Lecture 2

Learning outcomes:

- *Processing Devices*

❖ Processing Devices

- The processing devices are the computer hardware components that help to handle the processing of the information, storage and retrieval process of the information.
- ***There are different types of processing devices for computers such as:***

✓Motherboard

✓CPU

✓GPU

✓Memory

✓Microprocessors

✓Sound Card

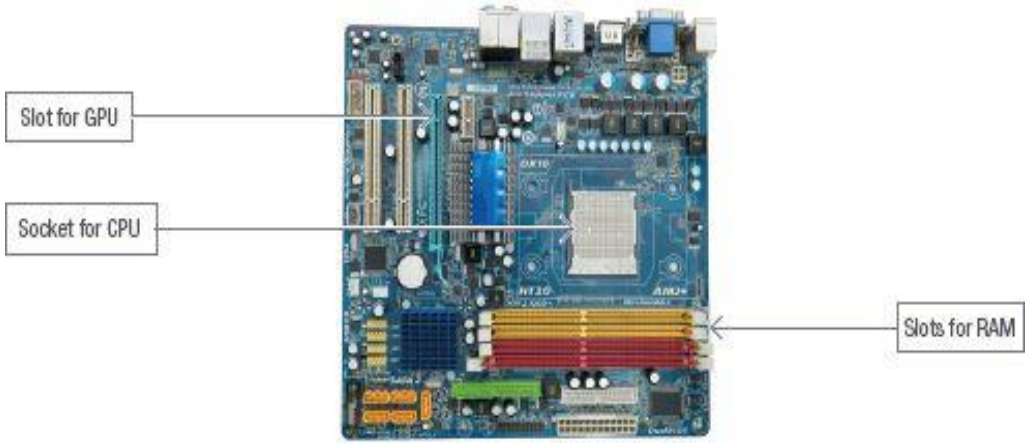
✓Video Card

✓Clock

✓Data bus

✓Address bus

❑ Motherboard



- A computer’s motherboard is a large printed circuit board that physically connects all the different components.
- On the motherboard, there are specific positions where the CPU, GPU and RAM can be inserted.
- There are also connectors that allow you to connect a power supply to a computer.
- In addition, the motherboard has several ports that allow you to plug in devices, such as keyboards, speakers and monitors easily.

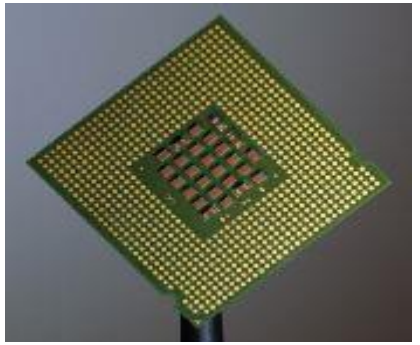
- ***The functions of the motherboard is to:***

- Provide a place for other devices or interfaces to be connected to (such as more memory or another graphics cards).

- Distribute power to the various components.

- Act as a communication hub as the components send and receive information through the motherboard.

❑ Central Processing Unit (CPU)



- The central processing unit (CPU) is located inside the computer case on the motherboard. It is the part of a computer responsible for receiving and carrying out computer instructions (processing).

- Each CPU can be made up of multiple cores, which are independent processing units that can complete tasks on their own (multithreading vs multiprocessing). By adding multiple cores to a CPU, the processing power available to the computer can increase dramatically, with little heat gain. These types of processors are called multi-core processors.

- The CPU is also known as the heart of the computer. It consists of three units, generally known as the Control Unit (CU), Arithmetic Logical Unit (ALU), and the Memory Unit.

➢ **The Control Unit** is the part of the computer's central processing unit (CPU), which directs the operation of the processor. It was included as part of the Von Neumann Architecture by John von Neumann.

- It is the responsibility of the control unit to tell the computer's memory, arithmetic/logic unit, and input and output devices how to respond to the instructions that have been sent to the processor.

- It fetches internal instructions of the programs from the main memory to the processor instruction register, and based on this register contents, the control unit generates a control signal that supervises the execution of these instructions.

- A control unit works by receiving input information which it converts into control signals, which are then sent to the central processor.

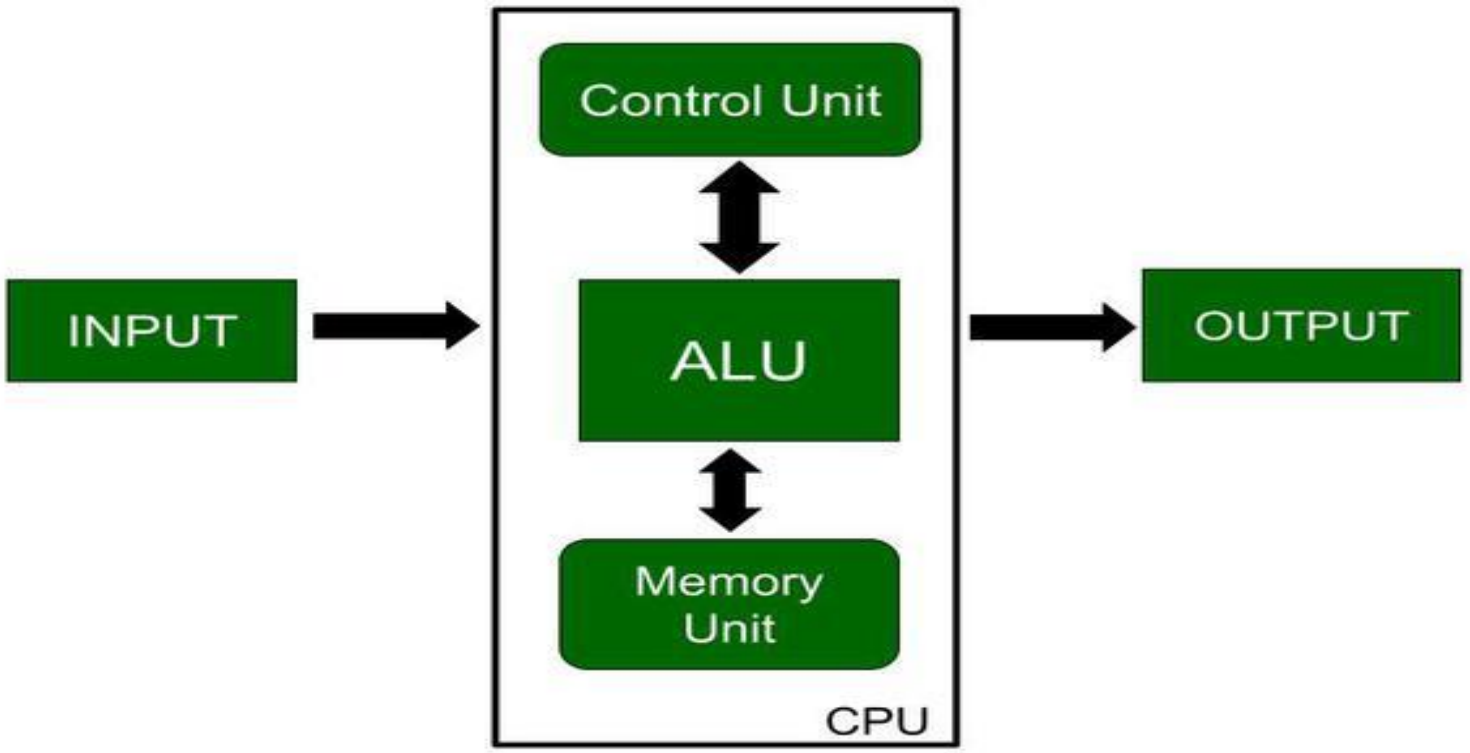
- The computer’s processor then tells the attached hardware what operations to perform.

- The functions that a control unit performs are dependent on the type of CPU because the architecture of the CPU varies from manufacturer to manufacturer

- **Arithmetic logic unit (ALU)** is a digital circuit that provides arithmetic and logic operations.
  - It is the fundamental building block of the central processing unit of a computer.

- **Memory devices** are digital systems that store data either temporarily or for a long term.
  - Digital computers to hard disks have built-in memory devices that can store the data of users or manufacturers.

Below is the block diagram of the CPU is given:



- ✓As shown in the diagram input is given to the CPU through input devices.
- ✓This input goes to memory and the control unit gets instructions from memory.
- ✓The control unit now decides what to do with the input or instructions and transfers it to ALU.
- ✓Now, ALU performs various operations like addition, subtraction, multiplication, division, logical operations, etc.
- ✓After that, the final result gets stored in memory and finally passed to output devices to give the output.
- *So, this is how the CPU works.*

▪ Graphics Processing Unit (GPU)

- The graphics processing unit (GPU) is located on plug-in cards on the motherboard or in the same chip as the CPU.

- It is responsible for creating and doing the calculations needed to display images on the screen.

❑ Memory

- Memory is the electronic holding place for the instructions and data a computer needs to reach quickly. It's where information is stored for immediate use. It refers to the components where data is stored temporarily (RAM) or permanently (ROM, hard drives, etc.).

- Memory is one of the basic functions of a computer, because without it, a computer would not be able to function properly.

- Memory is also used by a computer's operating system, hardware and software.

- There are technically two types of computer memory: primary (RAM and ROM) and secondary (storage devices).

➢ Primary memory is built inside the computer. As a result, data can be read from and written to primary memory extremely quickly. This gives the processor fast access to the data and instructions that the primary memory holds.

➢ **The types of primary memory:**

- *Random access memory (RAM)*
- *Read only memory (ROM)*

- **Random-access memory (RAM),** is physical hardware that temporarily saves data.
- ✓It serves as the computer's 'working' memory. RAM provides space for your computer to read and write data to be accessed by the CPU.
- ✓RAM is volatile, meaning that all data is lost once the electricity is disconnected or the power is lost.

- **Read Only Memory(ROM),** It is more permanent than RAM.
- ✓Data stored in these chips is non-volatile -- it is not lost when power is removed. Data stored in these chips is either unchangeable or requires a special operation to change.

Memory vs. Storage

- When comparing memory and storage, we first need to identify the role of the components.
- The computer’s main memory is the RAM. You can think of RAM as a workspace or workbench the computer uses to get work done. When you double-click on an app, or open a document, or do almost anything on your computer, RAM gets used to store the code of the app and the data while the processor (CPU) is working on it.
- The storage unit i.e. HDD, SSD or Flash drive, by contrast, is the cupboard or storage shelf you might use to permanently store your tools, apps, data and completed work. So, when the task is complete and you click save in the app, the resulting output is stored permanently on the storage unit.

Comparison Between Primary Memory (RAM) and Secondary Memory (storage devices):

Feature	Primary Memory (RAM)	Secondary Memory
Volatility	Volatile (data lost when power is off)	Non-volatile (data retained when power is off)
Access Speed	Faster	Slower
Capacity	Limited (a few GBs to tens of GBs)	Large (hundreds of GBs to TBs or more)
Cost	More expensive per GB	Cheaper per GB
Usage	Temporary storage for active processes	Long-term storage for data and programs

Ports: Means of connecting peripheral devices to your computer.

- **Monitor Ports** – Used to connect a monitor to the computer.

➢PCs usually use a ***VGA*** (Video Graphics Array) analog connector (also known as a D-Sub connector) that has 15 pins in three rows. Typically blue in colour.

➢Or ***HDMI*** (a digital video audio connection) which is a widely adopted and widely used standard for connecting audio-video devices, such as TVs, computer monitors, and Blu-ray players.

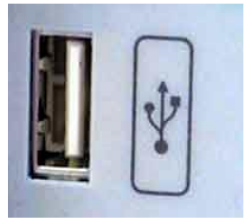
❑ **NOTE:**

✓***VGA:*** Supports lower resolutions by modern standards, typically up to 1080p (1920x1080), though it was originally designed for 640x480. The analog nature can cause a loss of image sharpness, especially at higher resolutions.

✓***HDMI:*** Supports much higher resolutions, from 1080p up to 4K and beyond. HDMI maintains perfect video quality due to its digital transmission.

- **Parallel Port** – Most often used to connect a printer to the computer. 25-pin connector. Long and skinny, often pink in colour. Transmits data at 50-100 Kb/s.

- **USB Port** – Universal Serial Bus. Now used to connect almost all peripheral devices to the computer. USB 1.1 transmits data at 1.5 Mb/s at low speed, 12 Mb/s at full speed. USB 2.0 transmits data at 480 Mb/s.



- **Network Card** – Used to provide a computer connection over a network. Transmit data at 10/100/1000 Mb/s.

- **Ethernet Port** – This port is used for networking and fast internet connections. Data moves through them at speeds of either 10 megabits or 100 megabits or 1 gigabit (1,000 megabits) depending on what speed the network card in the computer supports. Little monitor lights on these devices flicker when in use.

- **Power Supply** – Gives your computer power by converting alternating current (AC) supplied by the wall connection to direct current (DC).