



GCSE Computer Science Knowledge Organiser

SLR 1.2.1 Memory and Storage:

RAM, ROM and Virtual Memory

The Need for Primary Storage

Primary storage consists of:

- Random-Access Memory (RAM)
- Read-Only Memory (ROM)
- Registers
- Cache

It holds data and instructions that the CPU needs to access while the computer is running.

The CPU can access data far more quickly from primary memory than from secondary storage.

Features

- Volatile: when device is turned off and no power, all instructions and data are lost – all except ROM.
- Relatively small capacity compared to secondary storage.
- Very fast access times compared to secondary storage.

Virtual Memory

- Virtual memory is required when there is not enough physical RAM to store open programs.
- Virtual memory is stored on the hard disk.
- Programs are transferred out to virtual memory from RAM when they are not currently executing.
- Programs are transferred back to RAM from virtual memory when they are required.

Random-Access Memory (RAM)

- Temporarily holds programs and data currently in use by the CPU.
- Volatile (contents are lost when the computer is powered off).
- Read-and-write.
- Large compared to ROM.



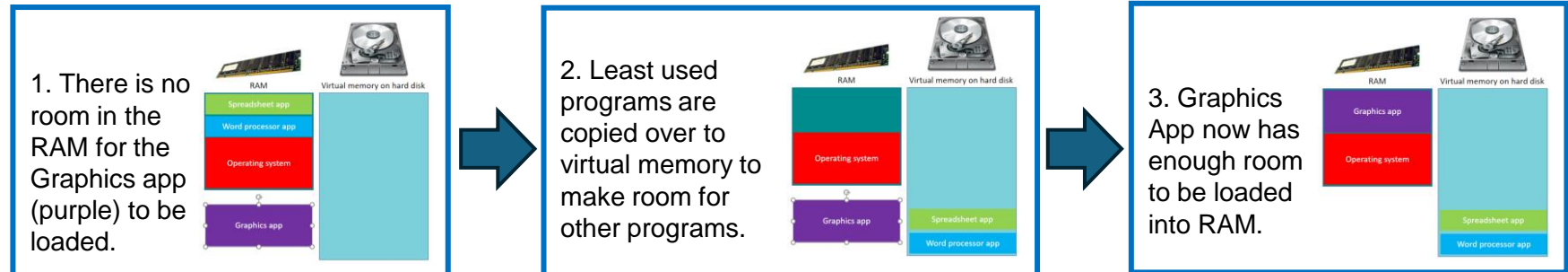
Read-Only Memory (ROM)

- Holds startup instructions for the computer, known as the bootstrap.
- In embedded systems, programs may be stored in ROM.
- Non-volatile (contents are retained when the computer is powered off).
- Read-only.
- Small compared to RAM.



Key Terminology	BCS Definition
Primary Storage	“Comprised of random-access memory (RAM) and read-only memory (ROM). It holds data and instructions that the CPU can access more quickly and easily than from secondary storage devices.”
RAM	Random-Access Memory: “Volatile (data is lost when the computer is powered off). Read-and-write. Purpose: Temporary storage of currently executing instructions and data – e.g., applications and the operating system.”
ROM	Read-Only Memory: “Non-volatile (data is retained when the computer is powered off). Read-only. Purpose: Stores startup instructions, otherwise known as the bootstrap.”
Virtual memory	“Using part of the hard disk as if it were random-access memory. Allows more applications to be open than physical memory can hold.”

Virtual Memory in Action





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The Need for Secondary Storage

The Need for Secondary Storage

Secondary storage is required because ROM is read-only and RAM is volatile. Secondary storage is used for:

- Storage of programs and data when the computer is powered off.
- Modifiable, semi-permanent storage of data.
- Backing up or archiving data.

Secondary storage holds the operating system, programs and data when they are not in use

Common Types of Secondary Storage

Optical (CD-R/RW, DVD-R/RW, Blu-ray)

- Low capacity compared to other types of storage.
- Slower access speeds.
- Thin, lightweight and portable.

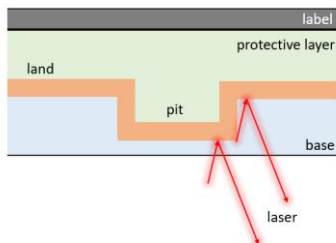


Positives

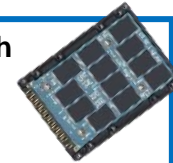
- Cheap
- Lightweight
- Portable

Negatives

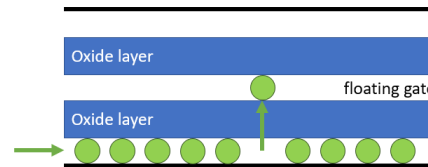
- Slow access times
- Prone to scratches



Solid-state (SSD, memory stick, flash memory card)



- Medium storage capacity.
- Fastest access speeds.
- No moving parts, so they are very reliable.
- No noise.
- Low power usage.
- Eliminates the need for defragmentation.
- Limited number of write cycles.
- Expensive compared to other types of storage.



Positives

- Durable
- Fast access times

Negatives

- Cost
- Limited lifespan

Key Terminology	BCS Definition
Secondary Storage	“Permanent storage of instructions and data not currently in use by the processor. Stores the operating system, applications and data. Read-and-write and non-volatile.”
Optical Storage	“CD-R, CD-RW, DVD-R, DVD-RW. Use: Music, films and archive files. Low capacity. Slow access speed. High portability. Prone to scratches. Low cost.”
Magnetic Storage	“Hard disk drive. Use: Operating system and applications. High capacity. Medium data access speed. Low portability (except for portable drives). Reliable but not durable. Medium cost.”
Solid State Storage	“Memory cards and solid-state hard drives (SSD). Use: Digital cameras and smartphones. Medium capacity. High portability. Reliable and durable. No moving parts. Fast data access speed. High cost.”

Magnetic (hard disk drive, tape)

- High storage capacity.
- Faster access speeds.
- Has moving parts that will eventually fail.
- Hard disks perform better if they are defragmented.

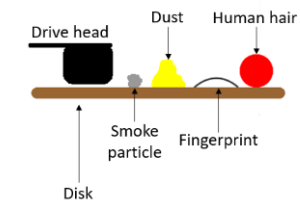


Positives

- Cheap
- Large capacity

Negatives

- Slow access times
- Fragile





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Suitable Storage Devices

The question of which storage device to use comes down to:

- **Capacity:** How much data needs to be stored?
- **Speed:** How quickly does the data need to be read or transferred?
- **Portability:** Does the data need to be transported?
- **Durability:** How robust is the media? Can it be damaged by shocks or extreme conditions?
- **Reliability:** Does the storage media need to be used over and over without failing?
- **Cost:** How expensive is the media per byte of storage?

Optical media (CD-R/RW, DVD-R/RW, Blu-ray) is suitable for:

- Large-scale, read-only data distribution.
- Low data capacity requirements.



Scenarios where Optical Media can be used:

- Distributing a video game for a console.
- A company storing training videos long-term.



Magnetic media (hard disk drive) is suitable for:

- High data capacity requirements.
- Fast data access requirements.
- Low-cost storage solutions.
- Cloud storage on server farms



Scenarios where Magnetic Media can be used:

- A travel agent business backing up 800GB of data.
- A home computer storing an operating system and applications.



Solid-state media (SSD, memory stick, flash memory card) is suitable for:

- Low-power embedded systems.
- Rugged applications.
- Low-to-medium data capacity requirements.
- Silent-operation storage solutions.
- Very fast data access requirements.
- Small, lightweight devices.



Key Terminology	BCS Definition
Storage capacity	"The amount of data a storage device can store."
Storage Speed	"The read/write access speed of a storage device."
Storage portability	"How easy it is to transport a storage device – e.g., solid-state and optical storage are highly portable, whereas magnetic storage is designed to stay in place."
Storage durability	"How resistant a storage device is to damage and wear. Devices with low durability are likely to fail earlier."
Storage reliability	"A relative measure of confidence that a storage device will function correctly and allow you to write, read, delete and modify data."
Storage cost	"The relative price of a storage device – e.g., per megabyte of data."

Scenarios where Solid-State Media can be used:

- A student transferring files between home and school.
- A helmet-mounted action camera.
- Storing audio tracks on a portable MP3 player.

