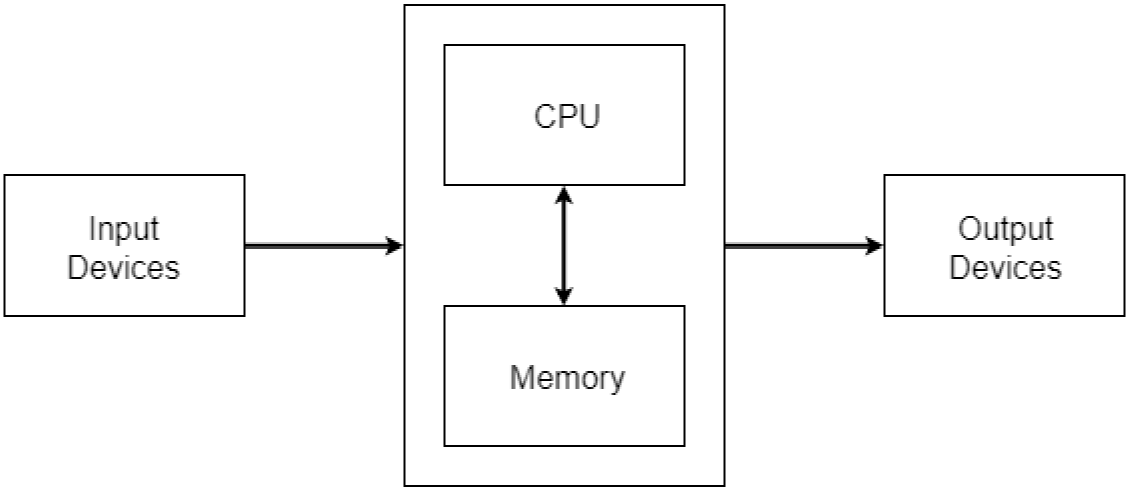
Unit 3

Algorithms

Components of Computers
Nearly all modern computers are based on the von Neumann architecture—a theoretical computer architecture described in 1945 by the mathematician John von Neumann. In this architecture, a computer consists of four main parts:

- CPU
- Memory
- Input Devices
- Output Devices



CPU (Central Processing Unit) and Memory

In the von Neumann architecture, CPU acts as the brain of the computer. It is the place where all instructions are processed and carried out. The CPU continuously queries the memory for new instructions and data to process. If there are no new instructions or data, the computer is said to be idle.

The memory acts as a place for the CPU to temporarily store both data and instructions. Data is any information the CPU performs operations on but does not instruct the CPU what to do. Instructions are special bits of information that instruct the CPU on which operations to perform on what data.

Input and Output

Input Devices

Input devices allow users to give new data and instructions to the computer. Input devices may include:

- Keyboard
- Mouse
- Microphone
- Webcam
- Scanner

Output Devices

Output devices allow computers to output the results of the computer's computations to the user. The output device also allows the computer to output results in a human-readable format. Examples of output devices include:

- Monitor
- Speaker
- Printer

Storage Devices

In addition to the components of a computer laid out by the von Neumann architecture, there are storage devices. These devices allow data and instructions to be stored in a long-term fashion. These devices can be thought of as both input and output devices since instructions can be both read from them and written to them.

- Hard Drives
- Flash Drives
- Solid-state Drives
- CD-ROM's
- DVD-ROM's

Networking Devices

In addition to the components of a computer laid out by the von Neumann architecture, there are networking devices. These devices allow multiple computers to share resources and information. These devices can also be thought of as both input and output devices since instructions can be both sent to another computer over a network and received from another computer.

- Network-interface cards (NICs)
- Wi-Fi cards
- Ethernet Adapters

Compiler

A compiler is its own standalone program. Compilers scan a source code file and compile all the instructions given in the source code directly into machine code. This machine code can then be directly executed by the operating system. The compiler also checks for errors in the source code, and can help with debugging a program.

Advantages of compiled languages:

- More efficient because source is translated directly into machine code.
- Once compiled, the program package contains all of the necessary components to run.

Disadvantages of compiled languages:

- Different processors use different machine languages. This requires us to write a new compiler for every possible processor architecture.
- It is a greater process to make changes to the code as it must be recompiled after each change.

Example Languages that use compilers:

C and C++

Interpreter

In an interpreted language, the source code is translated into bytecode, a syntax tree, a tokenized representation of the source program, or some other intermediate form that cannot be directly run by the operating system. Another program, called the *interpreter*, then examines it and performs whatever actions are called for. The interpreter, in effect, is a middle-man that goes between the operating system and the intermediate code.

Advantages of interpreted languages:

- The code is easy to read and edit at any point during the process.
- Programs are more flexible, as the code can be run on different machines, using their own interpreter

Disadvantages of interpreted languages:

- The program will run slower because it must be processed through the interpreter as an additional step.

Example Languages that use interpreters:

Python (We will work with Python in Unit 5, Activity 2) and Ruby