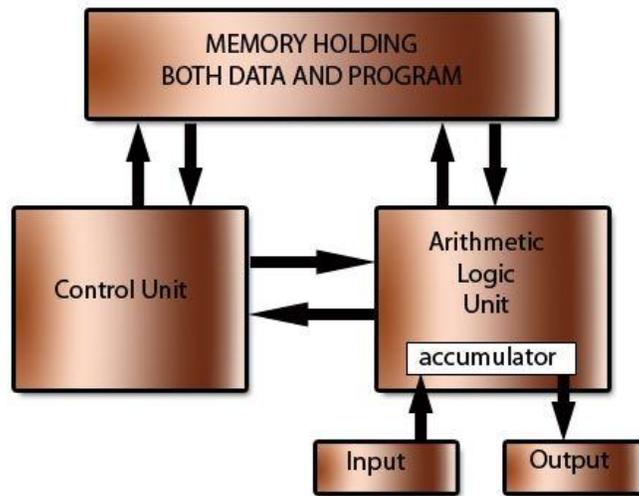


The Von Neumann Model

Although computers can have many different forms, there are four functional components that all computers must have:

1. Input/Output (I/O)
2. Memory
3. A Control Unit
4. An Arithmetic Logic Unit (ALU)



This idea about how computers should be built, called the von Neumann Architecture after mathematician John von Neumann who proposed it in 1945, is still the basis for computers today. Using these four components, a von Neumann computer will execute a series of instructions, called a program, which are stored in the computer's memory.

The Input/Output (I/O) components of a computer are hardware devices that are responsible for getting data from the computer to the user or from the user to the computer.

Although a computer has several types of memory, the memory referred to in the Von Neumann model is the main memory, also called RAM or Random Access Memory. Main memory is used by the computer for storing a program and its data while the program is running. RAM must be coded in binary - in terms of 0's and 1's.

Inside the computer, the remaining two components of the von Neumann Architecture are found on the CPU (Central Processing Unit) chip.

The **control unit** is a component of a computer's central processing **unit** (CPU) that directs operation of the processor. It tells the computer's memory,

arithmetic/logic **unit** and input and output devices how to respond to a program's instructions.

The Arithmetic/Logic Unit (**ALU**) on the CPU chip is circuitry for performing arithmetic and logical calculations.

In addition to these main components, there are 3 smaller components within the CPU that require explanation when demonstrating how a computer executes an instruction.

1. A register is a small, fast unit of memory located on the CPU, and used temporarily for storing data. Because the registers are close to the ALU, they are made out of fast memory, efficiently speeding up calculations.
2. The computer model also needs a decoder - circuitry that will take a computer instruction stored in main memory in binary (as a long string of 0's and 1's) and then convert it to signals that can execute an instruction.
3. Transmitting data between the different components is done using circuitry known as a data bus or bus. One bus connects memory to the CPU and another bus connects the relevant parts of the CPU.

What distinguishes a computer from a calculator is that the computer stores its program, the instructions it will be executing, in its own memory. Computer instructions are encoded and stored in memory as a language called machine code or machine language.

However, there is another language called assembly language, which uses more English like words to tell the computer what to do.