Lecture 01
History and the Evolution of the Computer Systems
Components of a Computer System

IT1020 Introduction to Computer Systems

Part 01 – Computer Fundamentals

Pre-lecture activities

- History of computer systems
  - Major Milestones
- Diagram of Von Neumann
- Components of computer systems
- Storage devices

Lecture Outline

1. Generations of Computers
   - Characteristics of each Generation
2. Components of Computers
   - Different types of components

1. Generations of the Computers

1st Generation computers(1944-1955)

2nd Generation computers (1955-1964)

3rd Generation computers (1964-1971)

4th Generation Computers (1971- Present)

5th Generation Computers (Present and Beyond)

1. Generations of the Computers
1st Generation Computers (1944-55)

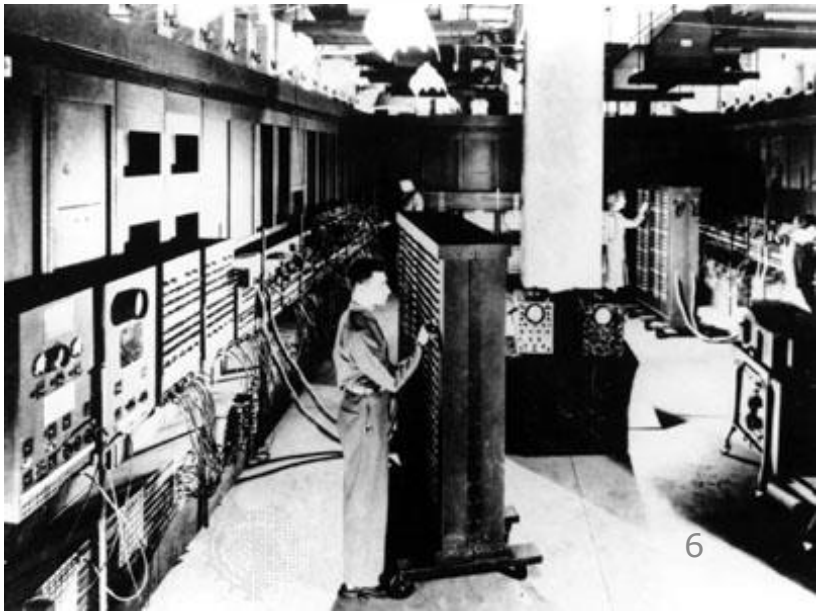
Main characteristics of this generation

- Used Thermion valves
- Large in size and very heavy in weight
- Power consumption was very high
- First Generation Computers relied on Machin Language
- Writing program on them was difficult or quite slow
- They were very expensive to operate, using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions

1. Generations of the Computers
1st Generation Computers

Electronic Numerical Integrator and Calculator (ENIAC)

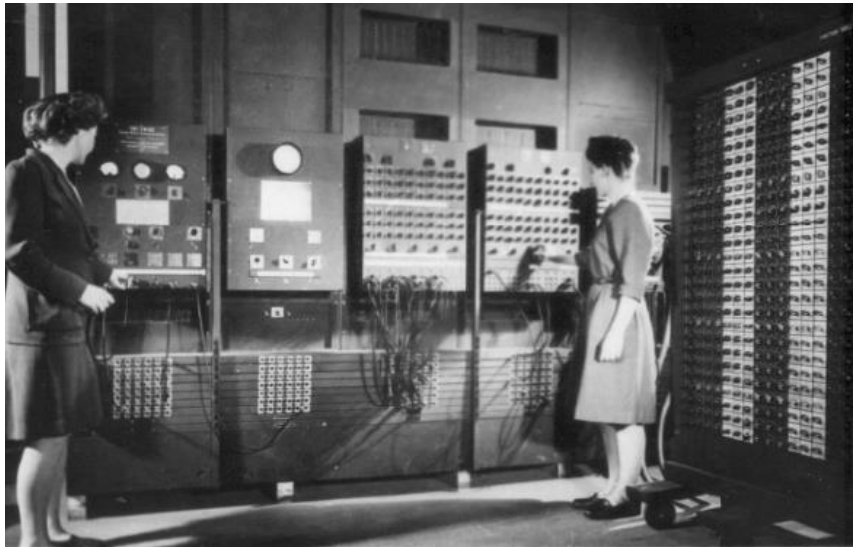
- 1946 : First electronic general purpose calculator, ENIAC was built in U.S, weighs 33 tons, consumes 150kw, and averages 5000 operations per second



1. Generations of the Computers
1st Generation Computers

Hard wired programming

- Early computers were programmed, using large number of switches in the console panel and plugging/unplugging cables
- It is called hardwired programming



Two women working with ENIAC computer

United States Army Photo.

1. Generations of the Computers
1st to 2nd generation

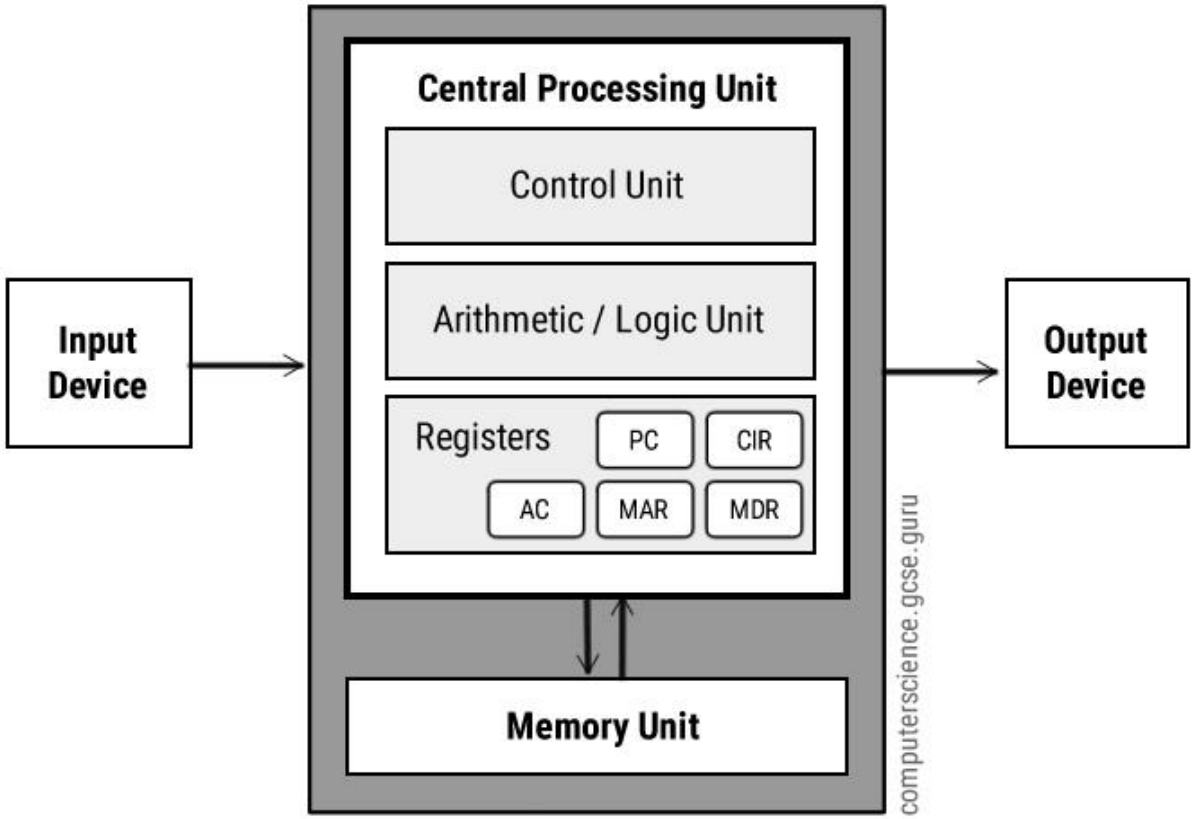
Von Neumann Architecture

- It was required re-wire and re-design the machine to run a different program. It was a manual and very tedious task
- Von Neumann proposed that programs and data can be stored in a **memory** device and instead of rewiring the machine we can change the program easily.

John Von Neumann

1. Generations of the Computers
1st to 2nd generation

Von Neumann Architecture



- All computers share the same basic architecture, whether it be a multi-million dollar mainframe or a Palm Pilot.
- All have memory, an I/O system, and arithmetic/logic unit, and a control unit.

1. Generations of the Computers
1st to 2nd generation

Von Neumann Architecture

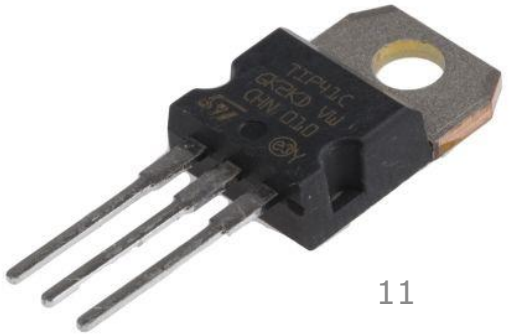
- The use of the binary number system
- A single sequentially addressed memory
- A separate arithmetic/logic unit for performing arithmetic and logical computations
- The stored program concept in which both the programs and its data are stored in memory.
- A controller that fetches instructions from memory and executes them.

1. Generations of the Computers
1st to 2nd generation

Invention of Transistor

- 1947 : Transistor, essential storage device for computers invented at Bell Labs by American engineers William Shockley, John Bardeen and Walter Bartain .

- Transistors were much smaller, more rugged, cheaper to make and far more reliable than valves.



1. Generations of the Computers
2nd Generation Computers (1955-64)

- Used transistors instead of Thermion valves.
- Comparatively higher operating speed.
- Size and weight of the computers decreased
- Manufacturing cost reduced
- The concepts of Central Processing Unit (CPU), memory, programming language and input and output unites were developed.
- High-level programming languages introduced
- Development of software for computers
- Computer industry experienced rapid growth.

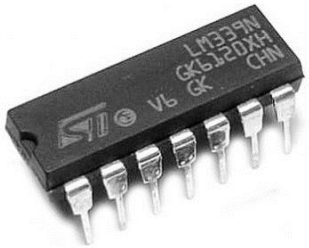
1. Generations of the Computers
2nd Generation Computers (1955-64)

IMB 1620

IMB 1401

1. Generations of the Computers
3rd Generation Computers(1964-71)

- Integrated Circuits (ICs) were used (A single IC has many transistors, resisters and capacitors built on a single thin slice of silicon.)
- The size of the computer got further reduced
- High Level Languages were developed in this generation



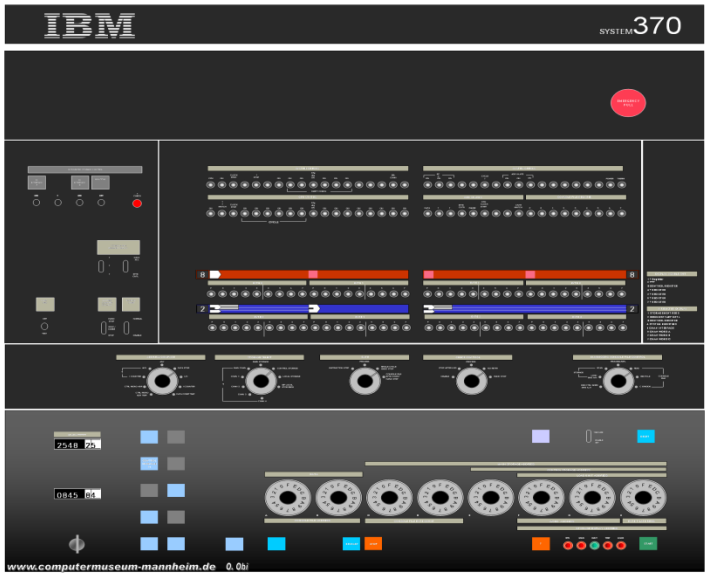
- Large IC companies were started. (INTEL started in 1968, AMD started in 1969)
- The computers were low cost, large memory and processing speed was very high.

1. Generations of the Computers
3rd Generation Computers(1964-71)

- Substantial **operating systems** were developed to manage and share the computing resources and time sharing operating systems were developed. These greatly improved the efficiency of computers.
- Computers had by now pervaded most areas of business and administration.
- Allowed the device to run many different applications at one time.

1. Generations of the Computers
3rd Generation Computers(1964-71)

IBM System/360



IBM System/370

1. Generations of the Computers
4th Generation Computers (1971-)

- Personal computers were developed and IBM launched
- the Power PC and Pentium introduced the 8088 and 8086 microprocessors. (Most of the computers at present are belong to this generation)
- It uses large scale Integrated Circuits (LSIC) built on a single silicon **chip** called **microprocessors**.
- Memory chips are in megabit range

1. Generations of the Computers
4th Generation Computers (1971-)

- On the software side, more powerful operating systems are available such as Unix.
- Fourth generation languages (4GLs) make the development process much easier and faster.
- Applications software has become cheaper and easier to use.
- Software development techniques have vastly improved.

1. Generations of the Computers
4th Generation Computers (1971-)

Microprocessor

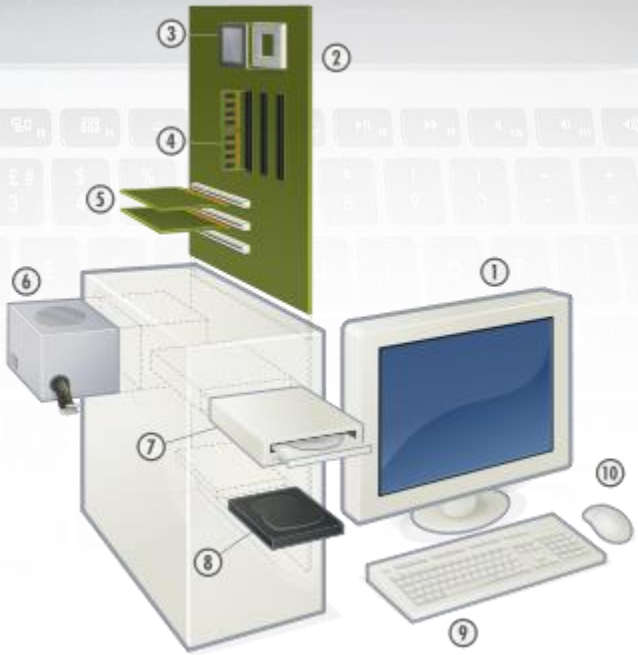
1. Generations of the Computers
5th Generation Computers

Present and beyond

- Fifth generation computing devices, based on Artificial Intelligence (AI).
- Are still in development, though there are some applications, such as voice recognition.
- The use of parallel processing and superconductors is helping to make artificial intelligence a reality.
- The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

2. Components of the Computer

1. Input devices
2. Output devices
3. Processing devices
4. Storage devices
5. Other devices
   - Motherboard, Expansion cards, Power supply



2. Components of the Computer
Basic layout

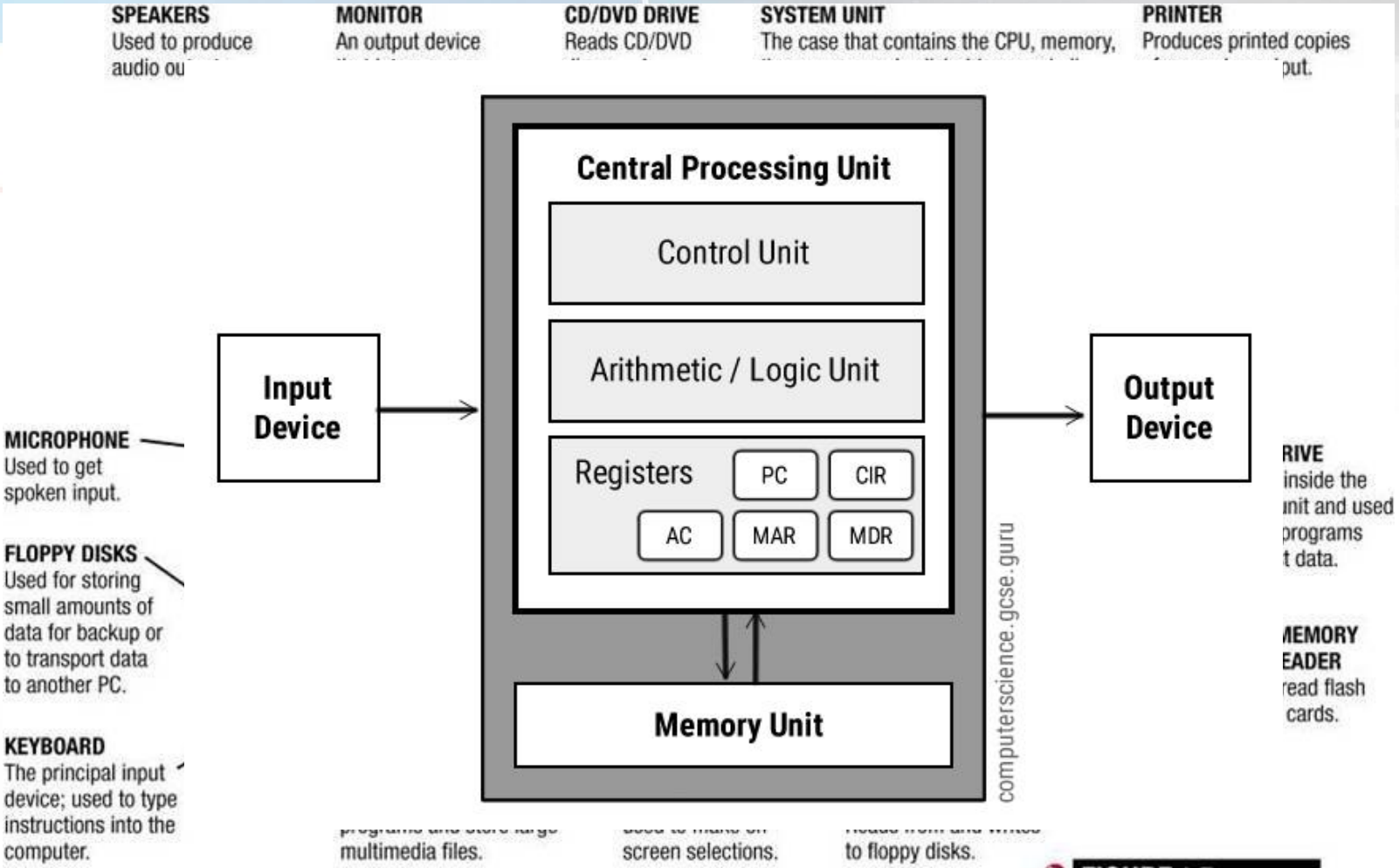
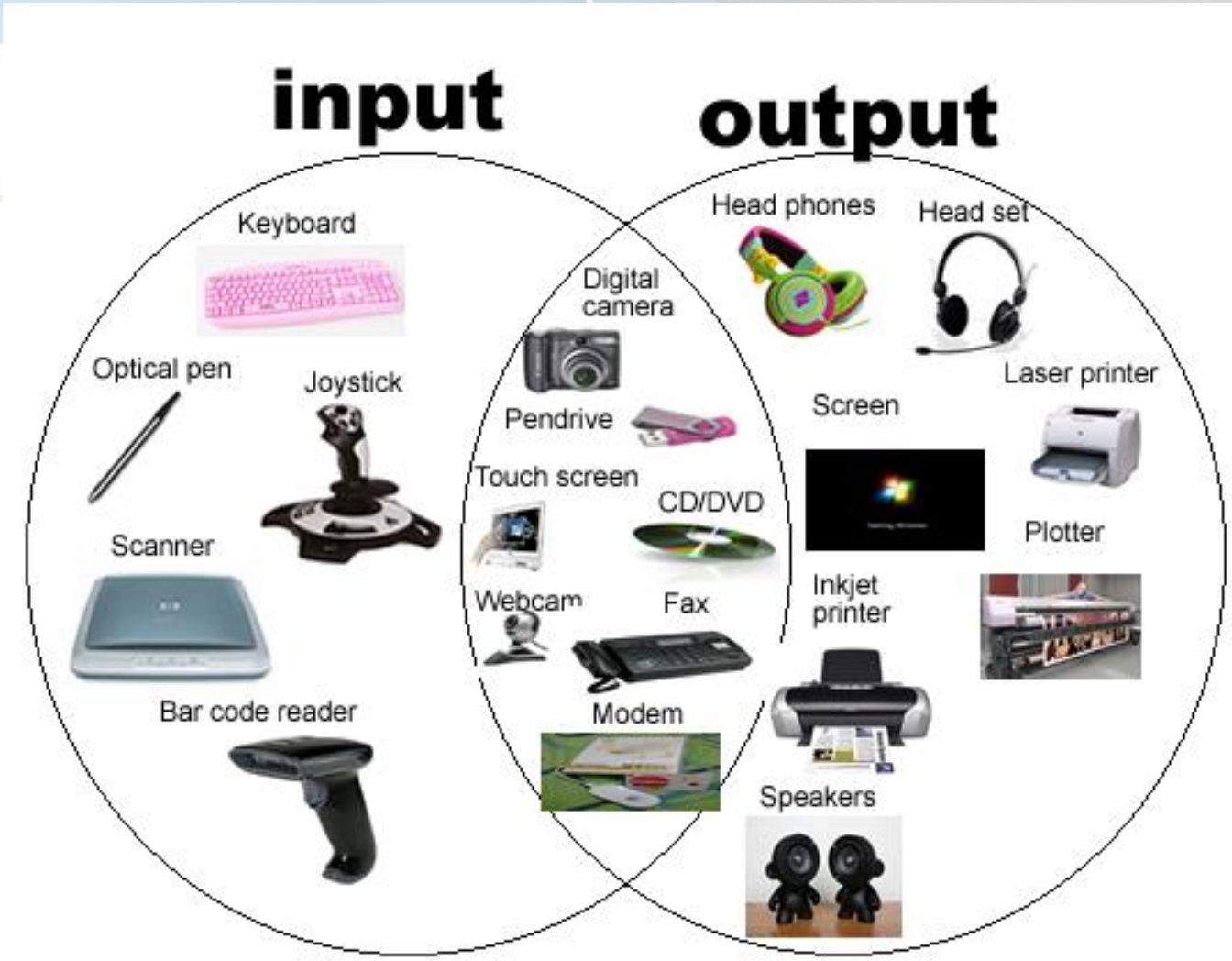


FIGURE 1-7
Typical computer hardware.

2. Components of the Computer
Input and output devices



2. Components of the Computer
Processing devices

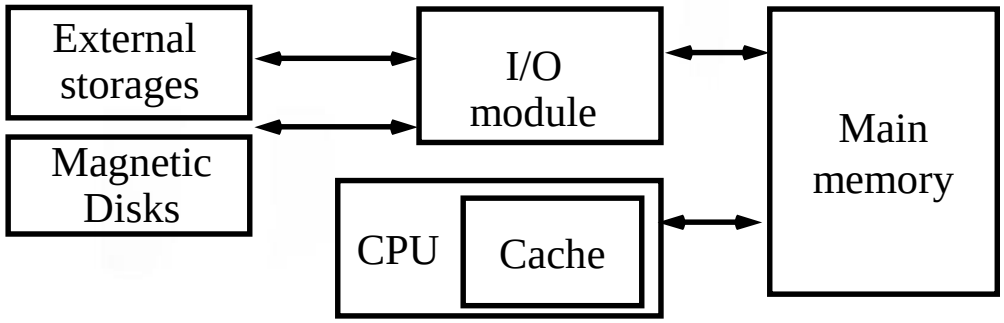
2. Components of the Computer Storage Devices – Features

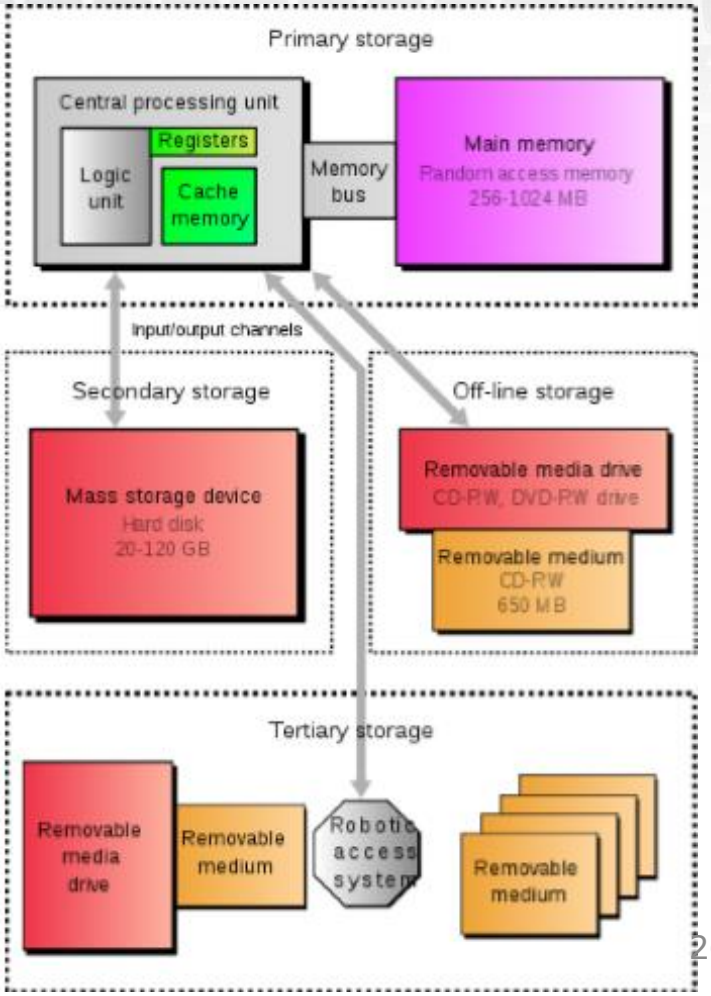
1. Volatility
   - Volatile storage
   - Non-Volatile storage
2. Accessibility
   - Random access
   - Sequential access
3. Mutability
   - Read/write storage or mutable storage
   - Read only storage
   - Slow write, fast read storage
4. Addressability
   - Location addressable
   - File addressable
   - Content addressable

2. Components of the Computer Storage Devices – Types

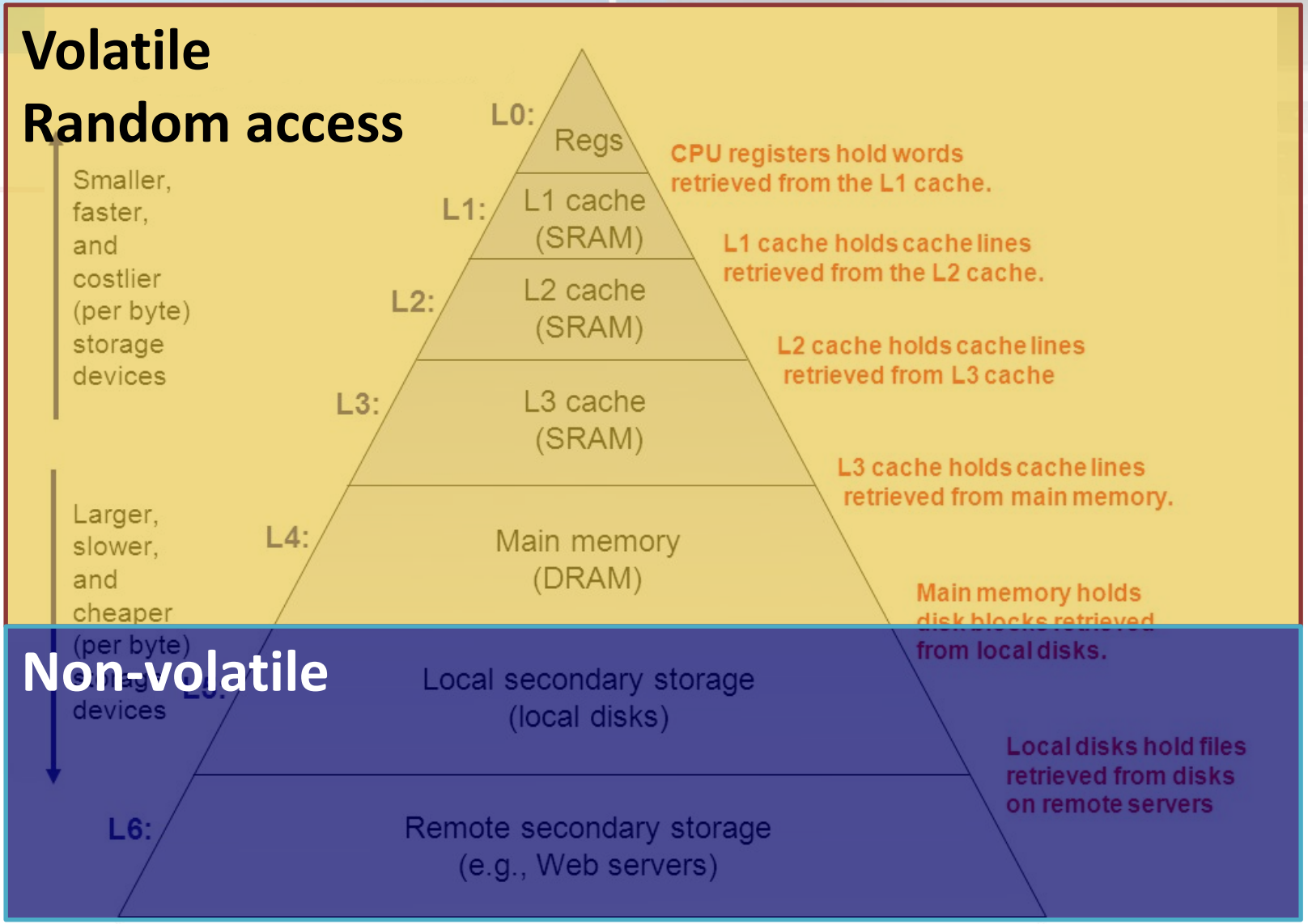
There are four type of storage:

1. Primary Storage
2. Secondary Storage
3. Tertiary Storage
4. Off-line Storage





2. Components of the Computer Storage Devices – Hierarchy



2. Components of the Computer Storage Devices – Primary storage

Primary storage types

1. Registers
2. Main Memory
3. Cache

2. Components of the Computer Storage Devices – Primary storage

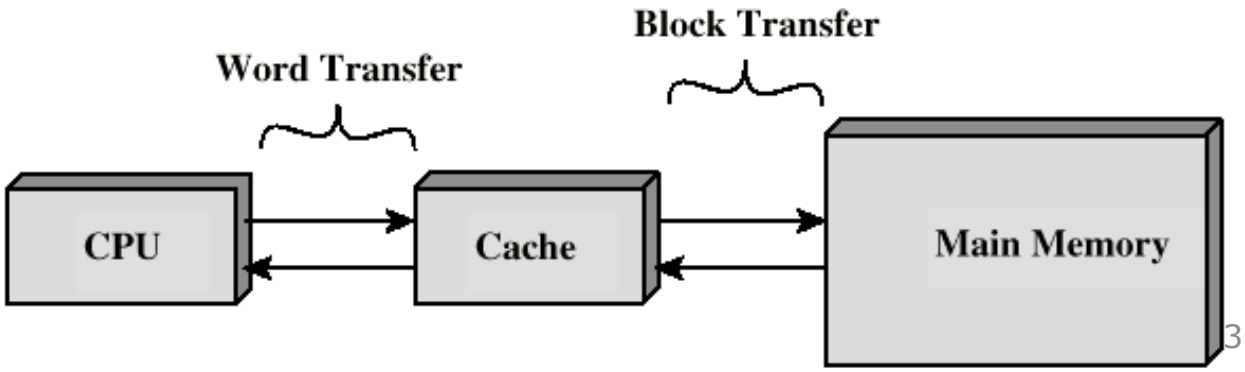
Registers

- very small amount of very fast memory that is built into the CPU
- This is to speed up its operations by providing quick access to commonly used values.
- Fastest memory in computer.
- Registers are normally measured by the number of bits they can hold, for example, an 8-bit register or a 32-bit register.
- Registers can also be classified into
  1. general purpose
  2. special purpose.

2. Components of the Computer Storage Devices – Primary storage

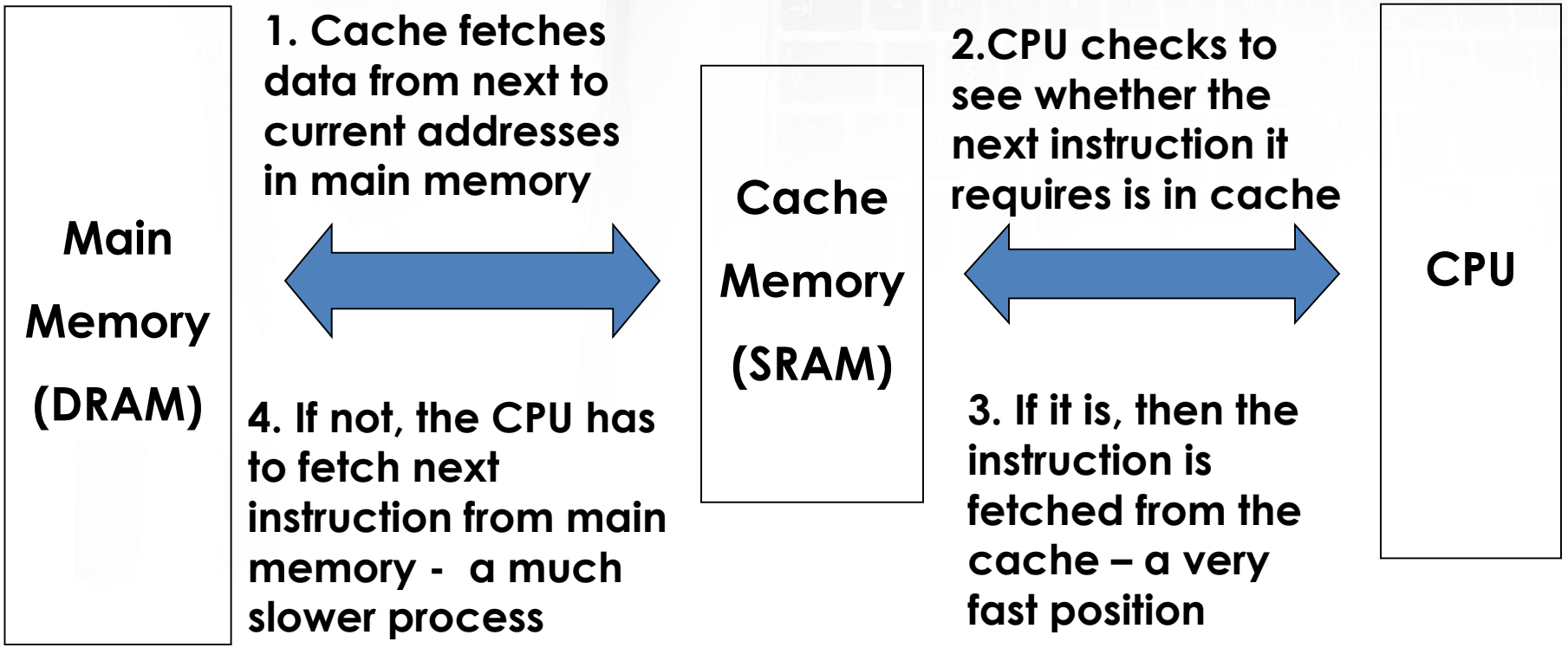
Cache

- Small amount of fast memory (Faster than RAM, static memory)
- Sits between normal main memory and CPU
- May be located on CPU chip or module.
- Cache works on the principal of locality of reference.



2. Components of the Computer Storage Devices – Primary storage

Cache – a The operation of cache memory



2. Components of the Computer Storage Devices – Primary storage

Memory – technologies

Static memory	Dynamic memory
▪ No charges to leak ▪ No refreshing needed when powered ▪ More complex construction ▪ Larger implementation per bit ▪ More expensive ▪ Faster that dynamic memory	▪ Bits stored as charge in capacitors ▪ Level of charge determines value - charges leak ▪ Need refreshing even when powered (need refresh circuits) ▪ Simpler construction, smaller per bit ▪ Less expensive ▪ Slower than Static memory

2. Components of the Computer Storage Devices – Primary storage

Memory – types

Read Only Memory (ROM)	Random Access Memory (RAM) Also called read/write memory.

▪Non-volatile in nature
▪These cannot be accidentally changed
▪Use static memory
▪Faster than dynamic memory
▪E.g. **BIOS chip**
  ▪Masked ROM
  ▪Programmable ROM (PROM)
  ▪Erasable PROM (EPROM)
  ▪EEPROM
	▪Volatile
	▪This is a semi conductor memory (dynamic memory)
	▪E.g. **Main memory**
	  ▪Main memory is usually called RAM. (misnamed because all semiconductor memory is random access)
	  ▪Main Memory can be made faster by using static memory. Then why don't we do that?
	  ▪Main memory is directly or indirectly connected to the central processing unit via a bus.
	  ▪The CPU continuously reads instructions stored in the main memory and executes them as required.

2. Components of the Computer Storage Devices – Primary storage

Memory – Main memory

- Main memory consists of a number of storage locations, each of which is identified by a unique address
- The ability of the CPU to identify each location is known as its addressability
- Each location stores a word i.e. the number of bits that can be processed by the CPU in a single operation. Word length may be typically 16, 24, 32 or as many as 64 bits.

2. Components of the Computer Storage Devices – Primary storage

Memory – Main memory

- Program and data are stored in memory prior to execution.(This is called Stored Program Concept proposed by Von Neumann).
- Memory is a semiconductor device in modern computers (Magnetic core memories were used earlier)
- Main memory, primary storage are synonyms to memory. (RAM also denotes the same)

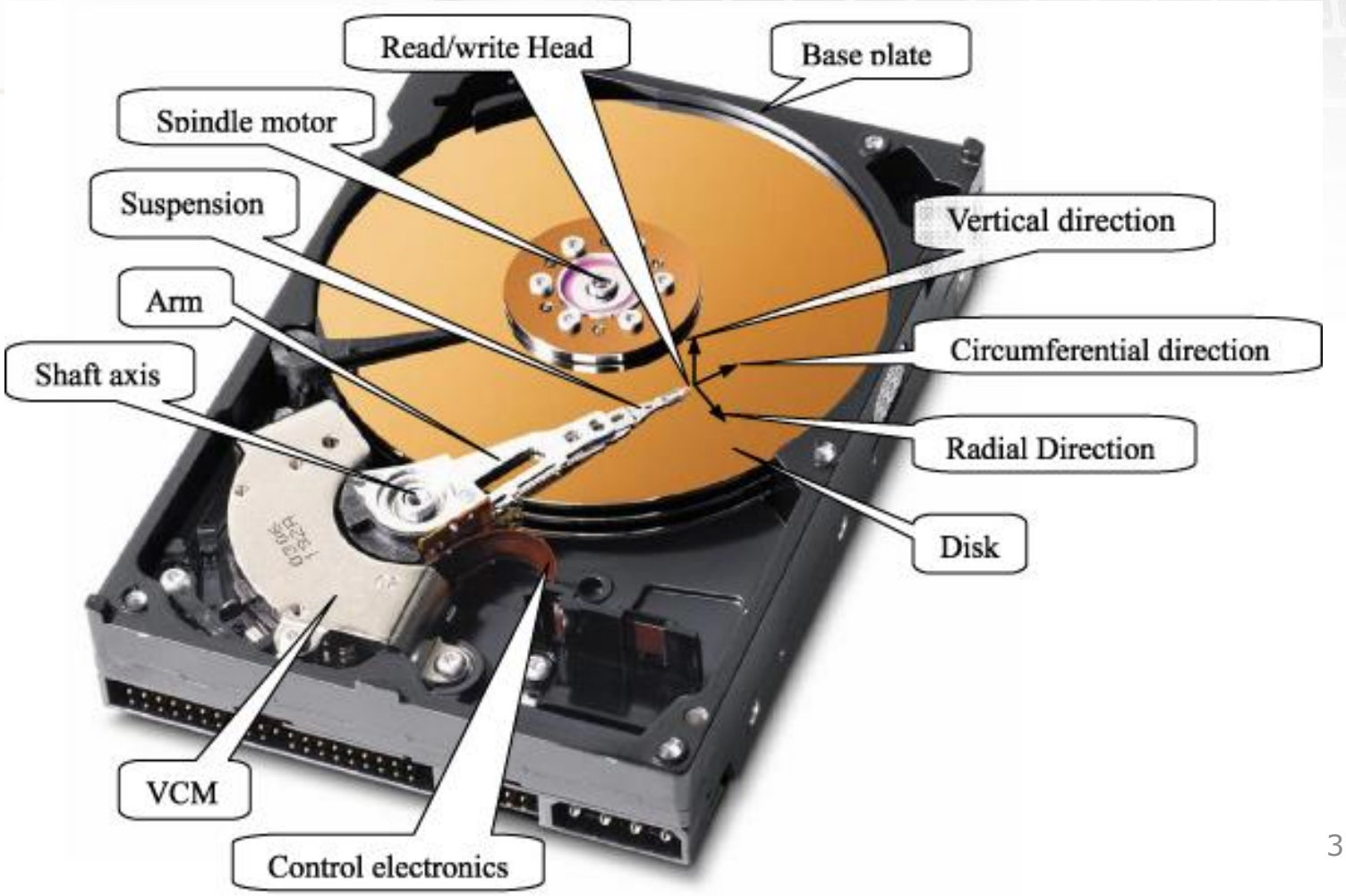
2. Components of the Computer Storage Devices – Primary storage

Memory – Main memory

- Memory is byte addressable
- Each byte has a unique address
- Addresses start from zero and increment sequentially.
- Memory Refresh – Memory refresh is the process of periodically read data from an area of computer memory and immediately writing the read information to the same area with no modifications.

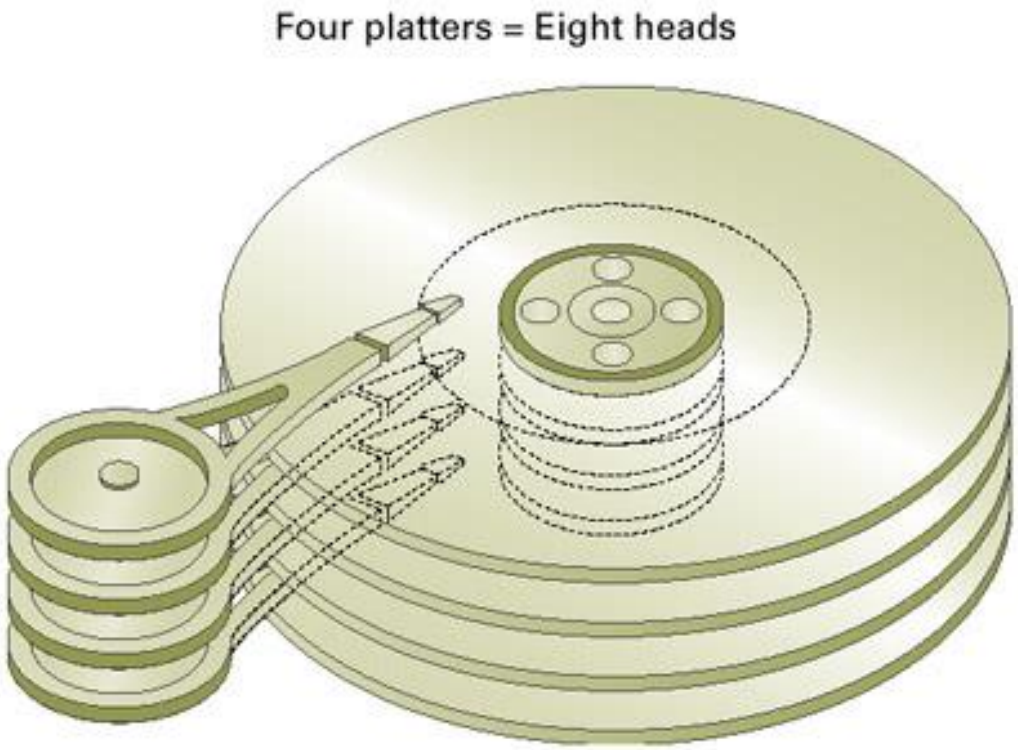
2. Components of the Computer Storage Devices – Secondary storage

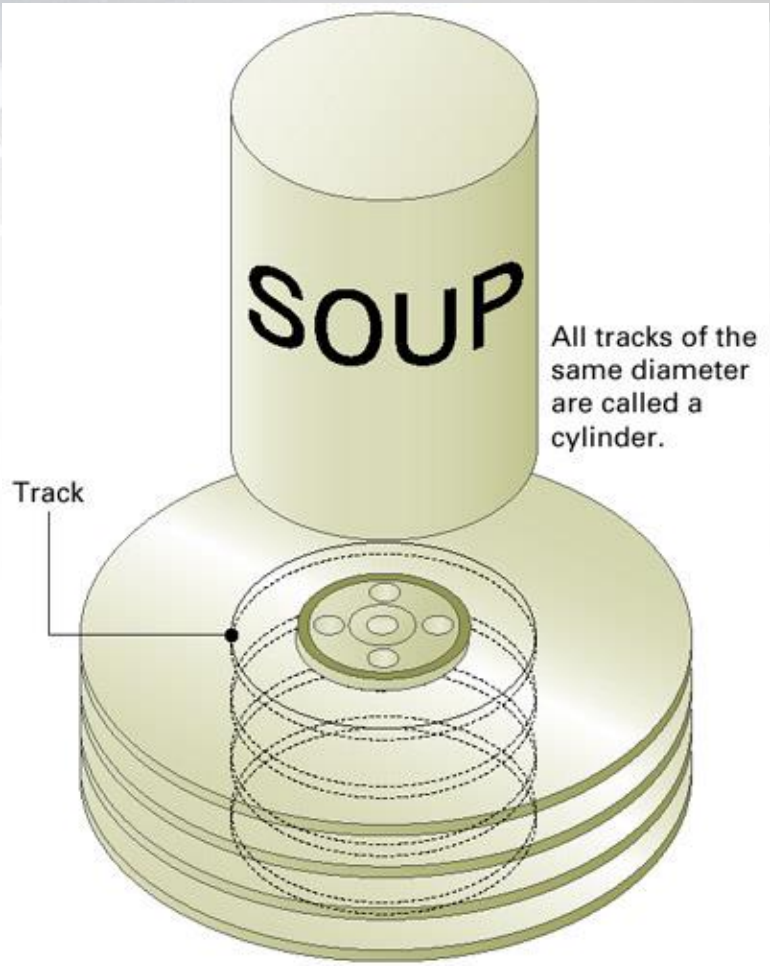
Hard disk



2. Components of the Computer Storage Devices – Secondary storage

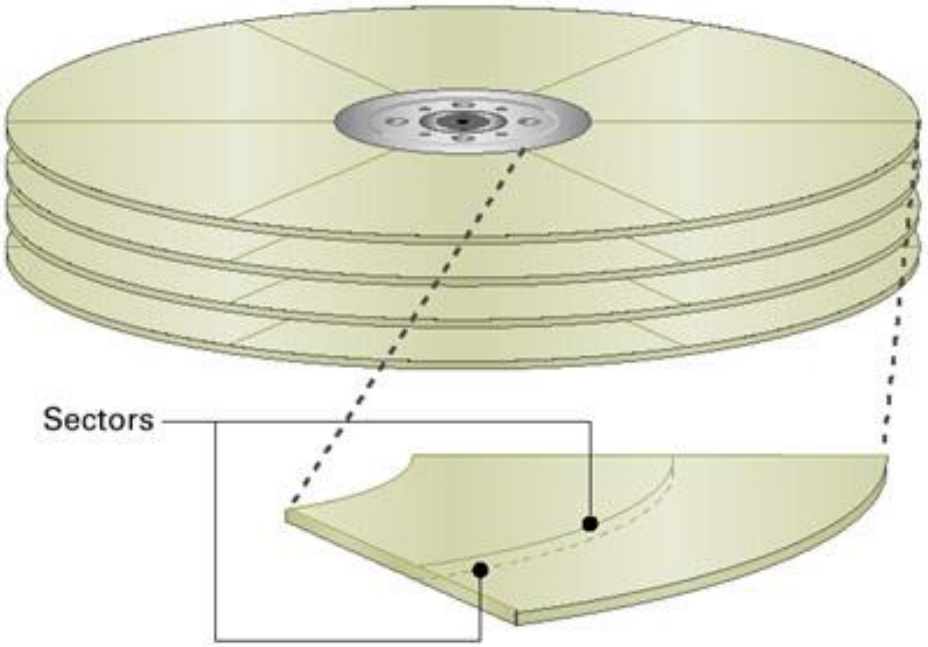
Hard disk

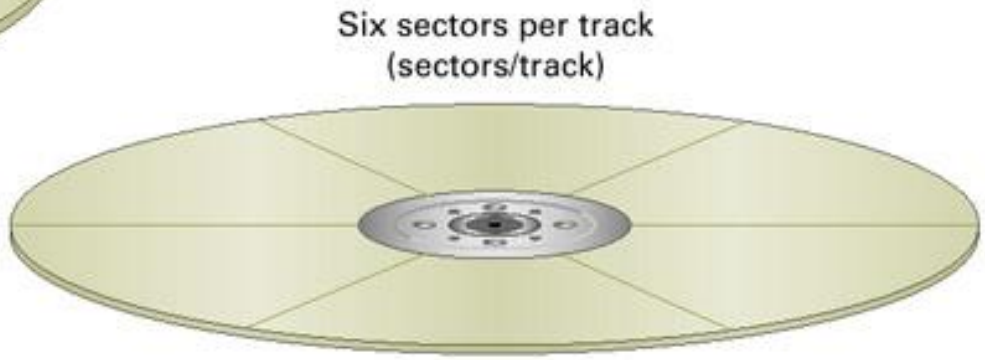




2. Components of the Computer Storage Devices – Secondary storage

Hard disk





2. Components of the Computer Storage Devices – Secondary storage

Hard disk – performance parameters

- **Access time** – seek time + rotational delay+ transfer time
- **Seek time** – track selection time (moving the head on the desired sector on the track)
- **Rotational delay** – the time it takes for the head to reach the beginning of the sector
- **Transfer time** – the time required to transfer data

2. Components of the Computer Storage Devices – 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.

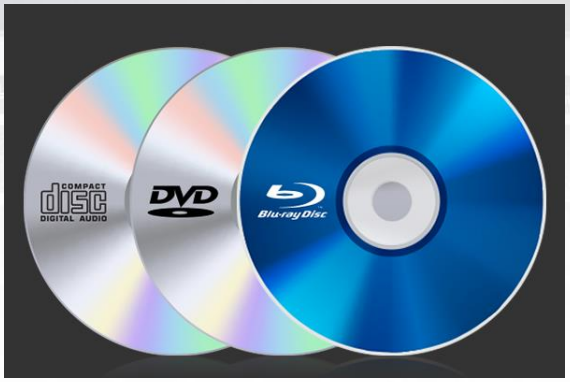
2. Components of the Computer Storage Devices – Tertiary Storage

2. Components of the Computer Storage Devices – Offline 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
- Examples
  - Floppy Disk
  - CD/DVD/Blue-ray
  - USB Flash Drive
  - Memory Cards

2. Components of the Computer Storage Devices – Offline Storage

- 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".



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.


Secure Digital card (SD)

MiniSD

Compact Flash


Memory Stick

- 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.

2. Components of the Computer Storage Devices – Offline Storage

	CD	DVD
Stands for	Compact Disc	Digital Versatile Disc
Purpose	CDs are made with the purpose of holding audio files as well as program files.	DVDs are made with the purpose of holding video files, movies, substantial amount of programs, etc.
Media type	Optical disc	Optical disc
Capacity	Typically up to 700 MiB (up to 80 minutes audio)	DVD can range from 4.7 GB to 17.08 GB.
Types	CD-R, CD-RW, CD-Text ETC.	DVD-RW, DVD+RW, DVD-RAM and Blu-Ray.

2. Components of the Computer Storage Devices

Other Storage techniques

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.

2. Components of the Computer Storage Devices

Other Storage techniques

Cloud Storage

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

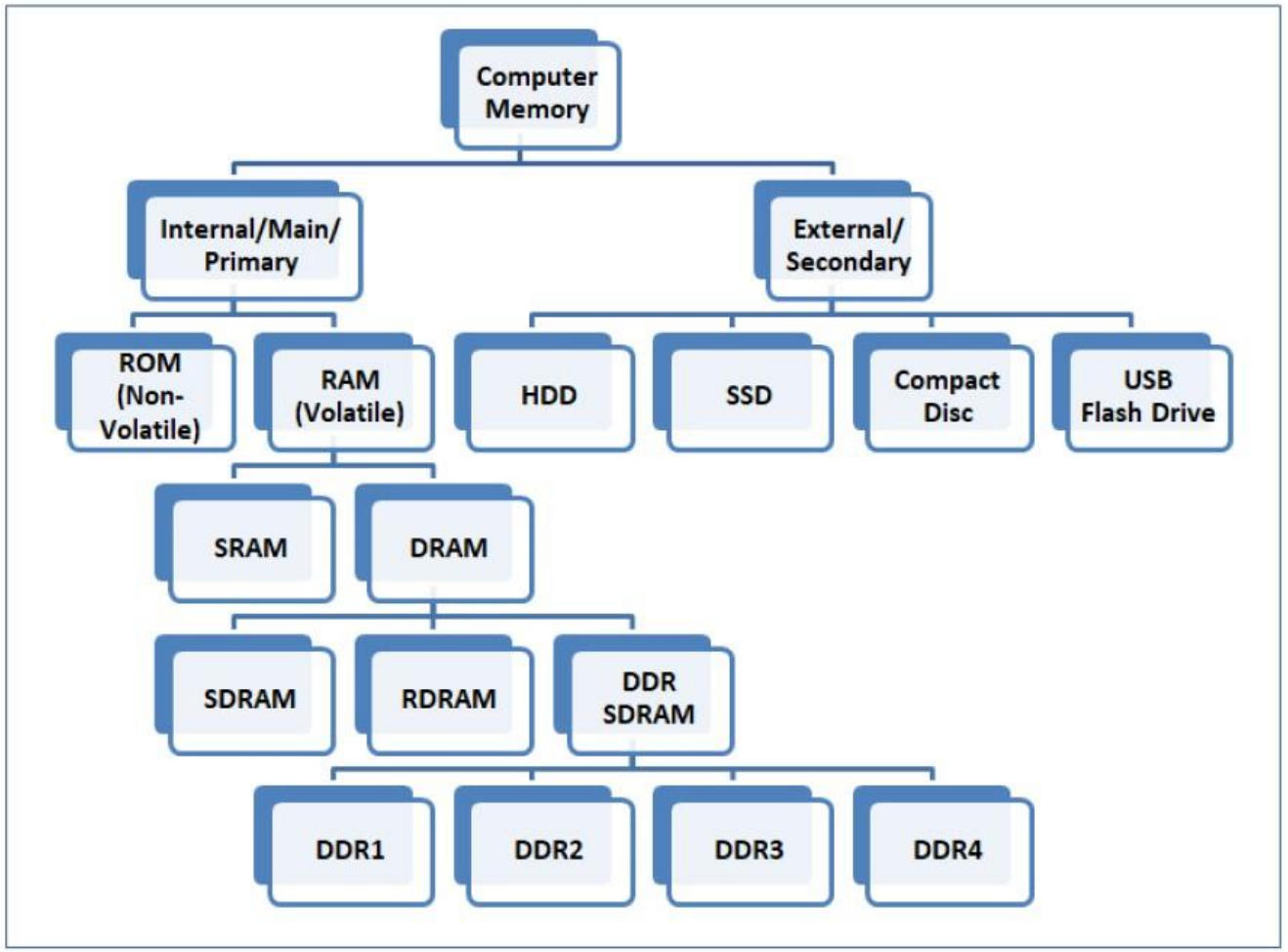
Google Drive

flickr

SkyDrive

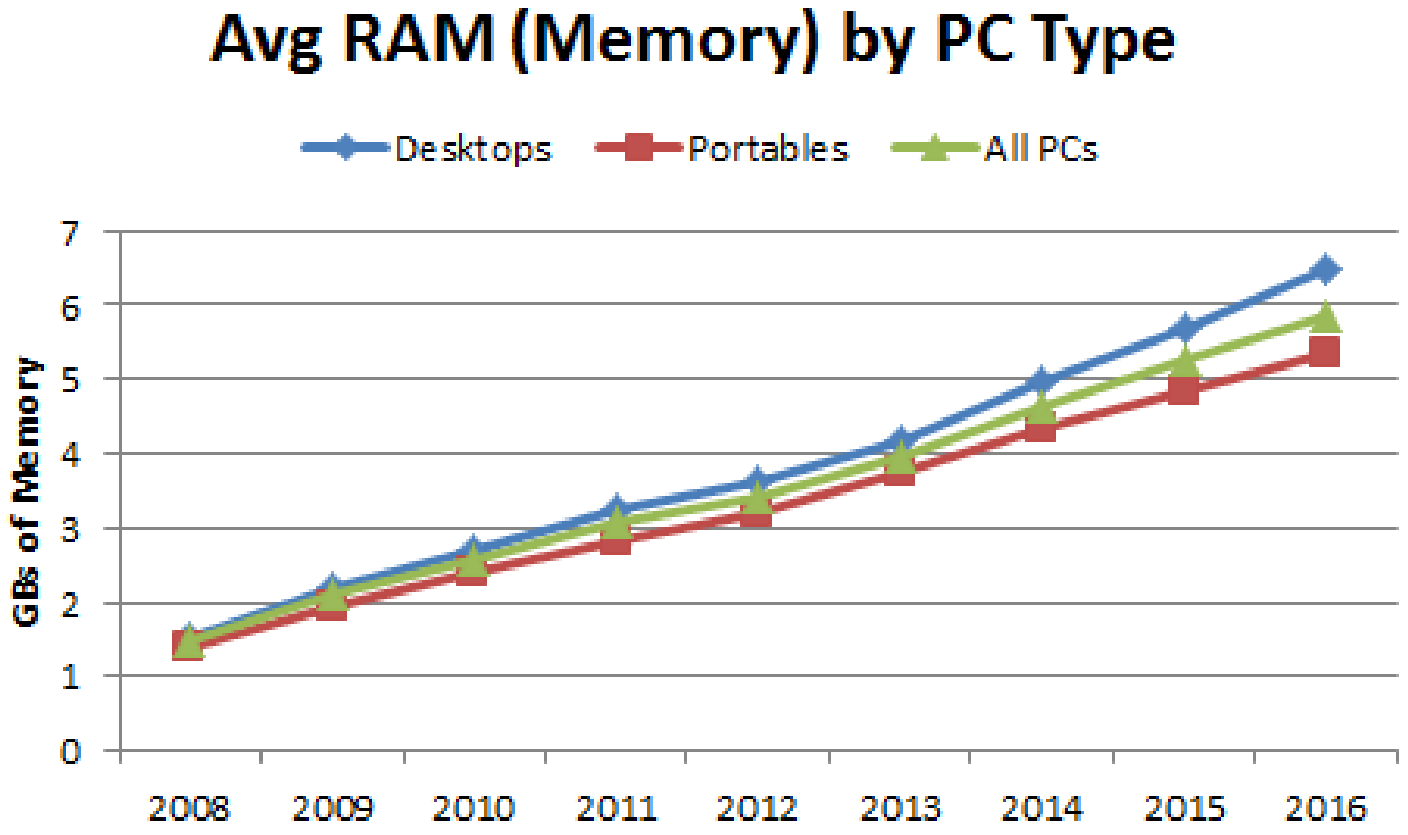
2. Components of the Computer Storage Devices

Evolution of storages



2. Components of the Computer Storage Devices

Evolution of storages



Thank You

Lecture01 - Post-lecture activities

Find facts and create graph of
CPU Ops, Speed, Cores, Disk space, RAM speed

Lecture 02

Data representations

Lecture02 - Pre-lecture activities

Data & Information, Different Types of Data, ASCII/Unicode