed corresponds to its normal one.

Particular cases: Maximum number of login attempts for a given user, login must be at predetermined time of day, remote login is restricted to specific computers.
References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the typing speed is the primary authentication criteria</td>
<td>G06F 21/32</td>
</tr>
<tr>
<td>Observing the pattern of computer usage in order to trigger alarm and</td>
<td>G06F 21/554</td>
</tr>
<tr>
<td>detect intrusion</td>
<td></td>
</tr>
</tbody>
</table>

G06F 21/32

using biometric data, e.g. fingerprints, iris scans or voiceprints

Definition statement

This place covers:

Using physiological data intrinsic to a principal and what a principal is able to do. Examples:

- Typing/mouse clicking frequency;
- Handwritten signature.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authenticating a user by observing the pattern of computer usage, e.g.</td>
<td>G06F 21/316</td>
</tr>
<tr>
<td>typical user behaviour</td>
<td></td>
</tr>
<tr>
<td>Use of unusual or unconventional user registration</td>
<td>G06F 2221/2117</td>
</tr>
<tr>
<td>Authenticating a user by using biometrical features, e.g. fingerprint,</td>
<td>H04L 29/06809</td>
</tr>
<tr>
<td>retina-scan</td>
<td></td>
</tr>
</tbody>
</table>

G06F 21/33

using certificates

Definition statement

This place covers:

All authentication mechanisms implying use of a ticket, token or certificate issued by a third party upon initial user authentication. The ticket contains a proof of the initial authentication which is accepted by all parties. Examples: Kerberos, OSF DCE.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication by using a single sign-on procedure provides access to a</td>
<td>G06F 21/41</td>
</tr>
<tr>
<td>plurality of nodes</td>
<td></td>
</tr>
<tr>
<td>Verifying identity using certificates, signatures, hash functions and/or</td>
<td>H04L 9/32</td>
</tr>
<tr>
<td>encryption</td>
<td></td>
</tr>
<tr>
<td>Authenticating by using tickets, e.g. Kerberos</td>
<td>H04L 29/06761</td>
</tr>
<tr>
<td>Authenticating by using certificates</td>
<td>H04L 29/06775</td>
</tr>
</tbody>
</table>
G06F 21/335

{for accessing specific resources, e.g. using Kerberos tickets}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Authentication by using a single sign-on procedure provides access to a plurality of nodes | G06F 21/41 |

G06F 21/34

involving the use of external additional devices, e.g. dongles or smart cards

Definition statement

This place covers:
The additional device is used for authentication with the purpose of accessing a computer system.

Particular cases: The additional device is a cryptographic processor.

References

Limiting references

This place does not cover:

| If the additional device is used to access a program | G06F 21/123 |
| Using hardware token other than for authentication (e.g. storing secret data) | G06F 2221/2153 |

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Authenticating by using an additional device, e.g. smartcard, SIM | H04L 29/06802 |

G06F 21/35

communicating wirelessly

Definition statement

This place covers:
Examples: Continuous detection of wireless authentication token carried by user. Particular cases:
Wireless presence detector, logout when not present.

References

Limiting references

This place does not cover:

| If the additional device is used to access a program | G06F 21/123 |
Informative references

Attention is drawn to the following places, which may be of interest for search:

| Authenticating by using an additional device, e.g. smartcard, SIM | H04L 29/06802 |

G06F 21/36

by graphic or iconic representation

Definition statement

This place covers:

The graphical or iconic code is generated by a local system, a remote system or a principal.

Examples: The graphical code is used to challenge a principal and check something he should know, typically by manipulation of symbols or elements of a drawing or variation of key arrangement on a virtual keyboard.

References

Limiting references

This place does not cover:

| Handwritten signature | G06F 21/32 |

G06F 21/41

where a single sign-on provides access to a plurality of computers

Definition statement

This place covers:

Using a third party performing a mapping of the credentials of the user for a first application to credentials valid for other applications.

Examples:

The third party is a password server.

The third party is a smart card. Particular cases: The third party is the first application.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Authentication using certificates | G06F 21/33 |
G06F 21/42

using separate channels for security data

Definition statement
This place covers:

Examples:
• Authentication with portable phone, receive sms with password, connect via fixed telephone line using password.
• Voice call for authentication, server calls back terminal.

G06F 21/44

Program or device authentication

References
Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device authentication, i.e. authenticate client device independently of the user</td>
<td>G06F 2221/2129</td>
</tr>
</tbody>
</table>

G06F 21/445

{by mutual authentication, e.g. between devices or programs}

References
Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutual authentication</td>
<td>H04L 29/06816</td>
</tr>
</tbody>
</table>

G06F 21/50

Monitoring users, programs or devices to maintain the integrity of platforms, e.g. of processors, firmware or operating systems

Definition statement
This place covers:

Protecting computer platforms against harmful, malicious or unexpected behaviour or activities.

This group is not strictly limited to software solutions.

References
Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just-in-time application of countermeasures</td>
<td>G06F 2221/2125</td>
</tr>
<tr>
<td>Metering, i.e. counting events for security purposes</td>
<td>G06F 2221/2135</td>
</tr>
</tbody>
</table>
clearing memory or data when detecting an attack e.g. to prevent the data from being stolen

time stamp

special rules of classification

the difference between g06f 21/56+ and the others groups g06f 21/50+ (namely g06f 21/51, g06f 21/52+, g06f 21/55+ and g06f 21/57+) may be formulated as:

• g06f 21/56+: we would trust the code or system if it were not infected (we look for the infection as such)
• other groups g06f 21/50+ (see definition above): we don’t trust the code or system (we make an assessment of the global code or system; we don’t look for an infection as such) g06f 2221/031 (protect user input by software means) and g06f 2221/032 (protect user output by software means) are additionally used to distinguish documents dealing with securing user input/output, e.g. in banking systems / applications

the subclasses g06f 2221/03+ are used in combination with this group.

G06F 21/51

at application loading time, e.g. accepting, rejecting, starting or inhibiting executable software based on integrity or source reliability

definition statement

this place covers:

accept / reject loading of application:
    • onto platform for later execution.
    • into memory for immediate execution.

from
    • local storage
    • remove device (e.g. by downloading).

based on static features of the application when not being executed e.g.:
    • signature or certificate provided by application creator, provider or tester
    • integrity.
    • capability list.
    • capabilities of application determined by analysis.

an application is software distinct from firmware and os such as:
    • directly executable code (binary code)
    • interpretable programs (script language)
    • interpretable files such as html, word, etc. documents

examples:
    • verify integrity or application origin (application creator, provider, or tester) by checking a signature, certificate, etc. of application.
    • verify integrity of application or application origin by transforming and reverse transforming the application: by analyzing user content, e.g. analyse relationship of websites referred to by a web page.
    • check application capabilities versus a predefined security policy.
G06F 21/51 (continued)

References

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Authenticating web pages | G06F 2221/2119 |

G06F 21/52

during program execution, e.g. stack integrity {; Preventing unwanted data erasure; Buffer overflow}

Definition statement

This place covers:
Intrusion detection at the single program level, i.e. detect intrusion of:

• A system by a single program.
• A single program.

During execution of the single program e.g. by specifically monitoring execution of the single program at the single program level

Examples:

• Transform by obfuscation means which do not add code.
• Modify code to avoid security issue when fault injection.
• Modify code to enforce security policy.
• Detect code injection

References

Limiting references

This place does not cover:

Transformation by addition of security routines or objects to the program | G06F 21/54
Monitoring of the whole system running many programs | G06F 21/55

G06F 21/53

by executing in a restricted environment, e.g. sandbox or secure virtual machine

Definition statement

This place covers:
Intrusion detection at the environment level of the execution of the single program e.g.:

• Run program in secure, isolated environment (VM, sandbox), e.g. by modifying VM or sandbox to include special security measures
• Provide security measures in interface (library, API, OS) of program with its Environment, e.g.:
• Provide secure library or API interfacing the program
• Modify library, API or OS to include security measures
• Have OS service or library making security checks or running in protected environment
Examples: by using virtual machine, sandbox, secure library or by isolating processes at operating system level

**G06F 21/54**

by adding security routines or objects to programs

**Definition statement**

This place covers:

- Transformation by addition of code to Source code
- Executable program to be loaded or already loaded in memory for execution to ensure proper execution of program

Examples:

- Add / modify code to detect fault injection by enforcing proper execution sequence
- Modify code to detect improper execution flow when code error
- Add code to detect software attacks
- Modify code to enforce security policy
- Add code to detect code tampering in memory
- Add dummy instructions for obfuscation purposes

**References**

**Limiting references**

This place does not cover:

| Modification of code to include some static feature (e.g. a checksum) to be checked prior to execution | G06F 21/51 |
| Transformation of code not by addition, e.g. by obfuscation means | G06F 21/52 |

**G06F 21/55**

Detecting local intrusion or implementing counter-measures

**Definition statement**

This place covers:

Intrusion detection at the level of the system independently of execution of one single program e.g. by monitoring execution of the whole system while running many programs.

**References**

**Limiting references**

This place does not cover:

| Intrusion detection at the single program level during execution of the single program | G06F 21/52 |
G06F 21/552
{involving long-term monitoring or reporting}

Definition statement

This place covers:
Monitor the system, user actions within the system, etc., analyze the monitoring data gathered during long term and take action.

Examples:
- Determine normal user behaviour for later security issue detection
- Log security issue events for later action / risk assessment
- Collect system information and deduce security issue

G06F 21/554
{involving event detection and direct action}

Definition statement

This place covers:
Monitor the system, user actions on the system, etc., immediately analyze the monitoring data gathered and directly take action.

Examples: Detect abnormal user behaviour, security issue or physical attacks; and immediately react.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

If the monitoring and direct action is based on data obtained by long-term monitoring

G06F 21/556
{involving covert channels, i.e. data leakage between processes (inhibiting the analysis of circuitry or operation with measures against power attack G06F 21/755)}

Definition statement

This place covers:
A covert channel is defined as being a communication channel that allows a process to transfer information in a manner that violates the system's security policy.

E.g.: software measures against:
- Intended malevolent internal signalling or communication between processes on system.
- Intended malevolent external signalling or communication by process on system.
- Accidental internal leakage of data between processes on system by storage or communication
- Accidental external leakage of data of process on system by storage or communication
- Accidental internal or external leakage of system or process state or behaviour

Examples:
• Protect against physical (e.g. electromagnetic; non power consumption) monitoring to obtain information on data manipulated by the system or code executed by the system.
• Protect against fault attacks
• Data leakage between processes via common / non secure memory Secure data transfer within processes
• Hidden communication between processes by one process observing other process behaviour
• External data leakage by hidden communication
• Unwanted data leakage in programs
• Modify code to avoid information exposure in memory

References

Limiting references

This place does not cover:

| Protect against root kits by scanning for malwares at boot. | G06F 21/56 |
| Inhibiting the analysis of circuitry or operation with measures against power attack | G06F 21/755 |

G06F 21/56

Computer malware detection or handling, e.g. anti-virus arrangements

Definition statement

This place covers:

Examples:
• Protection against root kits by scanning for malwares at boot.
• Virus resistant computer by booting from authenticated read-only boot device, transfer accepted file types only.
• Determine malicious (child) processes by file generation time changes
• Remote control upon virus detection (i.e. cut communications).
• Send executable email contents to sacrificial server to verify execution for virus activity.
• Analyze file with respect to virus families, family based extraction.
• Trojans.

References

Limiting references

This place does not cover:

| If for avoiding or detecting spam. If for virus detection in network (system) or at network protocol level | H04L 63/00 |

Special rules of classification

• The difference between G06F 21/56 and the others subgroups under G06F 21/50 (namely G06F 21/51, G06F 21/52, G06F 21/55 and G06F 21/57) may be formulated as:
  • G06F 21/56: we would trust the code or system if it were not infected (we look for the infection as such).
  • Other groups under G06F 21/50 (see definition above): we don’t trust the code or system (we make an assessment of the global code or system; we don’t look for an infection as such).
Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virus</td>
<td>A malicious (i.e. intended to harm) executable code or script hidden or embedded in a normally non malicious data, code or system. It need not be self-replicating</td>
</tr>
</tbody>
</table>

G06F 21/561

{Virus type analysis}

Definition statement

This place covers:
Information relating to a specific type or family of viruses.

G06F 21/562

{Static detection}

Definition statement

This place covers:
Detect presence of virus without executing directly or by emulation, except emulation for the purpose of higher level analysis (control code, data flow)

Examples of such detections:
- Analyse source code or scripts.
- Execute intermediate compiled code and analyse.
- Compile and analyse.
- Disassemble binary code and analyse control flow or data flow and/or match execution code patterns without simulation of execution.
- Validate file formats.
- Verify based on file type.

G06F 21/563

{by source code analysis}

Definition statement

This place covers:
Starting point for analysis: source code, script or file type or format. The source code may be obtained by disassembly.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

If the source code is compiled and executed or emulated for analysis

G06F 21/566
**G06F 21/564**

{by virus signature recognition}

**Definition statement**

*This place covers:*

Concerns virus detection by binary or source code pattern matching or the process of enhancing the signature recognition procedure.

Examples:
- By using virus binary code signature.
- By using a virus source code pattern.

**G06F 21/565**

{by checking file integrity}

**Definition statement**

*This place covers:*

Examples:
- Detect change of files.
- Detect change of file portions.

**G06F 21/566**

{Dynamic detection, i.e. detection performed at run-time, e.g. emulation, suspicious activities}

**Definition statement**

*This place covers:*

Examples:
- Execute directly or by emulation and observe effect by monitoring / limitation
- Emulation of code.
- Execution in sandbox / virtual machine.
- Monitoring / limiting Inputs/Outputs.
- Monitoring memory allocation / changes
- Encoding executable and decoding upon execution such that infection is detected at run time.
- Modifying execution such that infection is detected at run time.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Access rights if detection based on access right violation | G06F 2221/2141 |

**Special rules of classification**

Use additionally G06F 2221/033 (Test or assess a software) if detection at the level of execution of a single program.
Use additionally G06F 2221/034 (Test or assess a computer or a system) if detection at system level (as opposed to the level of execution of a single program).

G06F 21/567

{using dedicated hardware}

Definition statement

This place covers:

Use hardware specifically dealing with virus detection or removal. The hardware may be general purpose.

Examples:

- Normal boot using a general purpose external storage means (e.g. USB stick) with anti-virus software.
- Use intermediate server for virus detection.
- Use dedicated, specialized hardware means for detecting virus.
- Use dedicated, specialized hardware means for detecting suspicious activity.
- Use dedicated, specialized hardware means for alerting user upon virus detection.
- Use dedicated, specialized hardware means for avoiding virus infection by e.g. write protection.
- Use dedicated, specialized hardware means for avoiding propagation by binary transmission.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>If carried out on a separate, remote device (third party)</th>
<th>G06F 2221/2115</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of hardware tokens, smart cards or dongles</td>
<td>G06F 2221/2153</td>
</tr>
</tbody>
</table>

G06F 21/568

{eliminating virus, restoring damaged files}

Definition statement

This place covers:

Provision of software means to remove viruses or restore infected files. Examples:

- Restore system to earlier trustworthy state.
- Apply reverse behaviour of a detected virus in order to restore file/code.
- Observe potentially harmful software on computer at runtime, remove its effects.
- Verify/scan files upon file access; replace file with clean file.
- Boot one OS to scan other OS for viruses and cleanup.
G06F 21/57

Certifying or maintaining trusted computer platforms, e.g. secure boots or power-downs, version controls, system software checks, secure updates or assessing vulnerabilities

Definition statement

This place covers:

- Validate trusted platform configuration.
- Defeat computer security by installing software into RAM using peripheral DMA.
- Receive vulnerability alert, retrieve and install patch.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Non secure initialization, program loading or initiating without any security aspects

G06F 9/4401
G06F 9/445

G06F 21/572

{Secure firmware programming, e.g. of basic input output system [BIOS]}

Definition statement

This place covers:

Securely update, patch or load firmware or firmware modules.

Examples:

- Authenticate firmware updates, patches or modules.
- Authenticate configuration file listing updates, modules to load.
- Authenticate key to allow firmware update.
- Authenticate firmware / configuration update program / command.

G06F 21/575

{Secure boot}

Definition statement

This place covers:

Examples:

- Authenticate boot code(s) at start-up.
- Verify configuration at boot.
- Pre-boot authentication (user authentication or by using unlock code authentication).
- Disable boot device
- Boot read-only system.
- Security action (e.g. Malware scan) by booting safe system in dual boot system.
- Load high security barrier code.
G06F 21/577
{Assessing vulnerabilities and evaluating computer system security}

Definition statement

This place covers:

Examples:

- Analyze or test a computer or a program against vulnerabilities or threats at computer level or at program level.
- Analyze or test a computer or a program for security relevant capabilities.

References

Limiting references

This place does not cover:

If assessing/evaluating the network per se

H04L 63/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Testing software

G06F 9/44589,
G06F 11/36

Special rules of classification

Use additionally G06F 2221/033 (Test or assess a software) or G06F 2221/034 (Test or assess a computer or a system) to distinguish between assessment of computer or software.

G06F 21/60

Protecting data

Definition statement

This place covers:

Authorizing access to an executable program using techniques specific to executable programs (e.g. manipulation of the code, manipulation of the instruction flow or data flow, security routine in the program to verify a code in a dongle) Protecting data in an environment substantially within the data owner's control (or in a non-hostile environment). The term "hostile environment" means data and operational environment of the data are controlled by different entities.

Example: non-hostile environment: FT(Financial Times) has a server where users who pay get a username+password to access FT-newspaper-articles on the server. FT has full control over the server, the data is stored on the server, and therefore the data is not in a hostile environment.

References

Limiting references

This place does not cover:

Protecting data in an environment substantially outside the data owner's control (or in a hostile environment)

G06F 21/10
Informative references

Attention is drawn to the following places, which may be of interest for search:

| Recurrent verification | G06F 2221/2139 |

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

| Data | Also includes programs |

G06F 21/602

{Providing cryptographic facilities or services}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| For hardware details | G06F 21/72 |

G06F 21/608

{Secure printing}

Definition statement

This place covers:

The protection mostly relates to the secrecy, confidentiality and integrity of printed data.

Examples:

- Ensure a printed document is authentic copy of electronic document by protecting the transmission between the host and the printer. Selected for print is encrypted at the user's computer and decrypted at the printer upon user authentication at the printer, e.g. using a password or a badge.
- Ensure document can only be printed out by the intended user, e.g. by password input at printer or authentication using a smartcard containing the private key of the user.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Scanning, transmission or reproduction of documents | H04N 1/32144 |
**G06F 21/62**

Protecting access to data via a platform, e.g. using keys or access control rules

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the solution is achieved via the display or its driver.</td>
<td>G06F 21/84</td>
</tr>
</tbody>
</table>

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>File encryption, i.e. use of unusual or unconventional encryption techniques</td>
<td>G06F 2221/2107</td>
</tr>
<tr>
<td>Time limited access e.g. to data</td>
<td>G06F 2221/2137</td>
</tr>
<tr>
<td>Access rights</td>
<td>G06F 2221/2141</td>
</tr>
<tr>
<td>inheriting rights or properties, e.g. propagation of permissions or restrictions across a hierarchy</td>
<td>G06F 2221/2145</td>
</tr>
<tr>
<td>Locking files</td>
<td>G06F 2221/2147</td>
</tr>
<tr>
<td>Restricted operating environment, e.g. creating a user-specific working environment, parental control</td>
<td>G06F 2221/2149</td>
</tr>
</tbody>
</table>

**G06F 21/6209**

{to a single file or object, e.g. in a secure envelope, encrypted and accessed using a key, or with access control rules appended to the object itself}

**Definition statement**

This place covers:

Object access right control is performed by a dedicated application or function (separate from an optional access right control offered by the file system. Access control based on a file-system goes to G06F 21/6218 and subgroups). Access rights or keys, and a security function to apply the rights, are associated directly to an individual file.

**References**

**Limiting references**

This place does not cover:

<table>
<thead>
<tr>
<th>Description</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>For access control based on a file-system</td>
<td>G06F 21/6218+</td>
</tr>
</tbody>
</table>
G06F 21/6218
{to a system of files or objects, e.g. local or distributed file system or database}

Definition statement
This place covers:
Examples:
- Access rights in databases provided by user capability lists.
- How the file system or the operating system enforce access rights.

G06F 21/6227
{where protection concerns the structure of data, e.g. records, types, queries}

Definition statement
This place covers:
Examples:
- The security is at the level of records in a structured file or database, there is a field for each record dedicated to protecting this record and containing for instance a security level, access rights or encryption keys.
- The structure of the database (tables, records, views, queries, stored procedures...) is the target of the security, and by doing this the data is protected.
- Particular case : if the protection is "outside" the database, e.g. rules stored outside the DB and enforced when the DB is queried, because "outside" becomes "inside" if the security is based on database-queries.

References

Limiting references
This place does not cover:

| Data structures not related to security | G06F 16/00 |

Informative references
Attention is drawn to the following places, which may be of interest for search:

| Information retrieval (from databases and internet) | G06F 16/00 |

G06F 21/6236
{between heterogeneous systems}

Definition statement
This place covers:
Problem to be solved: Maintain security when exchanging data between systems with different (heterogeneous) security architectures.
G06F 21/6245

{Protecting personal data, e.g. for financial or medical purposes}

Definition statement
This place covers:
Problem to be solved: Confidentiality of the personal data. General protection of personal data (e.g. encrypting all data, access rules, ...).

References
Limiting references
This place does not cover:
If just the link from the data to the person is protected

G06F 21/6254

{by anonymising data, e.g. decorrelating personal data from the owner’s identification}

Definition statement
This place covers:
Protecting where the data may be accessed without revealing the person's identity, e.g. by anonymising or decorrelating" Personal Data is related to a person via a link.

Without the link, the data is no longer personal private data, and needs no further protection. Decorrelating or anonymising means partly or completely removing the link.

Examples: A hospital-server with special techniques to protect the confidentiality of patient-data, where the patient data and the sickness data are stored separately.

G06F 21/629

{to features or functions of an application}

Definition statement
This place covers:
Protecting functions or features provided by specific software application like a word processor, an email client, a calendar application.

Examples: Restricting the printing function in a word processor based on access rights. Restricting entry editing in a shared calendar application.
References

Limiting references
This place does not cover:

If the protection is restricted to techniques specific to executables. G06F 21/121

Informative references
Attention is drawn to the following places, which may be of interest for search:

For access to hardware functions G06F 21/70

G06F 21/64
Protecting data integrity, e.g. using checksums, certificates or signatures

Definition statement
This place covers:
- Protection of the integrity of data only.
- Example: A contract between two individuals where the integrity of the contract is protected.
- Particular case: If the code is not executed but transferred for collaborative programming.
- Protection of the integrity of data only.
- Examples: A contract between two individuals where the integrity of the contract is protected.

References

Limiting references
This place does not cover:

When code integrity is at stake or if the verification takes place in the context of protecting computer platforms against harmful, malicious or unexpected behaviour or activities G06F 21/50

G06F 21/645
{using a third party}

Definition statement
This place covers:
Example: A notary certifies that the contract (file) is the original contract (file).

G06F 21/70
Protecting specific internal or peripheral components, in which the protection of a component leads to protection of the entire computer

Definition statement
This place covers:
The hardware itself of the component must be protected; Usage of dedicated hardware to secure an entire platform, authentication, a software or data is not enough to classify here; In most cases,
it is particular hardware that is protected, but a hardware solution to protecting data would also be
classified here; The protected asset and/or the countermeasure to be implemented in hardware.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Just-in-time application of countermeasures

G06F 2221/2125

G06F 21/74

operating in dual or compartmented mode, i.e. at least one secure mode

Definition statement

This place covers:

Two modes of operation at processor level.

Examples: 68020 supervisor mode / user mode.

References

Limiting references

This place does not cover:

When dual mode in not the main aspect is of the invention

G06F 2221/2105

G06F 21/75

by inhibiting the analysis of circuitry or operation

Definition statement

This place covers:

Examples: to counter reverse engineering; Countermeasure against analyzing microprocessor or other
components to infer which instructions are ran and retrieve statistical information about the arguments
of the instructions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Dummy operation e.g. a processor performs dummy operations as countermeasure to differential power analysis

G06F 2221/2123

Countermeasures at the cryptographic algorithm level against power analysis attacks, e.g. modifying the S-Box layout in a DES algorithm

H04L 9/003
**G06F 21/755**

{with measures against power attack}

**Definition statement**

*This place covers:*

Software and hardware measures against monitoring of power consumption to obtain information about the system such as differential power attack or simple power attack.

**Examples:**
- Hide boot order.
- Multiple processors to hide power consumption.
- Algorithm design for general purpose processor.
- Use special hardware logic.
- Execute dummy instructions.
- Randomize execution flow.
- Change instruction clocking.
- Hide memory / register accesses.

**G06F 21/77**

in smart cards

**Definition statement**

*This place covers:*

Only for protection of the smartcard as such.

**G06F 21/78**

to assure secure storage of data (address-based protection against unauthorised use of memory G06F 12/14; record carriers for use with machines and with at least a part designed to carry digital markings G06K 19/00)

**References**

**Limiting references**

*This place does not cover:*

| Protection of disk controllers (input/output device) | G06F 21/82 |

**Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

| Chip on media | G06F 2221/2121 |
G06F 21/79
in semiconductor storage media, e.g. directly-addressable memories

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection Method</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address-based protection against unauthorised use of memory</td>
<td>G06F 12/14</td>
</tr>
<tr>
<td>Secure firmware programming</td>
<td>G06F 21/572</td>
</tr>
<tr>
<td>Record carriers for use with machines and with at least a part designed to carry digital markings</td>
<td>G06K 19/00</td>
</tr>
</tbody>
</table>

G06F 21/80
in storage media based on magnetic or optical technology, e.g. disks with sectors (preventing unauthorised reproduction or copying of disc-type recordable media G11B 20/00)

References
Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Protection Method</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventing unauthorised reproduction or copying of disc-type recordable media</td>
<td>G11B 20/00</td>
</tr>
<tr>
<td>Usage of defectuous sectors for copy protection</td>
<td>G11B 20/00086</td>
</tr>
</tbody>
</table>

G06F 21/805
{using a security table for the storage sub-system}

Definition statement
This place covers:
Examples: Access Control Lists stored in a disk controller.

G06F 21/83
input devices, e.g. keyboards, mice or controllers thereof

Definition statement
This place covers:
Examples: Keyboard with password locking mechanism embedded in the keyboard.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

Biometric input devices G06F 21/32
**G06F 21/84**

output devices, e.g. displays or monitors

**Definition statement**

*This place covers:*

Examples:

Protecting data shown on a display.

Hardware solution for protecting displayed data.

**References**

**Limiting references**

*This place does not cover:*

| Use of password or smartcard to activate session of a printer | G06F 21/608 |

---

**G06F 21/85**

interconnection devices, e.g. bus-connected or in-line devices

**Definition statement**

*This place covers:*

Examples:

Encryption circuit between motherboard and hard-disk.

Device between computer components allowing/banning interconnections therebetween in accordance with user IDs; user-specific hardware configuration.

---

**G06F 21/86**

Secure or tamper-resistant housings

**Definition statement**

*This place covers:*

Housing resisting tampering or housing with tamper detection means. The protection takes place at the housing level.

Examples:

- PC with housing-open detection switch.
- Tamper resistant circuit.

**References**

**Limiting references**

*This place does not cover:*

| The protection takes place at the chip level | G06F 21/87 |
| Secure enclosure, mechanical anti-theft mechanism if no computer component is protected | G08B 13/14 |
Informative references
Attention is drawn to the following places, which may be of interest for search:

- Clearing memory, e.g. to prevent the data from being stolen

G06F 21/87
by means of encapsulation, e.g. for integrated circuits

Definition statement
This place covers:
The protection takes place at the chip level.

References
Limiting references
This place does not cover:
The protection takes place at the housing level

G06F 21/88
Detecting or preventing theft or loss

Definition statement
This place covers:
Example: Hardware locks itself / is locked when outside of RF-field.
Particular cases: Send a hardware locking message to stolen device.

References
Informative references
Attention is drawn to the following places, which may be of interest for search:

- If the sent message is not to trigger hardware lock but to force authentication

G06F 2221/03
Indexing scheme relating to G06F 21/50, monitoring users, programs or devices to maintain the integrity of platforms

Special rules of classification
This group and its lower subgroups are designed for use in combination with G06F 21/50.
G06F 2221/07

Indexing scheme relating to G06F 21/10, protecting distributed programs or content

Special rules of classification

• This group and its lower subgroups are primarily designed for use in combination with G06F 21/10, they could also be used in combination with G06F 21/105 or groups under G06F 21/12 if such a combination make sense.

• The general rule is to limit to the best-suited group but there could be a plurality of groups for a document if that document discloses many relevant aspects when taken separately (e.g. a document having isolated disclosures) or in combination, in particular when a combination of groups is more suited to reflect the disclosure.

• Only classify documents here if a relevant technical implementation of the concept corresponding to the class is disclosed. Example: the group G06F 2221/0724 is not intended to be used to classify a document disclosing only the fact that the content could be edited or that the rights attached to content are modified. Only document disclosing a technical implementation of the way to achieve the content edition will be classified here. Documents disclosing a “basic” technical implementation or an implementation disclosed in more much details in other known documents will not be classified.

G06F 2221/0704

Device

Definition statement

This place covers:

The license is bound to one rendering device the user uses e.g. mp3-player, computer, mobile phone, ...

G06F 2221/0706

Domain

Definition statement

This place covers:

The license is bound to a group or type of rendering devices the user uses e.g. list, type, capabilities of devices... something the device belongs to

G06F 2221/0708

Location

Definition statement

This place covers:

The license is bound to a location
**Token**

**Definition statement**

*This place covers:*

The license is bound to something the user has e.g. token, mobile phone, recording medium, USB-stick, ... The content can be transferred from one device to another.

**Glossary of terms**

*In this place, the following terms or expressions are used with the meaning indicated:*

| Token | not rendering the content |

**User**

**Definition statement**

*This place covers:*

Binding the content to a user.

**Characteristics**

**Definition statement**

*This place covers:*

The license is bound to characteristics of the user e.g. biometrics, fingerprint, iris, behaviour.

**Domain**

**Definition statement**

*This place covers:*

The license is bound to a group the user belongs to e.g. domain, family, friends, university, library, company, ...

**Knowledge**

**Definition statement**

*This place covers:*

The license is bound to something the user knows e.g. password...
G06F 2221/0724
Editing

Definition statement
This place covers:
Any editing, modifying the content by the user.

References
Limiting references
This place does not cover:
Personalisation of content

G06F 2221/0728
Conversion

Definition statement
This place covers:
Converting content for different system requirements e.g. different Digital Right Management systems, less powerful device, interoperability, compatibility...

G06F 2221/0731
On user or administrative requirements

Definition statement
This place covers:
User defined content, specifically created on user-request or business requests.

G06F 2221/0733
Watermark

Definition statement
This place covers:
Watermark identifying e.g. content, user, device, ...

G06F 2221/0735
Restriction at operating system level

Definition statement
This place covers:
Usage restrictions implemented at Operating System to prevent e.g. access to registers, clipboard, APIs etc.
**G06F 2221/0737**

Traceability

**Definition statement**

*This place covers:*

Content traceability.

**G06F 2221/074**

Tracing pattern recognition

**Definition statement**

*This place covers:*

Content can be traced without watermarks, e.g. by looking for typical pattern or properties of the specific content.

**G06F 2221/0742**

Enhanced product

**Definition statement**

*This place covers:*

E.g. same copy for demo version / product version.

**G06F 2221/0744**

Unique instance (*G06F 2221/0702* takes precedence)

**Definition statement**

*This place covers:*

Different protection for each instance of software, e.g. creating hardware/user specific versions, binding software to specific terminals or devices

**References**

*Limiting references*

*This place does not cover:*

- **Binding**

<table>
<thead>
<tr>
<th>G06F 2221/0702</th>
</tr>
</thead>
</table>

**G06F 2221/0746**

Emerging technologies

**Definition statement**

*This place covers:*

DRM techniques that may trigger specific technology development in Digital Right Management.
G06F 2221/0748
Hiding

Definition statement
This place covers:
Hiding content, license or key e.g. inside the content, the file-system, at Operating System level, by obfuscating.

G06F 2221/0753
Distribution

Definition statement
This place covers:
Techniques of key distribution specifically designed for Digital Right Management implementation.

G06F 2221/0755
Generation

Definition statement
This place covers:
Techniques of key generation specifically designed for Digital Right Management implementation.

G06F 2221/0759
Conversion

Definition statement
This place covers:
Converting a license for e.g. different Digital Right Management system, language, version, user needs, less powerful device, interoperability, compatibility...

G06F 2221/0764
Grace period

Definition statement
This place covers:
Grace period, e.g. in offline systems the user should be able to continue for some time even if license is expired.

G06F 2221/0766
Language

Definition statement
This place covers:
How rights are defined e.g. rights definition language, grammar, syntax, semantics, graphical representation of rights, parser, right consistency...
**G06F 2221/0768**

**Editing**

**Definition statement**

*This place covers:*

Modifying or creating a license for e.g. re-distributing rights, adjustment to user-needs, license changes, business requirements, circumstances, ... also including shareware where the license is updated.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Superdistribution of content | G06F 2221/0791 |

**Special rules of classification**

G06F 2221/0791 has precedence.

**G06F 2221/0771**

**Revocation**

**Definition statement**

*This place covers:*

Methods for revoking licenses, e.g. preventing licenses to be restored again from backup, looking after copies of the license to delete all instances of the license.

**G06F 2221/0773**

**Recurrent authorisation**

**Definition statement**

*This place covers:*

Performing recurrent authorisation checks, not just at installation or loading time.

**G06F 2221/0775**

**Logging**

**Definition statement**

*This place covers:*

Logging, metering or counting e.g. copy, usage, play, transfer, move, delete, modification, time... (license logging also falls under this definition, because for logging a license is just content).
G06F 2221/0777

Return

Definition statement

This place covers:
The content or license is given back from the user/client, e.g. for floating licenses, check-in/check-out, renting, etc.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| Tools for software licence management or administration | G06F 21/105 |

G06F 2221/0782

Backup or restore

Definition statement

This place covers:
Techniques for allowing, supporting or preventing backup/restore specifically designed for DRM.

G06F 2221/0784

Fragments

Definition statement

This place covers:
Transferring fragments of content / licence for:
- Payment: shareware, part of the content/license is send after payment.
- Optimisation: incremental, differential, update... The fragment alone is not sufficient for rendering

G06F 2221/0786

Indirect via third party

Definition statement

This place covers:
Third party with special Digital Right Management aspects (e.g. third party generates and stores part of the key). The third party is not only transferring data.

G06F 2221/0788

Peer-to-Peer [P2P]

Definition statement

This place covers:
Digital Right Management systems especially adapted to peer-to-peer solutions.
References

Limiting references

This place does not cover:

| Peer to peer in general | H04L 29/06 |

G06F 2221/0791

Superdistribution

Definition statement

This place covers:

Permitting further distribution of digital content, e.g. from user to user, but still maintaining some control over re-distributed copies. License editing is frequently implied and the corresponding keyword is not necessary.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

| License editing | G06F 2221/0768 |

Special rules of classification

G06F 2221/0768 is frequently implied and should not be given (G06F 2221/0791 has precedence).

G06F 2221/0793

Synchronisation

Definition statement

This place covers:

Synchronisation between:

- (License)server: master/slave; or
- Between local and distant license.

Comprises also offline usage.

G06F 2221/0795

Transaction with ACID [Atomicity, Consistency, Isolation and Durability] properties

Definition statement

This place covers:

In an atomic transaction, a series of operations either all occur, or all do not occur (wish of content owners).
**G06F 2221/0797**

using dedicated hardware at the client

**References**

*Limiting references*

This place does not cover:

| Restricting unauthorised execution of programs by using dedicated hardware | G06F 21/123 |

**G06F 2221/21**

Indexing scheme relating to G06F 21/00 and subgroups addressing additional information or applications relating to security arrangements for protecting computers, components thereof, programs or data against unauthorised activity

**Definition statement**

This place covers:

Secondary and transversal aspects to G06F 21/00.

**Special rules of classification**

G06F 2221/03 Secondary and transversal aspects specific to G06F 21/50+

G06F 2221/07 Secondary and transversal aspects specific to G06F 21/10+

**G06F 2221/2101**

Auditing as a secondary aspect

**Definition statement**

This place covers:

Logging history of events.

**References**

*Limiting references*

This place does not cover:

| When the main aspect of the invention is auditing or monitoring | G06F 21/552, G06F 21/554 |
### G06F 2221/2103

**Challenge-response**

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Authentication</th>
<th>G06F 21/30</th>
</tr>
</thead>
</table>

### G06F 2221/2105

**Dual mode as a secondary aspect**

**Definition statement**

This place covers:

Computer working in two or more modes, e.g. protecting platform using secure/non secure mode, user/administrator mode.

**References**

**Limiting references**

This place does not cover:

| When the main aspect of the invention relates to protecting specific internal components or peripheral devices operating in dual or compartmented mode. | G06F 21/74 |

### G06F 2221/2107

**File encryption**

**Definition statement**

This place covers:

Use of unusual or unconventional encryption techniques.

### G06F 2221/2109

**Game systems**

**Definition statement**

This place covers:

Specific solutions for security of games within the context of G06F 21/00, e.g. special memory game cartridge, casino machines.

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

| Coin-freed apparatus for games, toys, sports or amusements | G07F 17/32 |
**G06F 2221/2115**  
*Third party*  
*Definition statement*  
*This place covers:*  
When the involvement of a third party is essential.

**G06F 2221/2117**  
*User registration*  
*Definition statement*  
*This place covers:*  
Use of unusual or unconventional user registration.

**G06F 2221/2119**  
*Authenticating web pages, e.g. with suspicious links*  

**References**  
*Informative references*  
Attention is drawn to the following places, which may be of interest for search:

- Protecting computer platforms against harmful, malicious and unexpected behaviours or activities at application loading time

**G06F 2221/2123**  
*Dummy operation*  
*Definition statement*  
*This place covers:*  
e.g. a processor performs dummy operations as countermeasure to differential power analysis.

**G06F 2221/2127**  
*Bluffing*  
*Definition statement*  
*This place covers:*  
e.g. pretending to have connected a user to a real node when in fact the connection is to a dummy.

**G06F 2221/2135**  
*Metering*  
*Definition statement*  
*This place covers:*  
Counting events for security purposes.
References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metering</td>
<td>G06F 2221/0775</td>
</tr>
</tbody>
</table>

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term monitoring or reporting</td>
<td>G06F 21/552</td>
</tr>
<tr>
<td>Monitoring involving event detection and direct action</td>
<td>G06F 21/554</td>
</tr>
<tr>
<td>Auditing</td>
<td>G06F 2221/2101</td>
</tr>
</tbody>
</table>

G06F 2221/2139

Recurrenc verification

Definition statement

This place covers:

Periodically carrying out authorization checks after initial installation or loading.

References

Limiting references
This place does not cover:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>when the main aspect of the invention is recurrent authorisation</td>
<td>G06F 2221/0773</td>
</tr>
</tbody>
</table>

G06F 2221/2145

Inheriting rights or properties, e.g., propagation of permissions or restrictions within a hierarchy

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Topic</th>
<th>CPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting data against unauthorised access or modification by protecting access to a system of files or objects</td>
<td>G06F 21/6218</td>
</tr>
</tbody>
</table>

G06F 2221/2147

Locking files

Definition statement

This place covers:

Concurrent access, collaborative control, e.g. when two users with different access rights concurrently edit the same document.
References

Informative references

Attention is drawn to the following places, which may be of interest for search:

<table>
<thead>
<tr>
<th>Protecting data against unauthorised access or modification by protecting access</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F 21/62</td>
</tr>
</tbody>
</table>

G06F 2221/2149

Restricted operating environment

Definition statement

This place covers:

E.g. creating a user-specific working environment, parental control.

G06F 2221/2153

Using hardware token as a secondary aspect

Definition statement

This place covers:

Use of hardware tokens, smart cards or dongles.

References

Limiting references

This place does not cover:

<table>
<thead>
<tr>
<th>When used for restricting or protecting executable software</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F 21/123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When for purposes of authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F 21/34</td>
</tr>
</tbody>
</table>