Memory and Data Storage Devices
Memory Devices

Memory devices are electronic devices that store information for immediate use in electronic hardware. Memory devices utilize digital logic to perform their operations.

Examples:
• EEPROM
• RAM
• Flash Memory
Memory devices are often constructed with logic gates and simple memory circuits such as latches and flip-flops.

Types of Logic Gates:
- AND, OR, NOT, NAND, NOR

Types of Latches
- SR NOR, SR NAND, SR AND-OR

Types of Flip-Flops
- D Flip-Flop, T Flip-Flop, JK Flip-Flop
Memory Types

There are two main types of memory devices: volatile and non-volatile

**Volatile Memory** is memory that requires power to maintain stored information (Ex. RAM)

By contrast, **Non-Volatile Memory** is computer memory that stores information even after power has been cycled. (Ex. Flash memory)
ROM

- **Read-Only Memory (ROM)** is a type of non-volatile memory used to store programs and data.
- Traditional ROM cannot be changed after it has been written.
- EEPROM and EPROM are types of ROM that can be changed after the initial programming. The write time for such devices is often relatively slow.
- EEPROMs have a finite amount of times it be erased and rewritten.
- Often used to store software or data that is rarely changed (ex. firmware, lookup tables).
Flash Memory

- Flash memory is a type of non-volatile computer memory that can be erased and reprogrammed
- Flash memory is a type of EEPROM with larger memory block sizes
  - This means it also has a limited number of times it can be erased and rewritten
- Flash memory is often used for large solid-state digital storage
- Solid-state hard drives are often made using flash memory
RAM

- **Random Access Memory (RAM)** is a type of volatile computer memory where memory cells can be accessed in any order.
- Since programs do not need to look up addresses for memory, RAM is significantly faster than other memory devices.
- RAM is often used for programs or software that are actively being used.
• **Hard disk drives** are non-volatile memory devices used for storing large amount of data

• Data is stored in individual blocks of memory that can be stored or retrieved in any order

• Data is saved by magnetizing ferromagnetic material on a disk using a magnetic lever. The encoding allows for data to be stored even when power is lost

• Primarily used as secondary storage devices for computers.
SD Cards

- Secure Digital (SD) cards are a type of non-volatile memory devices used for portable devices
- SD cards utilize flash memory to store large quantities of data in a small physical size
- SD Cards are available in multiple storages size ranging from 512 MB to 1 TB
- SD cards are frequently used in cameras, personal computers, and embedded systems
SD Cards Physical Details

- SD cards are available in three physical sizes: standard, miniSD, and microSD
- Standard: 32 mm x 24 mm x 2.1 mm
- Mini: 32 x 20 mm x 1.4 mm
- Micro: 15 mm x 11 mm x 1.0 mm
- The pinout for each size varies
Most SD cards are formatted to contain a single file system. The capacity of the SD card is limited by the partition size. It is possible to change the partition size by reformatting the card.

- By default, most SD cards under 2GB have FAT16 partitioning. FAT16 allows for up to 2GB of storage
- FAT32 partitioning allows for up to 4GB of storage
- exFAT (FAT 64) partitioning allows for up to 2 TB of storage, but is often limited by the amount of memory on the card itself