

**CSCA0101  
COMPUTING BASICS**

**Chapter 5  
Storage Devices**

# CSCA0101 Computing Basics

## Storage Devices

1. Computer Data Storage
2. Types of Storage
3. Storage Device Features
4. Other Examples of Storage Device

### Storage Devices

- A **storage device** is used in the computers to store the data.
- Provides one of the core functions of the modern computer.

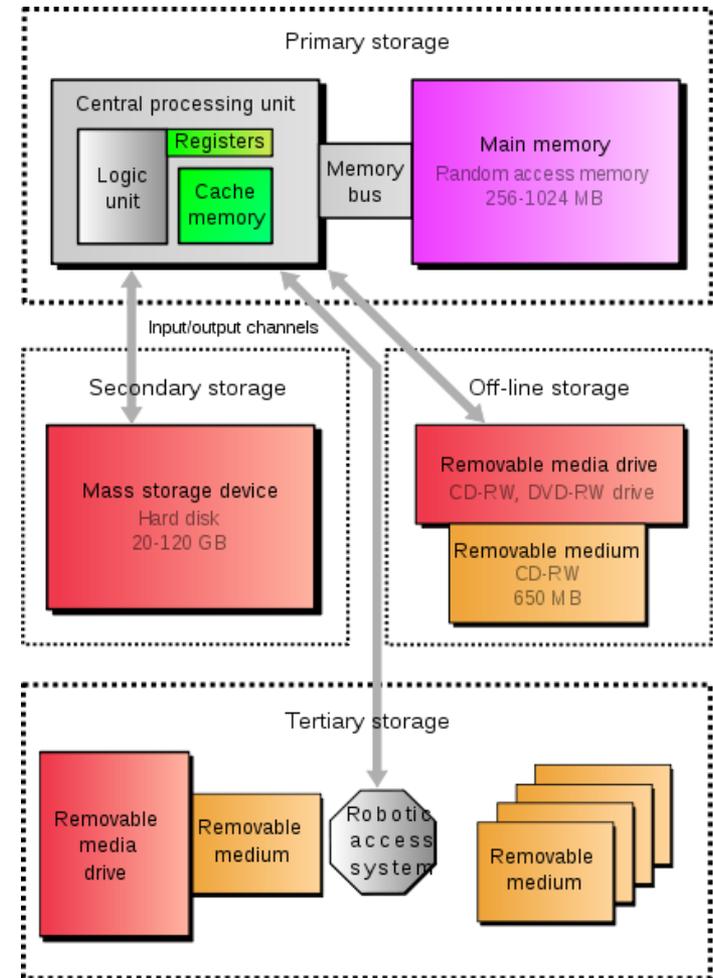
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## Storage Devices

### Types of Storage

There are four type of storage:

- Primary Storage
- Secondary Storage
- Tertiary Storage
- Off-line Storage



### Primary Storage

- Also known as **main memory**.
- Main memory is directly or indirectly connected to the central processing unit via a memory bus.
- The CPU continuously reads instructions stored there and executes them as required.
- Example:
  - RAM
  - ROM
  - Cache

### Primary Storage

#### RAM

- It is called Random Access Memory because any of the data in RAM can be accessed just as fast as any of the other data.
- There are two types of RAM:
  - DRAM (Dynamic Random Access Memory)
  - SRAM (Static Random Access Memory)

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## Storage Devices

### Primary Storage

#### RAM

Static RAM	Dynamic RAM
<ul style="list-style-type: none"><li>• Faster</li><li>• More expensive</li><li>• More power consumption</li><li>• does not need to be refreshed</li></ul>	<ul style="list-style-type: none"><li>• Slower</li><li>• Less expensive</li><li>• Less power consumption</li><li>• needs to be refreshed thousands of times per second</li></ul>
	

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## Storage Devices

### Primary Storage

#### ROM

- This memory is used as the computer begins to boot up.
- Small programs called firmware are often stored in ROM chips on hardware devices (like a BIOS chip), and they contain instructions the computer can use in performing some of the most basic operations required to operate hardware devices.
- ROM memory cannot be easily or quickly overwritten or modified.



### Primary Storage

#### Cache

- **Cache** is a high-speed access area that can be either a reserved section of main memory or a storage device.
- Most computers today come with L3 cache or L2 cache, while older computers included only L1 cache.

### Secondary Storage

- It is not directly accessible by the CPU.
- Computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage.
- Example:
  - Hard disk

### Secondary Storage

#### Hard Disk

- The hard disk drive is the main, and usually largest, data storage device in a computer.
- It can store anywhere from 160 gigabytes to 2 terabytes.
- Hard disk speed is the speed at which content can be read and written on a hard disk.
- A hard disk unit comes with a set rotation speed varying from 4500 to 7200 rpm.
- Disk access time is measured in milliseconds.

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## Storage Devices

### Secondary Storage

#### Hard Disk



Internal Hard disk



External Hard disk

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## Storage Devices

### Secondary Storage

#### Hard Disk

	<b>Internal Hard disk</b>	<b>External Hard disk</b>
Portability	No	Yes
Price	Less expensive	More expensive
Speed	Fast	Slow
Size	Big	Small

### Tertiary Storage

- Typically it involves a robotic mechanism which will mount (insert) and dismount removable mass storage media into a storage device.
- It is a comprehensive computer storage system that is usually very slow, so it is usually used to archive data that is not accessed frequently.
- This is primarily useful for extraordinarily large data stores, accessed without human operators.

### Tertiary Storage

- Examples:
  - Magnetic Tape
  - Optical Disc

### Tertiary Storage

#### Magnetic Tape

- A magnetically coated strip of plastic on which data can be encoded.
- Tapes for computers are similar to tapes used to store music.
- Tape is much less expensive than other storage mediums but commonly a much slower solution that is commonly used for backup.



### Tertiary Storage

#### Optical Disc

- **Optical disc** is any storage media that holds content in digital format and is read using a laser assembly is considered optical media.
- The most common types of optical media are
  - Blu-ray (BD)
  - Compact Disc (CD)
  - Digital Versatile Disc (DVD)

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## Storage Devices

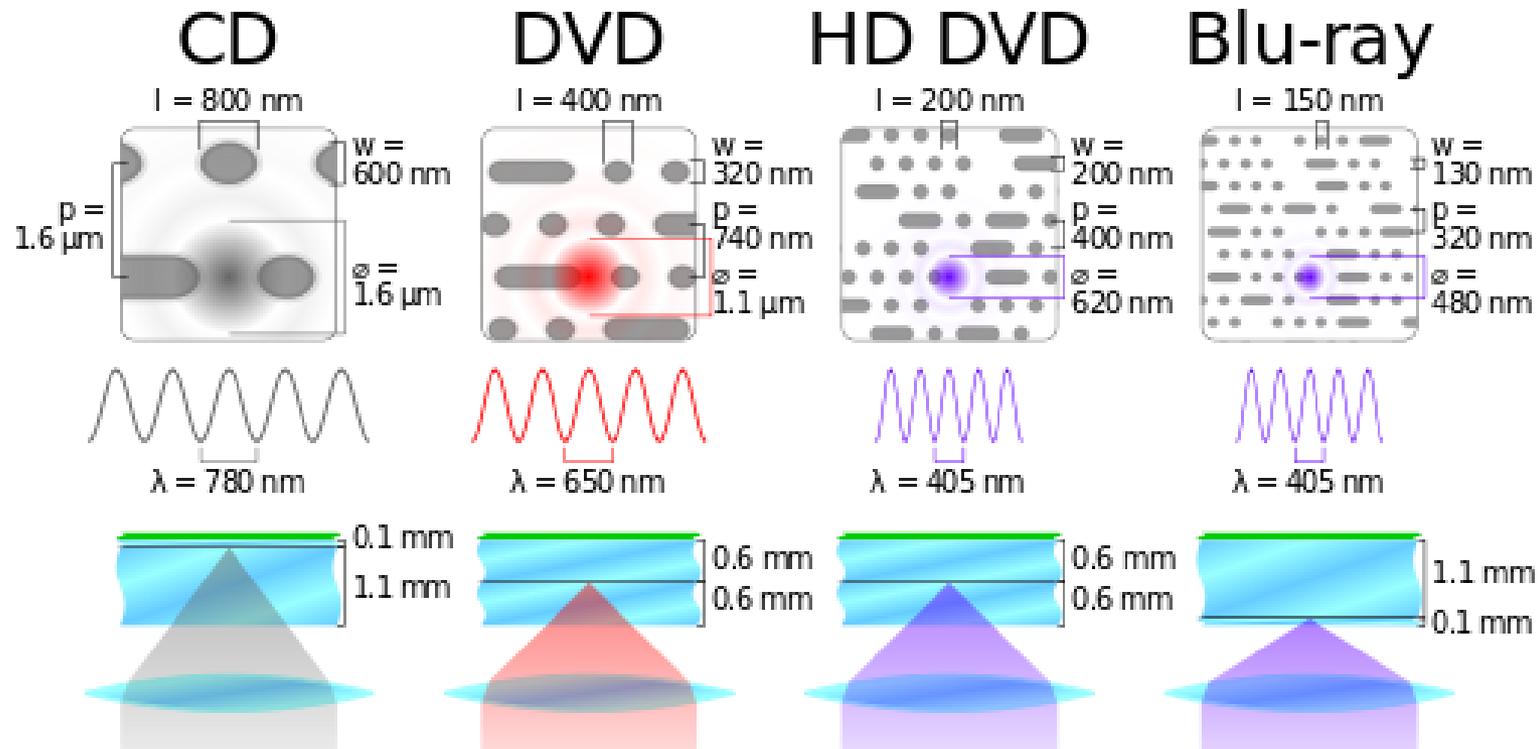
### Tertiary Storage

#### Optical Disc

	<b>CD</b>	<b>DVD</b>	<b>BD</b>
Capacity	700MB	4.7GB – 17GB	50GB
Wavelength	780nm	650nm	405nm
Read/Write Speed	1200KB/s	10.5MB/s	36MB/s
Example	<ul style="list-style-type: none"><li>• CD-ROM,</li><li>• CD-R</li><li>• CD-RW</li></ul>	<ul style="list-style-type: none"><li>• DVD-ROM</li><li>• DVD+R/RW</li><li>• DVD-R/RW</li><li>• DVD-RAM</li></ul>	<ul style="list-style-type: none"><li>• BD-R</li><li>• BD-RE</li></ul>

### Tertiary Storage

### Optical Disc



### Off-line Storage

- Also known as **disconnected storage**.
- Is a computer data storage on a medium or a device that is not under the control of a processing unit.
- It must be inserted or connected by a human operator before a computer can access it again.

### Off-line Storage

- Also known as **disconnected or removable storage**.
- Is a computer data storage on a medium or a device that is not under the control of a processing unit.
- It must be inserted or connected by a human operator before a computer can access it again.

### Off-line Storage

- Examples:
  - Floppy Disk
  - Zip diskette
  - USB Flash drive
  - Memory card

### Off-line Storage

#### Floppy Disk

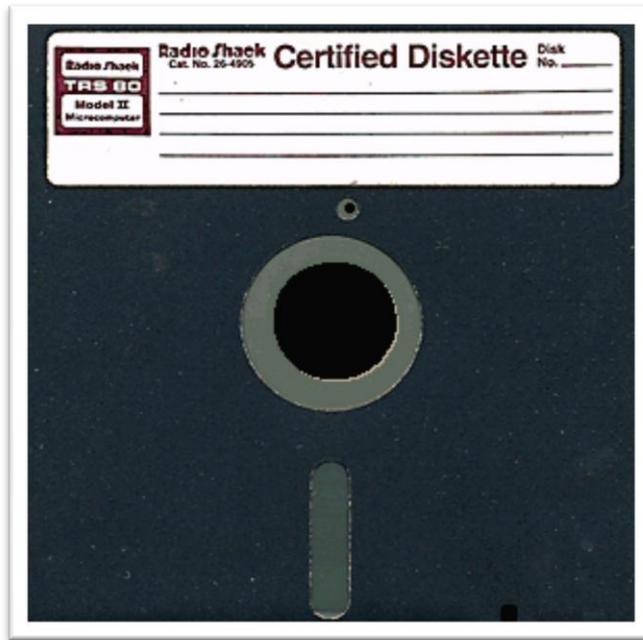
- A soft magnetic disk.
- Floppy disks are portable.
- Floppy disks are slower to access than hard disks and have less storage capacity, but they are much less expensive.
- Can store data up to 1.44MB.
- Two common sizes: 5 ¼” and 3 ½”.

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## Storage Devices

### Off-line Storage

#### Floppy Disk



5 1/4 inch Floppy Disk



3 1/2 inch Floppy Disk

### Off-line Storage

#### Zip Diskette

- Hardware data storage device developed by Iomega that functions like a Standard 1.44" floppy drive.
- Capable to hold up to 100 MB of data or 250 MB of data on new drives.
- Now it less popular as users needed larger storage capabilities.



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### Off-line Storage

#### USB Flash Drive

- A small, portable flash memory card that plugs into a computer's USB port and functions as a portable hard drive.
- Flash drives are available in sizes such as 256MB, 512MB, 1GB, 5GB, and 16GB and are an easy way to transfer and store information.



### Off-line Storage

#### Memory Card

- An electronic flash memory storage disk commonly used in consumer electronic devices such as digital cameras, MP3 players, mobile phones, and other small portable devices.
- Memory cards are usually read by connecting the device containing the card to your computer, or by using a USB card reader.

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## Storage Devices

### Off-line Storage

#### Memory Card



Secure Digital card (SD)



MiniSD



Compact Flash



Memory Stick



MultiMedia card



xD-Picture card



Memory card reader

### Storage Device Features

- Volatility
- Accessibility
- Mutability
- Addressability

### Volatility

- Two types of volatility:
  - Volatile Memory
  - Non-Volatile Memory

### Volatility

### Volatile Memory

- Requires constant power to maintain the stored information.
- The fastest memory technologies.
- All contents are erased when the system's power is turned off or interrupted.
- It has been more popularly known as **temporary memory**.

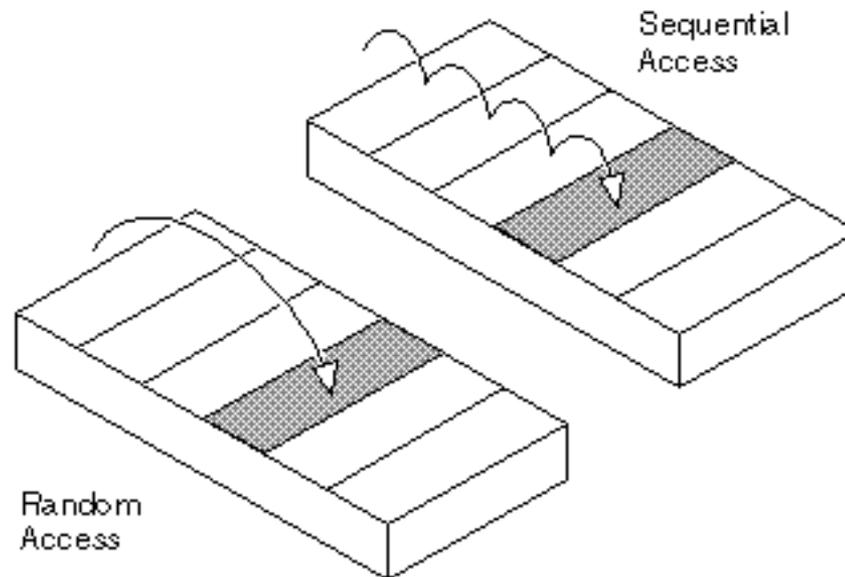
### Volatility

### Non-Volatile Memory

- Will retain the stored information even if it is not constantly supplied with electric power.
- Non volatile memory is the device which keeps the data even when the current is off.
- It is suitable for long-term storage of information.

### Accessibility

- Refers to reading or writing data records
- Two types of accessibility:
  - Random access
  - Sequential access



### Accessibility

### Random Access

- Any location in storage can be accessed at any moment in approximately the same amount of time.
- Such characteristic is well suited for primary and secondary storage.

### Accessibility

### Sequential Access

- The accessing of pieces of information will be in a serial order, one after the other; therefore the time to access a particular piece of information depends upon which piece of information was last accessed.
- Such characteristic is typical of off-line storage.

### Mutability

- Allows information to be overwritten at any time.
- A computer without some amount of read/write storage for primary storage purposes would be useless for many tasks.
- Three types of mutability:
  - Read/write storage or mutable storage
  - Read only storage
  - Slow write, fast read storage

### Mutability

#### Read/Write Storage or Mutable Storage

- Allows information to be overwritten at any time.
- A computer without some amount of read/write storage for primary storage purposes would be useless for many tasks.

### Mutability

### Read Only Storage

- Retains the information stored at the time of manufacture, and **write once storage** (WORM) allows the information to be written only once at some point after manufacture.
- These are called **immutable storage**.

### Mutability

### Slow Write, Fast Read Storage

- Read/write storage which allows information to be overwritten multiple times, but with the write operation being much slower than the read operation.

### Addressability

- Three types of addressability
  - Location-addressable
  - File addressable
  - Content-addressable

### Addressability

#### Location-addressable

- Each individually accessible unit of information in storage is selected with its numerical memory address.

### Addressability

#### File addressable

- Information is divided into files of variable length, and a particular file is selected with human-readable directory and file names.

### Addressability

#### Content-addressable

- Each individually accessible unit of information is selected based on the basis of (part of) the contents stored there.
- Content-addressable storage can be implemented using software (computer program) or hardware (computer device), with hardware being faster but more expensive option.
- Hardware content addressable memory is often used in a computer's CPU cache.

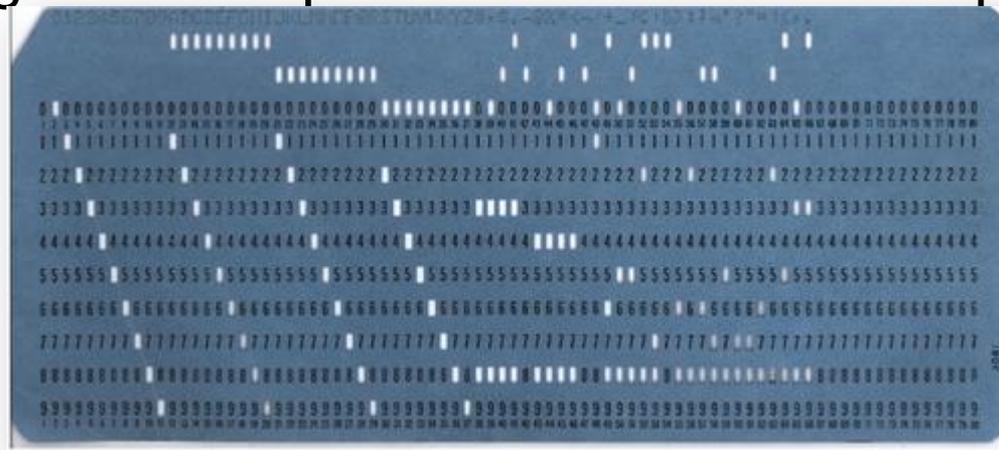
### Other Example of Storage Devices

- Punch card
- Cloud storage
- RAID

### Other Example of Storage Devices

#### Punched Card

- Early method of data storage used with early computers
- Punch cards also known as Hollerith cards
- Containing several punched holes that represents data



### Other Example of Storage Devices

#### Cloud Storage

- Cloud storage means "the storage of data online in the cloud," wherein a data is stored in and accessible from multiple distributed and connected resources that comprise a cloud.
- Cloud storage can provide the benefits of greater accessibility and reliability; rapid deployment; strong protection for data backup, archival and disaster recovery purposes.

### Other Example of Storage Devices

#### Cloud Storage

- Examples:
  - Google Drive
  - Flickr
  - Microsoft Sky Drive



Google Drive



### Other Example of Storage Devices

#### RAID

- RAID is short for **redundant array of independent** (or **inexpensive**) **disks**.
- It is a category of disk drives that employ two or more drives in combination for fault tolerance and performance.
- RAID disk drives are used frequently on servers but aren't generally necessary for personal computers.
- RAID allows you to store the same data redundantly (in multiple places) in a balanced way to improve overall storage performance.