4.7.1 Internal Hardware Components

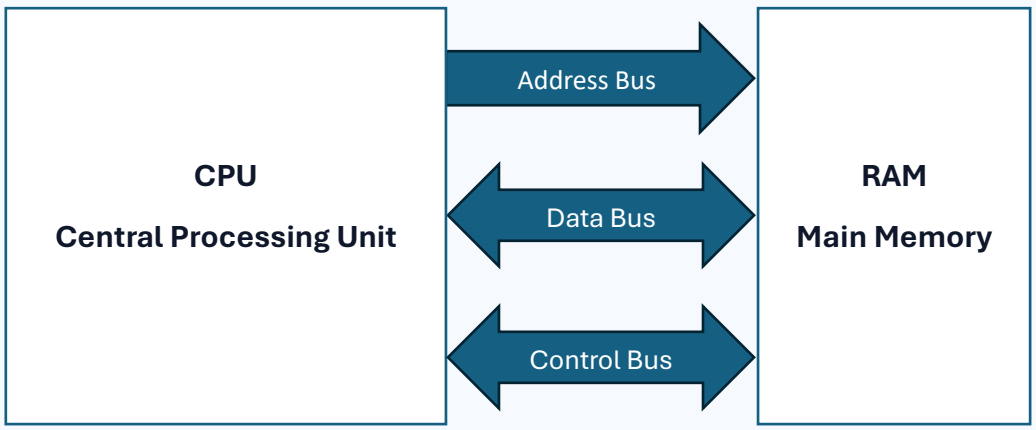
Processor

The **central processing unit (CPU)**, also known as the processor, has the task of fetching instructions from main memory, decoding the instructions and then carrying out these instructions. This cycle of fetching, decoding and executing is performed over and over as it runs the software programs being used on the computer.

It is made up of a number of different components. These include:

- Control Unit
- System Clock
- Arithmetic Logic Unit
- Buses
- Registers

The CPU is connected to main memory by buses



Main Memory

Random access memory (RAM), also known as **main memory**, are where program instructions and data are stored so they can be accessed by the processor.

Programs are stored in secondary storage devices, such as HDD or SSD drives, and **loaded into RAM when a program is run**.

RAM has **much faster access than secondary storage** drive but has a fraction of the capacity.

It is **volatile memory** meaning that the data on it is wiped when the power to the computer is turned off.

Buses

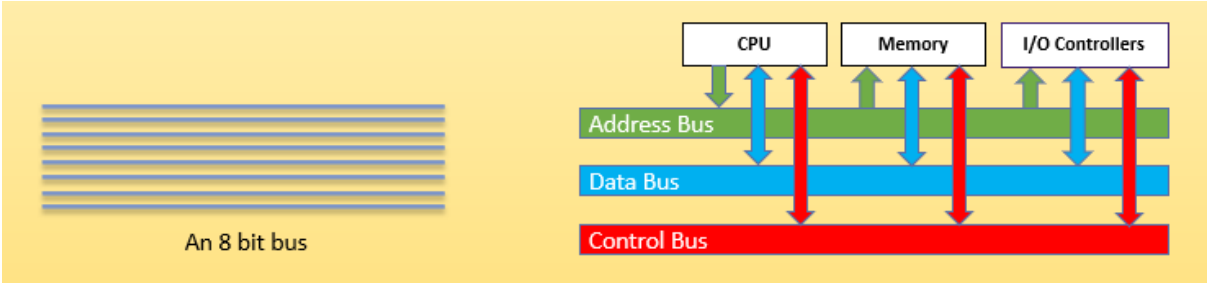
A bus is a set of parallel wires which connect components of a computer and CPU together.

They carry instructions, data and control signals between these components.

A bus can be unidirectional (allowing movement of data and signals in one direction) or bidirectional (allowing movement of data and signals in both directions

There are three types of bus:

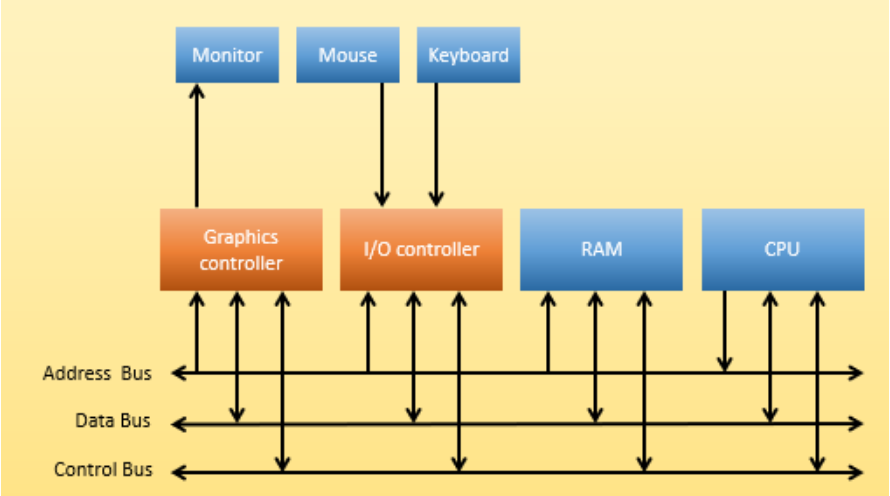
- **Address Bus** – a unidirectional bus that carries addresses to memory locations in main memory.
- **Data Bus** – a bidirectional bus that carries data between the CPU, main memory and other components.
- **Control Bus** – a bidirectional bus that carries control signals.



I/O Controllers

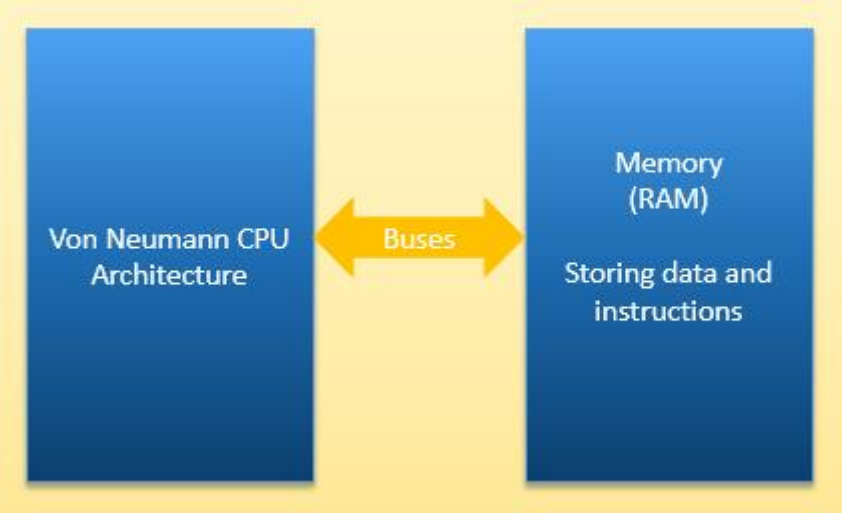
Input/output controllers (I/O controllers) are devices that act as intermediaries between the processor and peripheral devices such as keyboard, mice and monitors.

As different peripherals operate at different speeds and use different data formats the I/O controllers handle these differences to free up the CPU from being tied up waiting for the devices.



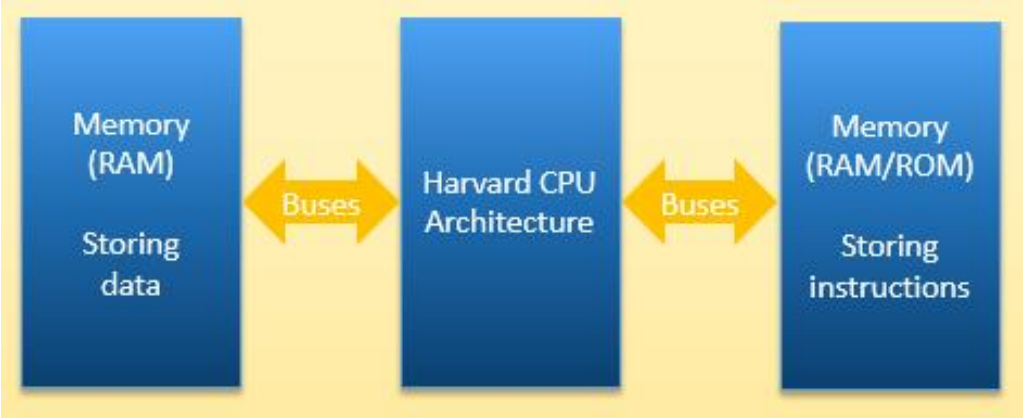
Von Neumann

- Basic architecture
    - Single control unit
    - Single ALU
    - Special registers within the CPU
- Instructions and data stored in the same area of memory.
- Has one set of buses for instructions and memory.
- Instructions and data stored in RAM.
- Single set of bus for instructions and data.
- Instructions and data sharing the same memory and buses can create a bottleneck because they cannot be fetched simultaneously.
- Used extensively in general purpose computing systems.



Harvard

- Instructions and data stored in the different areas of memory.
- Has a different set of buses for instructions and data.
- Instructions and data can use different memory types. E.g. ROM for instructions and RAM for data.
- Used extensively in embedded systems such as digital signal processing (DSP).



Advantages:

- Instructions and data can be accessed simultaneously because they use separate memories and buses, reducing the bottleneck and potentially improving performance.
- Instruction memory can be stored in ROM preventing modification.

Disadvantages:

- More complex design and circuitry.