

IG CS Topic 3.7-3.9 Data Storage

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Computer Storage

Primary Storage

Random Access Memory

Read Only memory

Secondary Storage

Magnetic storage

Optical storage

Solid-state

Virtual Memory

Why it is necessary

How it is operated

Cloud Storage

Cloud Storage v.s. Local Storage

Computer Storage

- there are two main categories of storage that exist in a computer
 1. **Primary Storage**
 2. **Secondary Storage**

Primary Storage

- **Primary storage** is a type of storage that **is directly accessed by the CPU**
- there are two main types of primary storage
 1. **Random access memory (RAM)**
 2. **Read only memory (ROM)**

Random Access Memory

- it is **volatile**
 - means that if the power is turned off, the contents of the RAM are **lost**
- it stores data that **currently in use by the computer**
- its content is **constantly being changed** as different data is processed by the CPU
- It is **possible** to increase the amount of RAM
 - by adding further RAM components

Read Only memory

- it is **non-volatile**
 - means that the contents of the ROM are **retained** even if the power is removed
- it stores **programs that initially boot the computer**, such as the bootstrap and the BIOS
- its content is **fixed** and is **hard to alter**

- it is **hard** to increase the amount of ROM

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4. Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

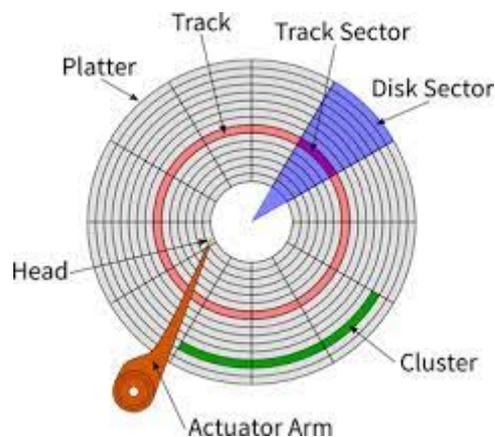
Difference between RAM and ROM

Secondary Storage

- **Secondary storage** is not directly accessed by the CPU and is necessary for more **permanent** storage of data
- examples include **CD, DVD, SSD, HDD**
- Secondary Storage uses three unique ways to store data
 1. **Magnetic**
 2. **Optical**
 3. **Solid-state**

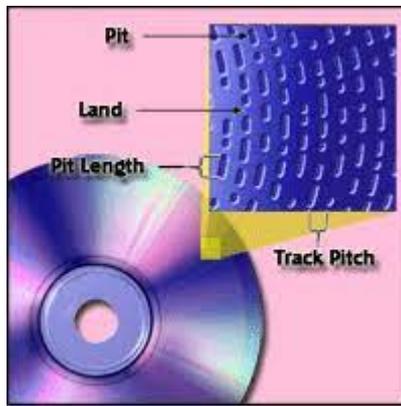
Magnetic storage

- **magnetic storage** uses **platters** that are divided into **tracks** and **sectors**. Data is read and written using **electromagnets**
- examples include **Hard Disk Drive (HDD)**



Optical storage

- **optical storage** uses **lasers** to create and read **pits** and **lands**
 - **pits** present "1"s
 - **lands** present "0"s



- examples include **Compact Disk (CD)** and **Digital Versatile Disc (DVD)**

Solid-state

- **solid-state (flash memory)** uses **NAND** or **NOR** technology
 - it uses **semi-conductor** technology
- there are two **transistors**
 - one called **control gate**, one called **floating gate**
 - When a solid state storage device is first created, all the transistors are set to the binary value 1. The electric current reaches each control gate and then flows through to the floating gate to be stored. When data is stored in the transistor, it is converted to the binary value 0.
- examples include **USB flash memory drives** and **Solid-state storage (SSD)**

Please remember the comparison chart below:

SSD	vs	HDD
faster	✓	✗ slower
shorter lifespan	✗	✓ longer lifespan
more expensive	✗	✓ cheaper
non-mechanical (flash)	✓	✗ mechanical (moving parts)
shock-resistant	✓	✗ fragile
best for storing operating systems, gaming apps, and frequently used files		best for storing extra data, such as movies, photos, and documents

Virtual Memory

- **virtual memory** is a type of memory that can be **temporarily** created as **an extension** to the RAM
 - it is not a physical memory (RAM)
- virtual memory is created with a **hard drive component**
 - a section of that hard drive is **partitioned off** and is effectively an extra bit for RAM

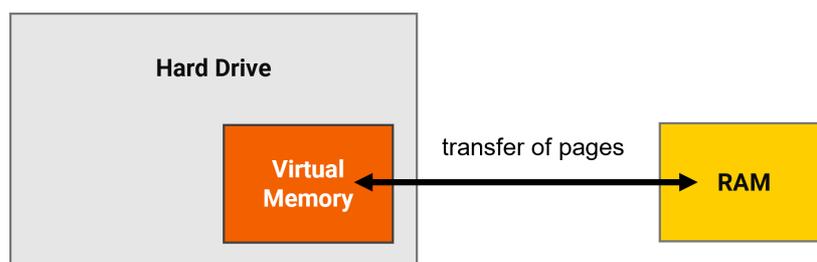
Why it is necessary

Virtual memory frees up RAM by swapping data that has not been used recently over to a storage device, such as a hard drive or solid-state drive (SSD). Virtual memory is important for improving system performance, multitasking and using large programs.

How it is operated

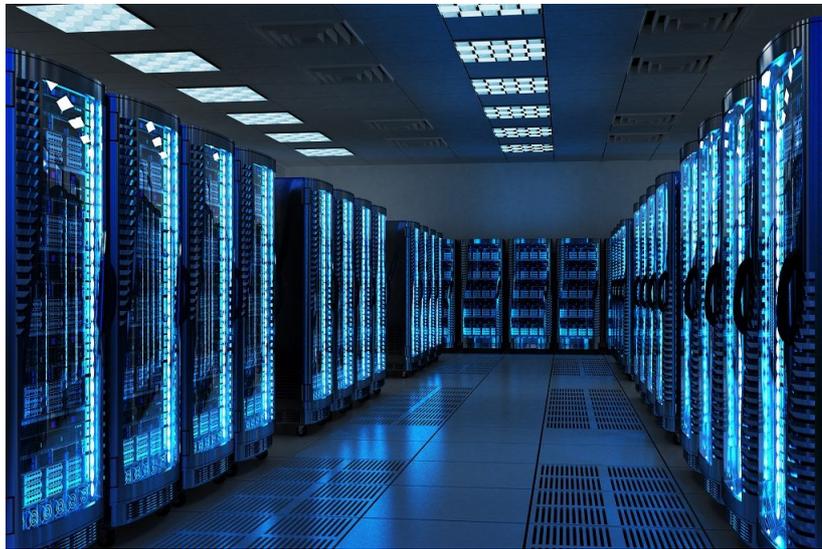
When the RAM gets full, the computer system can transfer pages of data to the virtual memory to be held there until it is needed.

- Page: a unit of data



Cloud Storage

- **cloud storage** is data storage that is owned by a **third party** and accessed by the user **using the internet**
 - it is a **collection of 3rd-party hardware**, such as computer servers, that individuals and companies can use to store data, and for a range of other services
- they appear because people found that they want and need to store larger amounts of data, and data storage is quite expensive to buy, keep and maintain
- cloud storage companies set up very large buildings that house and main thousands of computer servers to store the data
 - check out the photo below, it is pretty cool :)



Cloud Storage v.s. Local Storage

Cloud Storage	Local Storage
You do not have to pay for the hardware.	You will need to purchase the hardware, which is costly for a large amount of data.
You do not have the responsibility for the security of the hardware, it relies on the 3rd-party. However, if the 3rd-party makes a mistake, they may put your data at risk.	You will need to make sure that your data storage is well maintained.
You can access the data from anywhere using any device , if you have the internet .	You do not need an internet connection, but data is available only locally .
You can increase and decrease the amount of storage space you need very easily .	You might have redundant hardware, that you have paid for, that isn't used.