



**MINISTRY OF HIGH EDUCATION
FUTURE HIGH INSTITUTE FOR ENGINEERING IN FAYOUM
DEPARTMENT OF ELECTRICAL ENGINEERING**

Lecture 1

Introduction to Computer Hardware

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Computer and Programming

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Introduction to Computer

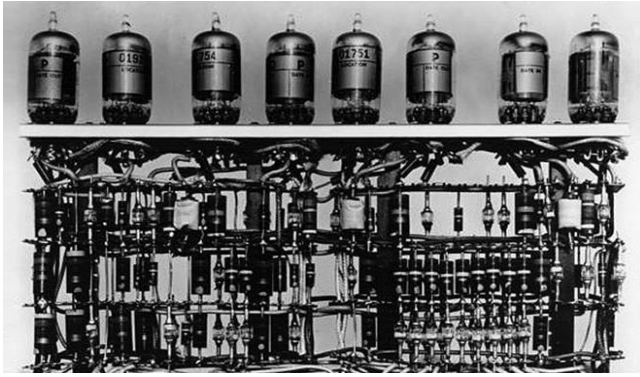
□ Computer Definition.

- “A **computer** is an **electronic device** that works based on a set of **instructions** that are stored in its memory.
- It receives **data** and process it using **programs** to produce **information**.
- Furthermore, it can store data and information for later usage.”

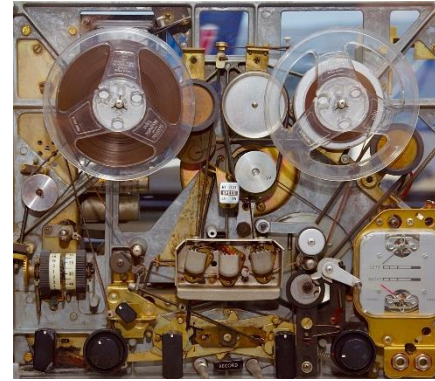
Introduction to Computer (cont.)

□ Computer Generations.

- **First Generation:** Vacuum Tubes



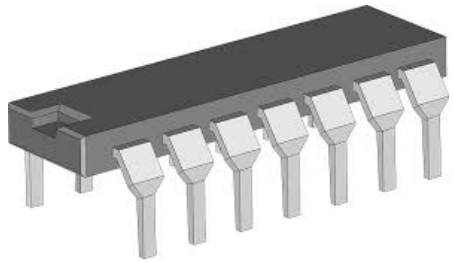
- **Second Generation:** Transistors and Magnetic Tapes



Introduction to Computer (cont.)

□ Computer Generations.

- **Third Generation:** Integrated Circuits



- **Fourth Generation:** Microprocessors



Types of computers

❑ Embedded computers.

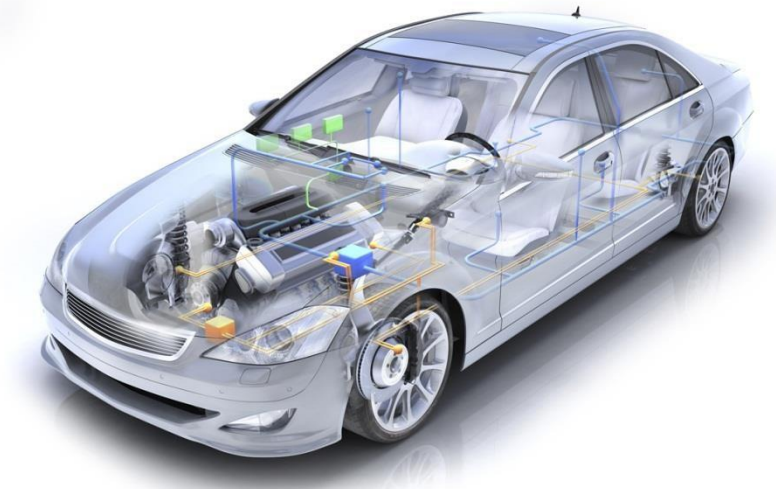
- A computer that is an internal component of another machine such as robotics, smart car, etc.



❑ Non-embedded computers.

They are classified based on their power, size, and speed :

- Microcomputers
- Workstations
- Mainframes
- Minicomputers
- Supercomputers



Types of computers (cont.)

❑ Embedded computers

❑ **Non-embedded computers**

They are classified based on their power, size, and speed :

- Microcomputers
- Workstations
- Mainframes
- Minicomputers
- Supercomputers



- A microcomputer is a computer with a microprocessor as its central processing unit (CPU). It includes a microprocessor, memory, and input/output (I/O) facilities.

Types of computers (cont.)

❑ Embedded computers

❑ **Non-embedded computers**

They are classified based on their power, size, and speed :

- Microcomputers
- Workstations
- Mainframes
- Minicomputers
- Supercomputers



- A workstation is a high-end microcomputer designed for technical or scientific applications. Intended primarily to be used by one person at a time, they are commonly connected to a local area network and run multi-user operating systems.

Types of computers (cont.)

❑ Embedded computers

❑ **Non-embedded computers**

They are classified based on their power, size, and speed :

- Microcomputers.
- Workstations.
- **Mainframes.**
- Minicomputers.
- Supercomputers.



- Operate at very high speed, have very large storage capacity and can handle the work load of many users.

Types of computers (cont.)

❑ Embedded computers

❑ **Non-embedded computers**

They are classified based on their power, size, and speed :

- Microcomputers.
- Workstations.
- Mainframes.
- Minicomputers.
- Supercomputers.

- The word “minicomputer ” is a term for a class of smaller computer that evolved in the mid-1960s and sold for much less than mainframe .



Types of computers (cont.)

❑ Embedded computers

❑ **Non-embedded computers**

They are classified based on their power, size, and speed :

- Microcomputers.
 - Workstations.
 - Mainframes.
 - Minicomputers.
 - Supercomputers.
- The fastest type of computer. Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations.
 - For example, weather forecasting , animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration.

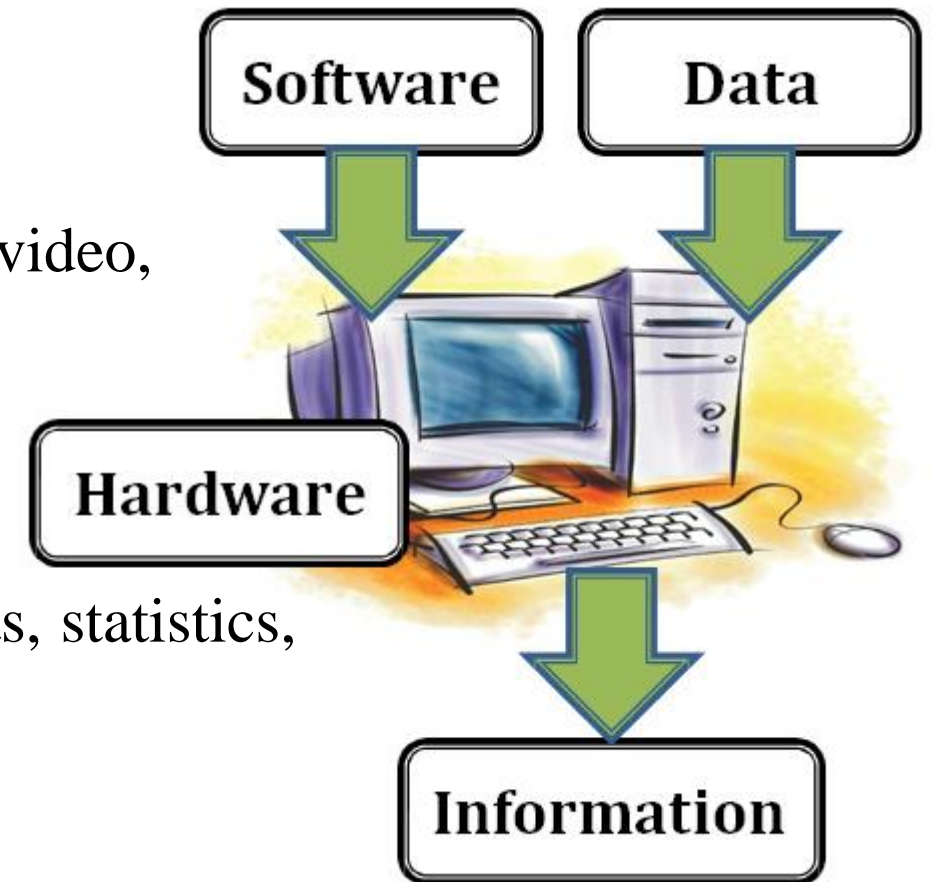


Main Components of a Computer System

- Computer System has four main components

❑ Computer System: Data vs Information.

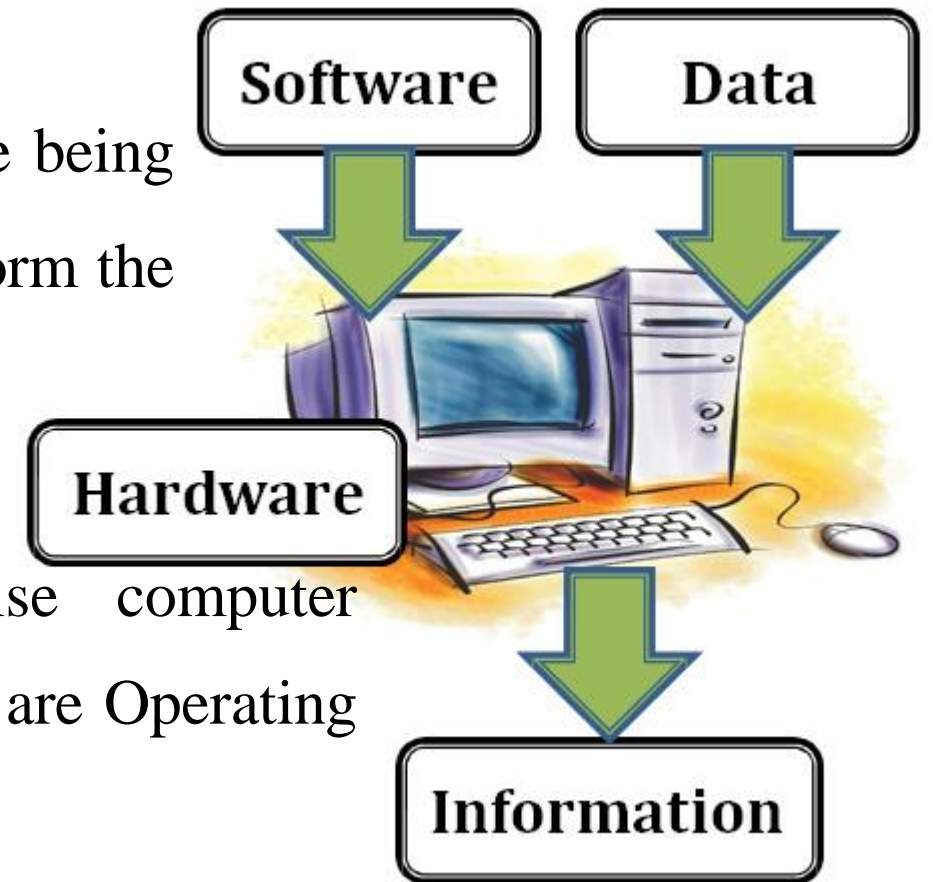
- **Data** are the set of facts such as symbols, words, pictures, video, numbers that represent the **inputs** to the computer
- **Information** is the data after being processed such as reports, statistics, charts that are produced as **outputs** from the computer.



Main Components of a Computer System (cont.)

❑ Computer System: Software.

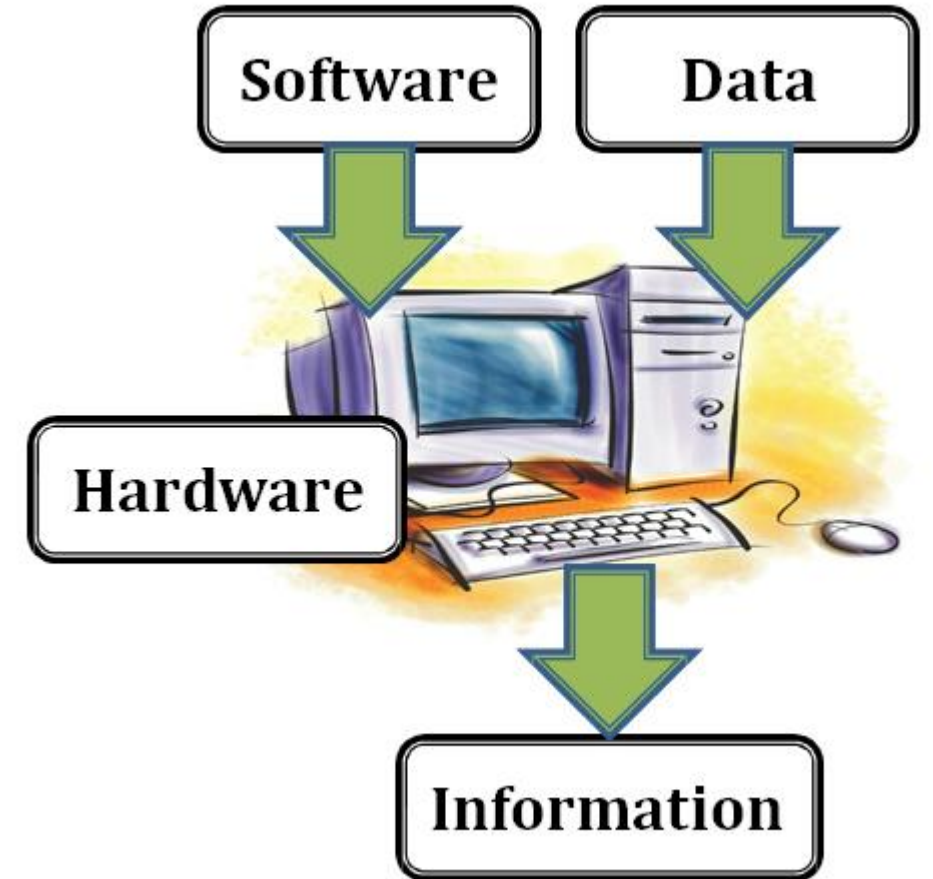
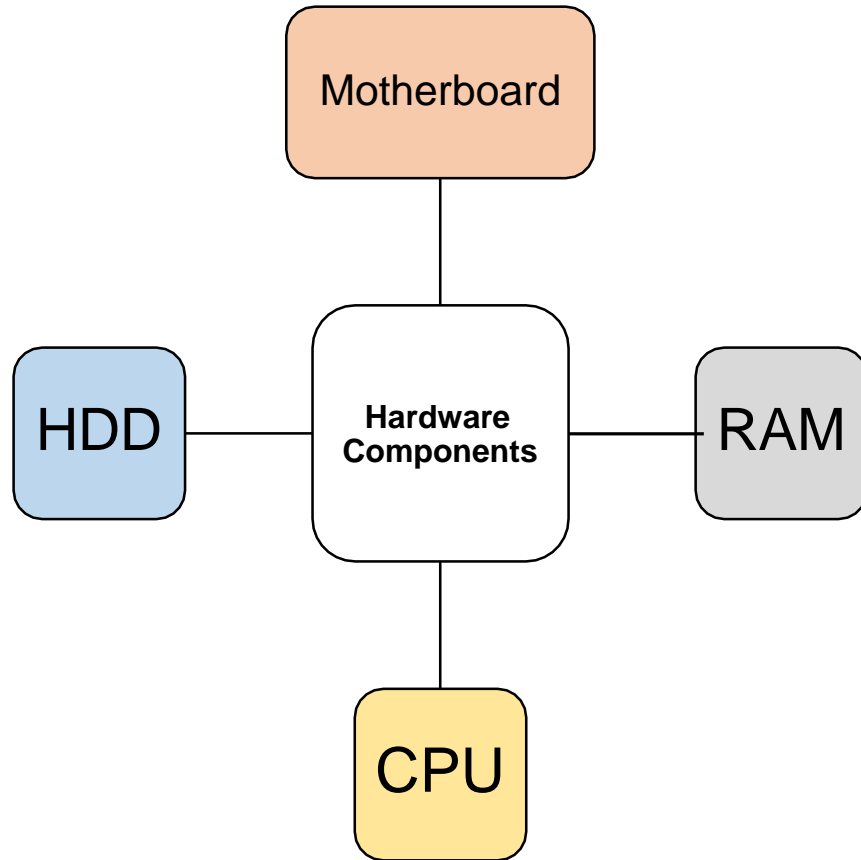
- **Software** a set of ordered and detailed instructions that are being loaded into main memory and instruct the computer to perform the needed operations from it.
- **Software Types.**
 - **System Software** are the ones which control and supervise computer components (both software and hardware). Examples of it are Operating Systems (e.g., Windows, Unix, Mac, Android,)
 - **Applications Software** are all the software that count on the existence of an underlying system software and the services provided by it. Examples of it include Games, Spreadsheet, Drawing software, Music player, Database,



Main Components of a Computer System (cont.)

❑ Computer System: Hardware.

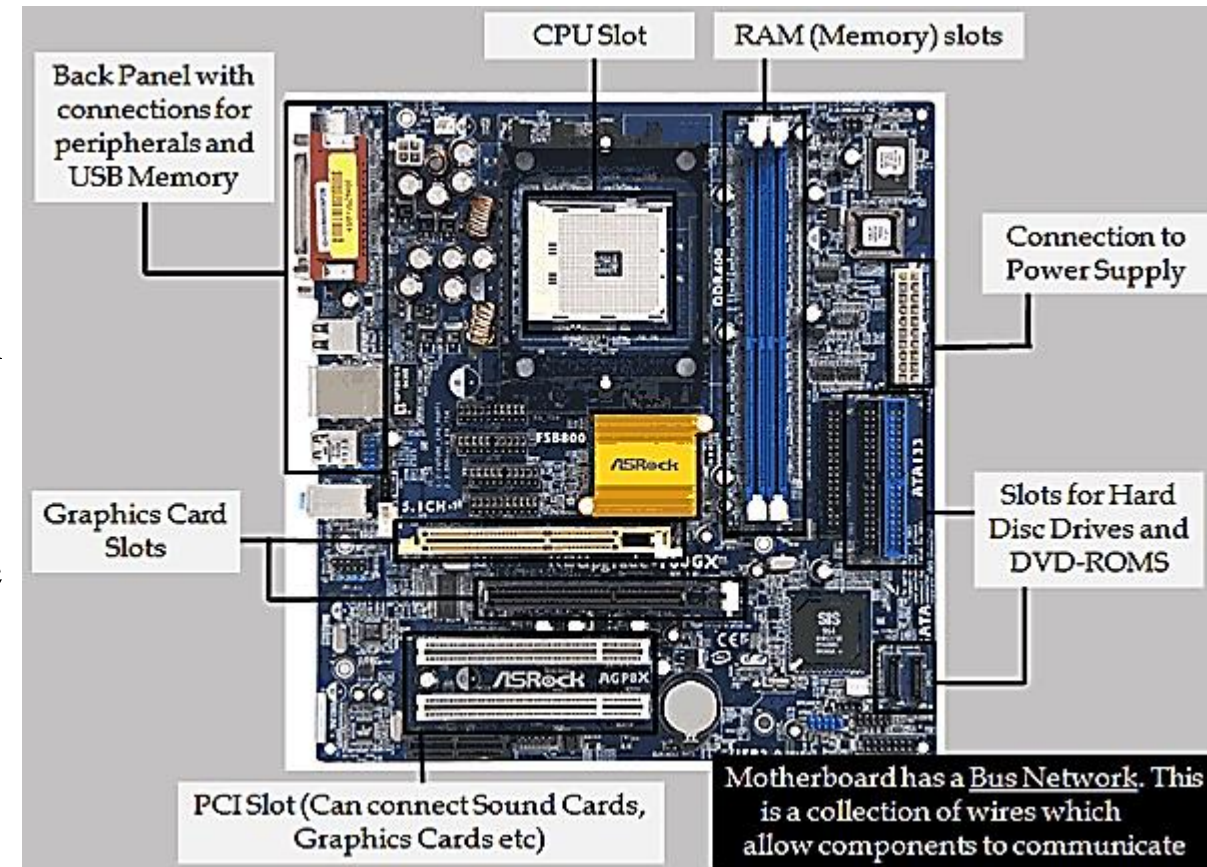
Hardware are the physical components of the computer.



Hardware Components

□ Motherboard

- **Motherboard** is a printed circuit board and foundation of a computer that is the biggest board in a computer chassis. A motherboard provides connectivity between the hardware components of a computer, like a processor (CPU), memory (RAM), hard drive, video card and all other computer hardware components.
- Components communicate and **send signals** to each other via the **BUS Network**.
- Each type of motherboard is designed to work with specific types of processors and memory; however, hard drives are mostly universal and work with the majority of motherboards.



Hardware Components (cont.)

□ Processor (Central Processing Unit “CPU”)

- The Central Processing Unit (CPU) is the **brain of the computer**.
- The CPU '**controls**' what the computer does and is responsible for performing **calculations** and **data processing**. It also handles the movement of data to and from system memory.
- CPU's come in a variety of speeds which are known as '**clock rates**'. Clock rates are measured in '**Hertz**'. Generally, the faster the clock rate, the faster the performance of the computer.
- There are two main brands of CPU currently on the market... **AMD** and **Intel**.



Central Processing Unit

Hardware Components (cont.)

□ Basic Elements of a Processor

■ Arithmetic and Logic Unit

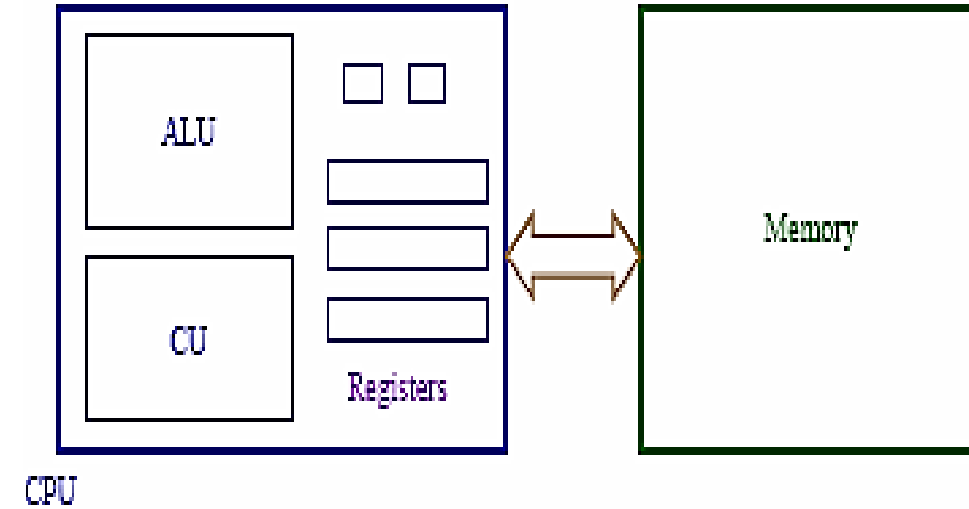
- Executes all arithmetic and logical operations.

■ Control Unit

- Reads and Decodes the instructions of programs in the main memory.
- Controls the operations inside the Processor.
- Controls the flow of the instructions and data from/to the main memory.

■ Registers

- Special units of very fast memory.



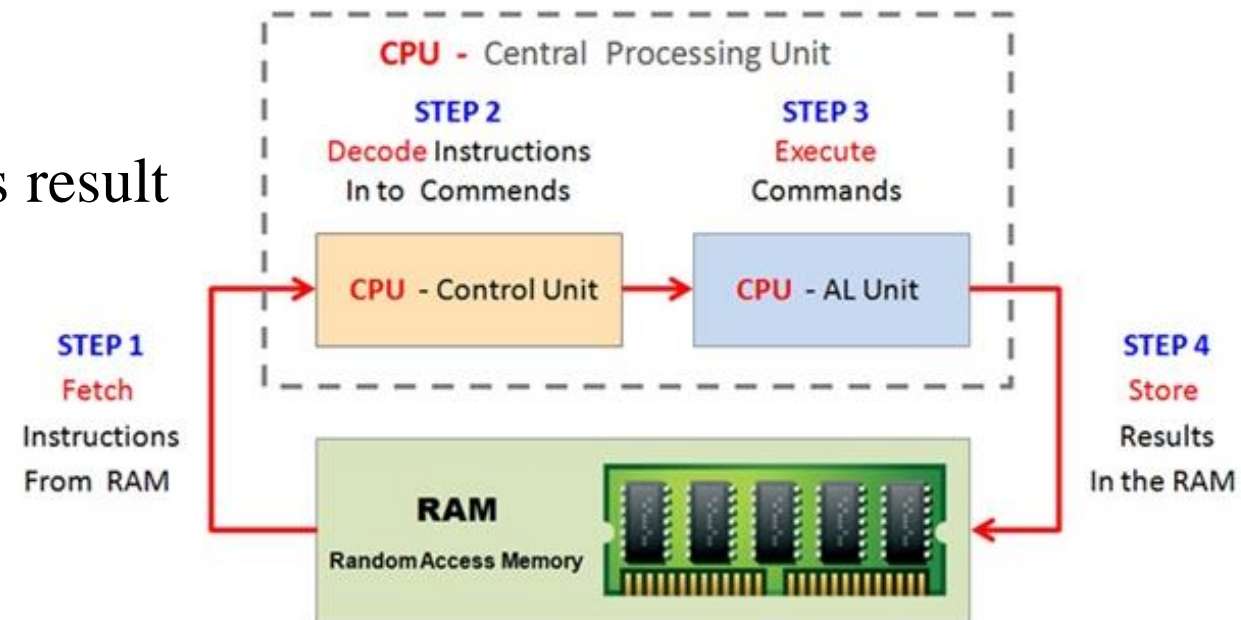
Hardware Components (cont.)

❑ Processor (Central Processing Unit “CPU”)

❑ CPU Operations

The four primary functions of a processor are fetch, decode, execute and write back.

- **Fetch:** is the operation which receives instructions from program memory from a systems RAM.
- **Decode:** In this operation, to convert all instructions into understandable ways then other components of CPU are ready to continue further operations, and this entire operations are performed by decoder.
- **Execute:** Here, to perform all operations and every components of CPU which are needed to activate to carry out instructions.
- **Write-Back:** After executing all operations, then its result is moved to write back.

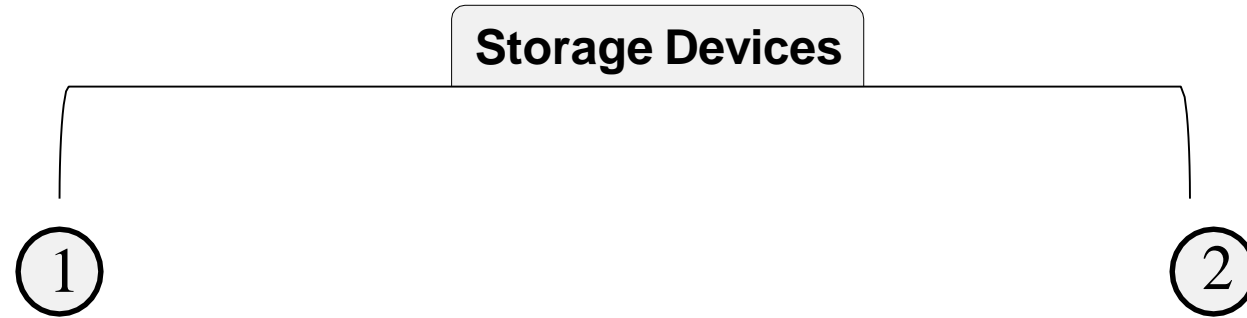


Hardware Components (cont.)

□ Efficiency Factors of Processors

- Data Bus Width
 - Amount of data that can be transferred between computer components simultaneously.
- Cache Memory type and size that comes with the processor.
- Clock Speed
 - 2.5 or 3.7 GHz
- Number of Cores.
- Generation.
- Turbo Boost and Hyper threading.

Storage Devices



Primary storage describes the main memory, or RAM, in a computer.

Secondary storage refers to devices that can store data permanently, such as a hard drive, flash drive, compact disc, DVD, or external hard drive.

Memory

- **Computer memory** helps to store or save all the important data such as songs, movies, pictures, software, and more.
- These data can be saved in two different modes; either temporary or permanent in nature.
- Memory are small cells. Each cell represents a bit. Each bit is either 0 or 1.
- The computer's workspace where application instructions and data are held during operation is called memory also known as main memory, primary storage or RAM (Random Access Memory).
- The capacity of a memory is important. Bigger memory means bigger workspace.

Memory

□ Units in Main Memory

- Smallest basic unit = bit
- Basic unit = byte (B) (1 byte = 8 bits)
 - 1 Kilobyte (KB) = 2^{10} byte
 - 1 Megabyte (MB) = 2^{20} byte
 - 1 Gigabyte (GB) = 2^{30} byte
 - 1 Terabyte (TB) = 2^{40} byte

Unit	Approximate value in bytes	Actual value in bytes
Kilobyte (KB)	1,000	$2^{10} = 1,024$
Megabyte (MB)	1,000,000	$2^{20} = 1,048,576$
Gigabyte (GB)	1,000,000,000	$2^{30} = 1,073,741,824$
Terabyte (TB)	1,000,000,000,000	$2^{40} = 1,099,511,627,776$

Memory Types

□ Volatile

- **Random Access Memory (RAM)**
 - Dynamic
 - Static (cache memory)

Volatile memory: contents are erased when the system's power is turned off or interrupted.

➤ Needs periodical refreshment (hundreds of times per second).

□ Non-Volatile

- **Read Only Memory (ROM)**
- **Programmable Read Only Memory (PROM)**
- **Erasable Programmable Read Only Memory (EPROM)**
- **Electrically Erasable Programmable Read Only Memory (EEPROM)**
- **Flash memory**

Memory Types (cont.)

□ Volatile

– **R**andom **A**ccess **M**emory (RAM)

➤ Dynamic

➤ Static (cache memory)

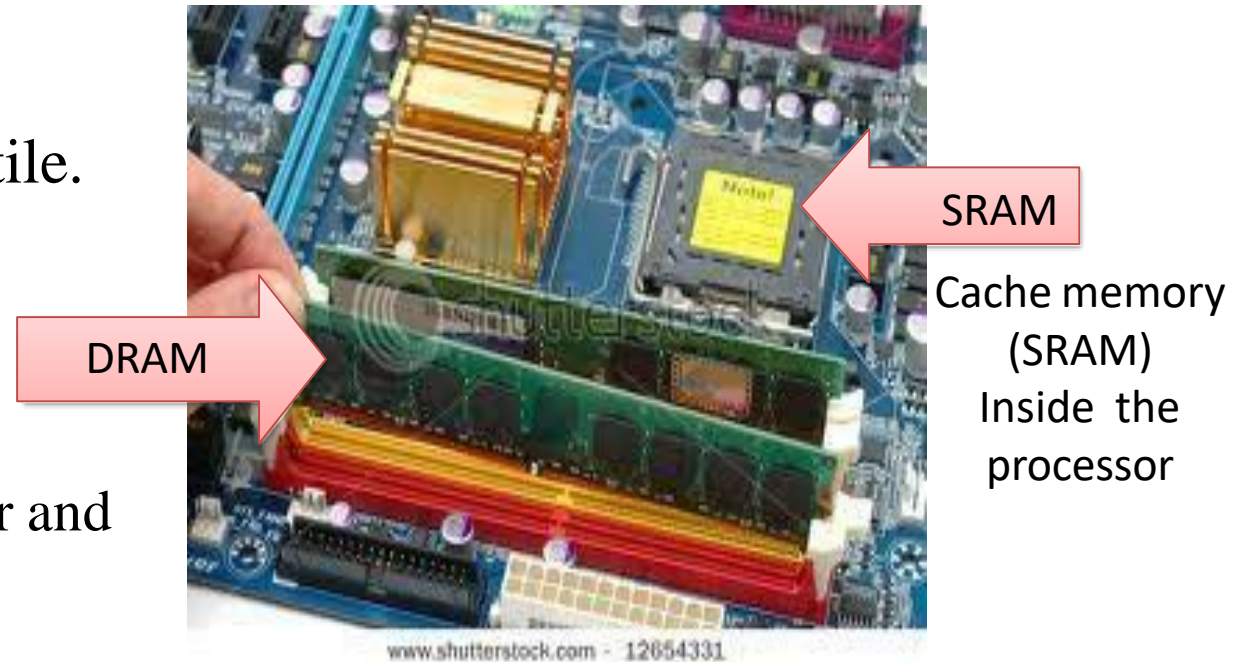
➤ **D**ynamic **r**andom-**a**ccess **m**emory (**DRAM**)

DRAM requires the data to be refreshed periodically in order to retain the data.

➤ **S**tatic **r**andom-**a**ccess **m**emory (**SRAM**)

SRAM does not need to be refreshed, but is still volatile.

- Processor looks first in Cache
 - Cache hit: Move to the processor
 - Cache miss: fetch from main memory to both processor and cache for fast retrieval in the future



Memory Types (cont.)

□ SRAM vs DRAM

- 1.SRAM is static while DRAM is dynamic.
- 2.SRAM is faster compared to DRAM.
- 3.SRAM is more expensive than DRAM.
- 4.Cheaper DRAM is used in main memory while SRAM is commonly used in cache memory.

Memory Types (cont.)

□ Non-Volatile

- **Read Only Memory (ROM)**
- **Programmable Read Only Memory (PROM)**
- **Erasable Programmable Read Only Memory (EPROM)**
 - To erase the data stored in the array of transistors, ultraviolet light is directed onto the die
- **Electrically Erasable Programmable Read Only Memory (EEPROM)**
- **Flash memory**
 - It was developed from EEPROM and must be erased in fairly large blocks before these can be rewritten with new data



ROM – PROM - EEPROM



EPROM



www.altysdk.com

Flash memory

Comparison of Memory Types

	RAM	ROM			Cache Memory
		ROM	PROM	EPROM	
(Re-)Writable? [Ability to write or store new content]	No Limit	Never	Only once	Multiple times	No Limit
Speed	Fast	Fast	Fast	Fast	Very fast
Persistence of Storage (Non-volatility)	Volatile	Non-Volatile	Non-Volatile	Non-Volatile	Volatile
Cost	Cheap	Cost	Cost+	Cost++	Too much cost

General Information

CPU Intel

- Celeron
- Dual Core
- Core 2 Duo
- Quad Core
- I- Series : i3, i5, i7 and i9

C – Desktop processor based on the LGA 1150 package with high performance graphics

H – High performance graphics

K – Unlocked

M – Mobile

Q – Quad-core

R – Desktop processor based on BGA1364 (mobile) package with high performance graphics

S – Performance-optimized lifestyle

T – Power-optimized lifestyle

U – Ultra-low power

X – Extreme edition

Y – Extremely low power

AMD Intel

- Athlon
- Athlon 2
- Phenom
- Phenom 2
- FX.
- A-series
- E-series
- Ryzen series

General Information (cont.)

