Paper 1 | GCSE Computer Science | **Components of a computer system**

Computer systems consist of hardware & software.
Hardware= physical stuff (CPU/ motherboard/ monitor & Printer)
Software= programs/applications e.g. operating system or video game).

Embedded systems are computers inside larger systems
- Examples include dishwashers, microwaves and TVs (**dedicated** systems).
- Used as **control systems** to **monitor and control** e.g. dishwasher controls water pumps and thermostat. ****Advantages- faster, cheaper, less power****

CPU- Fetches, decodes and executes instructions. Contains-
- **Control Unit- Decodes** instructions/ Sends **control signals** to control how data moves around the CPU.
- **Arithmetic Logic Unit**- does the calculations/ performs AND, OR, NOT and Binary Shifts/ contains the accumulator.
- **Cache- fast** access to **frequently used instructions** and **data** without having to go to the main memory **(RAM).**

CPU and system performance

Clock Speed
- Number of **instructions** a processor core can carry out per sec (Hz).
- Average 3.5GHz (3.5 billion instructions per second).
- **Higher clock**= more instructions.
- **Overclocked=** higher clock speed causes overheating and damage to system.

Number of cores
- Each core processes data independently.
- More cores means CPU can carry more instructions so faster processing.

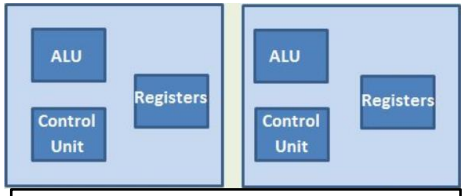
Cache Size- Larger cache give CPU faster access to more data to process.

Memory

RAM (random access memory)-
- Main memory where data, files and programs are stored when used.
- When computer boots, operating system copied to RAM.
- Slower than Cache memory.
- Can be read and written to.
- It is volatile/ temporary memory, needs requires power to retain data.
- Portable entertainment games system needs some RAM to store progress data as the game is being played.

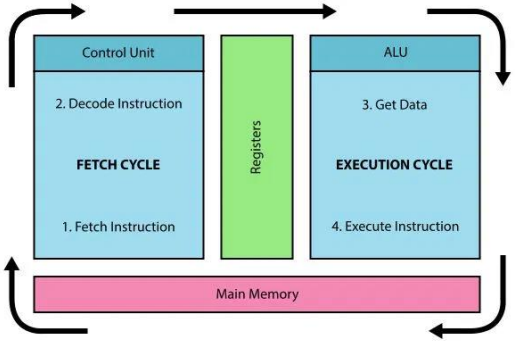
ROM (read only memory)-
- Non-volatile, can only be read NOT written to.
- Is on a chip built into the motherboard.
- Contains instructions to boot up- known as BIOS (basic input output system).
- A cartridge for a portable entertainment games system could be ROM because the instructions do not need to be changed.

Virtual Memory-
- When RAM full, application data that has not been used recently is put on virtual memory.
- Used when too many applications are open.
- If CPU needs to read data it moves it back to RAM.



Multi-tasking- ability to carry out **more than one** task at a time e.g. 2 cores can run 2 tasks simultaneously e.g. one core running word processing and one core running photo editing.

Von Neumann's Design Revolutionised Computing- describes a system where the CPU runs programs stored in memory. Programs consist of instructions and data which are stored in memory addresses.
- **Memory address register** holds the memory address used by the CPU.
- **Memory data register** holds **data fetched from** or **to be written to memory**
- **Program counter** holds the **address of the next instruction.** Once an instruction is fetched its value is increased by one.
- **Accumulator** stores intermediate results of calculations in the ALU.



Secondary Storage

How to get a faster system?

More RAM

- More applications or memory intensive applications can be run.
- Easy to upgrade RAM by replacing RAM sticks with higher capacity.

How to get a faster system?

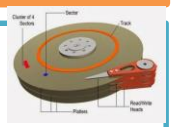
Graphics processing units

- GPUs handle graphics and image processing.
- They relieve the processing load on the CPU.
- High end GPUs used for better performance in graphics-intensive applications e.g. PC gaming and design software.

Three tiers of storage-

- **Primary-** memory areas that the CPU can access very quickly e.g. CPU registers, cache, ROM and RAM. It is the fastest read/write speeds and is mostly volatile.
- **Secondary-** Non-volatile, where all data is stored when not in use e.g. OS, applications and user files. Includes magnetic hard disk drives, solid state drives, CDs and SD cards.
- **Tertiary**- non-volatile, used for storing data more long term, used for archives and backs ups of large amounts of data. Examples include magnetic tape library.

Magnetic Hard Disks



- **Hard disk drives (HDDs)**- internal storage in PCs and laptops.
- Made of a stack of magnetised metal disks spinning 5400-15000 rpm (revolution per min).
- Data stored magnetically in sectors within circular tracks. Read/write heads on moving arm access the sectors.
- Used for backing up and transporting large amounts of data.
- **Advantages-** Cheaper/ Higher capacity/ Longer read/write life. **Disadvantage-** Can be noisy.

Solid state drives

- Storage devices with no moving parts. Most use flash memory.
- Have faster read/write times than HDDs. Quicker times for booting up and opening programs and files.

Advantages- Faster/ Don't need fragmentation/ More shock proof/ Silent.

Optical Discs

- Like CDs, DVDs and Blue-Ray.
- CDs- 700MB, DVD-4.7GB, Blue-Rays-25GB.
- Read only- CD-ROM/ DVD-ROM/ BD-ROM
- Write-once- CD-R/ DVD-R/ BD-R
- Rewritable- CD-RW/ DVD-RW/ BD-RW
- Declining in use because- Streaming and downloading increased e.g. Netflix, I-tune. Phones and tablets don't have optical drives.
- Advantages- cheap, portable and wont be damaged by water or shocks.

Magnetic tapes

- Greater storage capacity than HDDs and low cost.
- Used by large organisations for archiving data.
- Made of plastic cassettes (reels of tape).
- Tape is read/written sequentially i.e. start to end.
- Very slow to find data but fast to read/write when the correct place is found.

Flash memory

- Consumes very little power.
- Good capacity but less than hard disk.
- Used in hand held devices e.g. mobile phones.
- Examples include pen drives, SD cards.
- Used to expand the storage capacity of small devices.
- **A good choice for a cartridge for a portable entertainment games system because it could-** store the players progress when game switched off/ retain the settings/ continued on another system as the saved data is transferred with the game instructions on the cartridge/ more reliable.

Characteristics to consider when choosing secondary storage-

Capacity- Maximum amount of data that can be held.

Speed- How quickly data can be accessed e.g. 10 gigabytes per second.

Portability- How easy it is to move from one computer to another.

Durability- how robust is the medium?

Reliability- how resilient and long lasting is the medium?

Costs- price per gigabyte or megabyte.

Storage media comparison table

Medium	Type	Capacity	Speed of access	Portability	Durability	Reliability	Typical use
Hard disk	Magnetic	500 GB-12 TB	Slow	Internal devices are fixed. External hard disks are portable	Reasonable, but prone to damage if dropped or knocked	Generally very reliable if looked after	Long-term storage of programs and data
CD-ROM/R	Optical	640 MB	Very slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives, copies of data, distribution of programs and music
CD-RW	Optical	640 MB	Very slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Copies of data, transferring files between computers
DVD-ROM/R	Optical	4.7 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, copies of data, distribution of games, TV programs and movies
DVD-RW	Optical	4.7 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives, copies of data
Blu-ray-ROM/R	Optical	50 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Distribution of TV shows and movies
Blu-ray-RW	Optical	50 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives
Solid-state drive	Flash memory	256 GB-4 TB	Very fast	Internal devices are fixed. External hard disks are portable	Robust and resilient	Reliable	Long-term storage of programs and data where high performance is required
USB memory stick	Flash memory	2 GB-2 TB	Fast	Very portable	Robust and resilient	Reliable	Copies of data, transferring files between computers

Systems Software

Systems software is software designed to run and maintain a computer system. By far the most important one is the operating system (OS). There are also utility software.

Operating Systems- ***Communicates*** with internal and external hardware.

- Provides **user interface**, allowing user to interact with a computer.
- Platform for different applications to run.
- Allows computer to multi-task by controlling memory resources and the CPU.
- File and Disk management.

Operating system allows Multi-Tasking by managing resources

- Provides a platform to run applications (by configuring hardware so they can use it, and give access to the CPU and **memory**).
- Helps the CPU carry out multi-tasking by **managing memory** and CPU processing time.

Operating system- file and disk management

- Copying files, renaming files, deleting files, organising files into folders.
- Stores data as files e.g. images, spreadsheets. They have file extensions (.jpg, mp3, .mpeg). File extensions tell the computer which software should be used to open the file.
- Manages the hard disk by deciding which sector to write data to and keeps track of free space.
- Maintains hard disk with **utility software** and **defragmentation software**.

OS systems deal with user accounts

- **Single user** OS e.g. windows 10 allow x1 user to use the computer.
- **Multi- user** OS on supercomputers like mainframes gives multiple users access.
- Provides user control- access to resources varies per account.
- **Anti-theft** to prevent other users from accessing locked devices or accounts to steal information. Accounts maybe **password** or **pin** protected. Some have **patterns**, **fingerprinting** or **retina** access.

Device drivers- Act as a ***translator*** for signals between OS and hardware.

- When computer is booted up, OS chooses correct driver for the hardware it detects.
- Updates are released to fix bugs, add features, improve performance.

User interface- Allows user to ***interact*** with computer system.

- **Graphical User Interface-** visual, interactive and intuitive e.g. windows, icons, menus and pointers- easy to use.
- **Command line-** text based, less resource heavy, greater range of commands available for advanced users, can automate processes with scripts.
- **Menu-** successive options/menus shown to the user, single option at each stage, easy to follow for the user.

Utility Software

Defragmentation-puts broken files back together

- Files are stored in available spaces but over times gaps appear on the disks.
- When writing to the Disk the OS splits files into smaller blocks to fill the gaps.
- Over time the disk is more fragmented, slowing the read/write time.
- Defragmentation reorganises data on the hard drive. It also moves files to collect all the free space.

Backup utilities- backs up data

- Copy of computer system files and settings stored externally.
- Data loss can occur by fire, theft, flood, malware, hardware failure.
- **Full backup-** copy taken of every file on system. Takes up lots of storage space. Takes a long times.
- **Incremental backups-** only files created or edited since last backup copied. Less storage/ quicker.

Command line.

Compression software- Reduces file size so less disk space e.g. .zip files. Needs to be extracted before used.
Encryption software- Scrambles (**encrypts**) data to stop third parties accessing it. Decrypted using a special 'key'.

Open source and proprietary software

Open source software- software given away with its source code.

- Source code is freely available and legally modified to create their own spin off software.
- Examples include Mozilla Firefox (web browser) and VLC media player.
- Linux is an open source operating system. Android was developed from it.
- Supported by a strong online community (forum of users sharing ideas and solving problems).
- Users help improve the software and suggest bug fixes and improvements.

Proprietary software- closed source software.

- Software where only the compiled code is released. Source code is a guarded secret.
- License restricts modification, copying and redistribution.
- Paid for.
- Examples include Microsoft and Adobe.
- Businesses use proprietary because it has better customer support options.

Advantages of Proprietary

- Comes with warranties, documentation and customer support.
- Well tested and reliable.
- Cheaper for companies than building their own.
- Fixes and updates are regular.

Disadvantages of proprietary

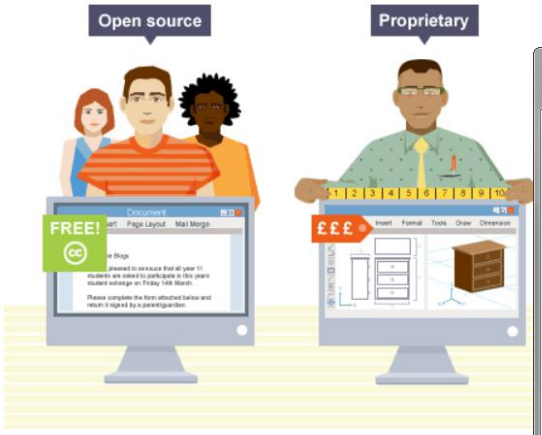
- Can be expensive.
- Might not meet users needs.
- Older versions of software might not be maintained.

Disadvantages of Open Source

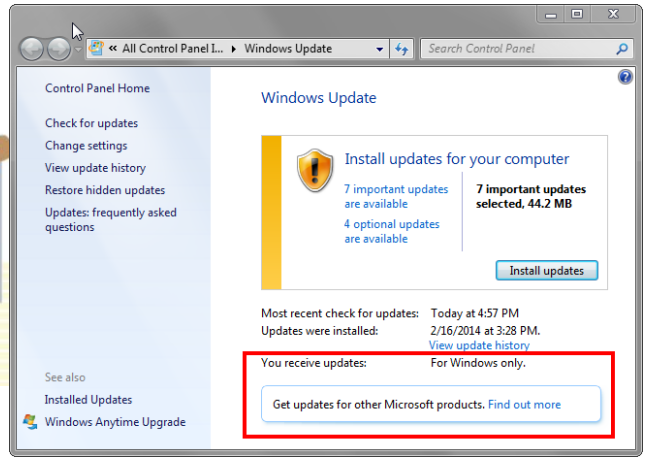
- Small projects don't get regular updates.
- Could be buggy.
- Limited user guides.
- No customer support.
- No warranties if something went wrong.

Advantages of Open Source

- Free.
- Benefits everyone, encourages collaboration, sharing of ideas.
- Software adapted to fit users needs.
- More collaborators means more creativity and innovation.
- Reliable and secure.



Microsoft



Components of a computer system

What is the purpose of the CPU?

What is the name of the component that performs calculations and decisions?

The program counter and accumulator are examples of what components of a CPU?

What is the purpose of the cache?

Give an example of an embedded system and explain why it is a computer system.

What is the purpose of the memory data register?

Explain the purpose of the program counter and how its value changes.

A von Neumann machine fetches and executes instructions from memory. Explain the first three stages of this cycle, naming the three registers used.

What are the three factors that affect the speed of a CPU? Explain how each one does this.

What two functions does the control unit perform?

Memory

What is the purpose of the ROM in a typical desktop computer?

What is the purpose of RAM?

Describe three differences between RAM and ROM.

Explain why virtual memory is needed

Give an example of flash memory in a typical desktop PC, and explain why it must be read/write memory.

Explain why a cartridge for a portable entertainment games system could be ROM

Explain why a portable entertainment games system needs some RAM

Explain why flash memory may be a good choice for a cartridge for a portable entertainment games system.

Open source and proprietary software

Write a definition of open source software.

Write a definition of proprietary source software.

Discuss the differences between open source and proprietary source software.

Explain two advantages and disadvantages for both open source and proprietary software.

Storage

What is the purpose of secondary storage?

State four characteristics that should be considered when choosing secondary storage devices for a given application.

State what is meant by the capacity of a device.

Put the following devices in order of capacity, lowest to highest: DVD-R, CD-R, Blu-Ray™.

Evaluate the merits of a hard disk drive or a solid state drive to use as the secondary storage in a laptop computer.

If one postcard sized photo is 6MB what would 200 photos be in GB?

If a music file is 6MB for 3min what would 21 tracks be in GB?

If a 1 page word document was 0.1MB, what would a 120 essays, each 3 pages long?

Systems software

What is the purpose of systems software?

State one type of user interface.

Describe two features of the user interface.

What does the term 'multi-tasking' mean?

Explain why a cartridge for a portable entertainment games system could be ROM.

Explain two ways in which an operating system manages the memory of a computer.

State the purpose of the device driver.

What is a 'multi-use' operating system?

What are 4 common file management actions an operating system facilitates?

Explain the difference between a full back up and an incremental backup.

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