

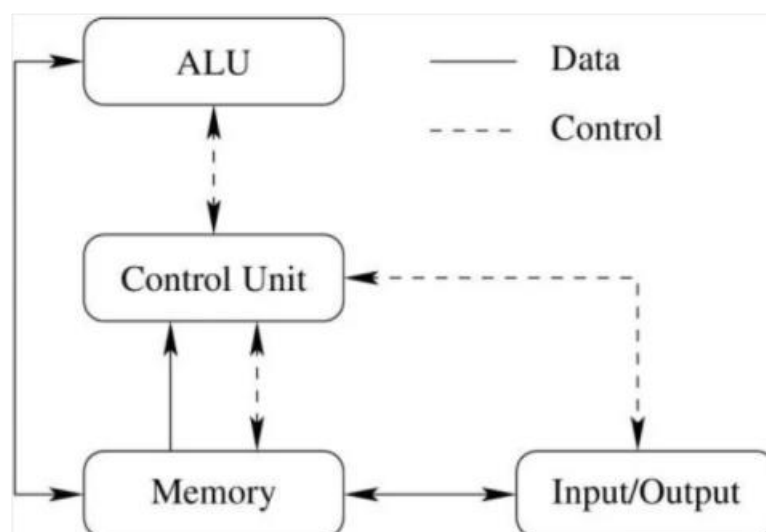
HOMEWORK 3 (SUBJECT - MPMC)

Question: Explain Von Neumann Machine and Harvard Machine.

Answer:

Von Neumann Architecture

- Between 1945 and 1951 John von Neumann set down the structure, layout, interaction, cooperation, realisation, implementation, functionality and activity for the whole computer as a system. The Von Neumann Architecture is characterized by: -
- A memory, arithmetical-logical unit (ALU), control unit, input and output devices.
- All parts of a computer are connected together by Bus, Memory and Devices are controlled by CPU.
- Data can pass through bus in half duplex mode to and from CPU.
- Memory holds both programs and data; this is also known as the stored program concept.
- Memory is addressed linearly; that is, there is a single sequential numeric address for each and every memory location.
- Memory is addressed by the location number without regard to the data contained within.
- Memory is split to small cells with the same size. Their ordinal numbers are called address numbers.
- Program consists of a sequence of instructions. Instructions are executed in stored in memory.
- Sequence of instructions are executed in order they are stored in memory.
- Sequence of instructions can be changed only by unconditional or conditional jump instructions.
- Instructions, characters, data and numbers are represented in binary form.



- The Von Neumann architecture has been incredibly successful, with most modern computers following the idea.
- You will find the CPU chip of a personal computer holding a control unit and the arithmetic logic unit (along with some local memory) and the main memory is in the form of RAM sticks located on the motherboard.
- Von Neumann architecture is also known as Stored-Program architecture.
- The most important feature is the memory that holds both data and program.
- It is better for desktop computers, laptops, workstations and high-performance computers.

Advantages of Von Neumann Architecture

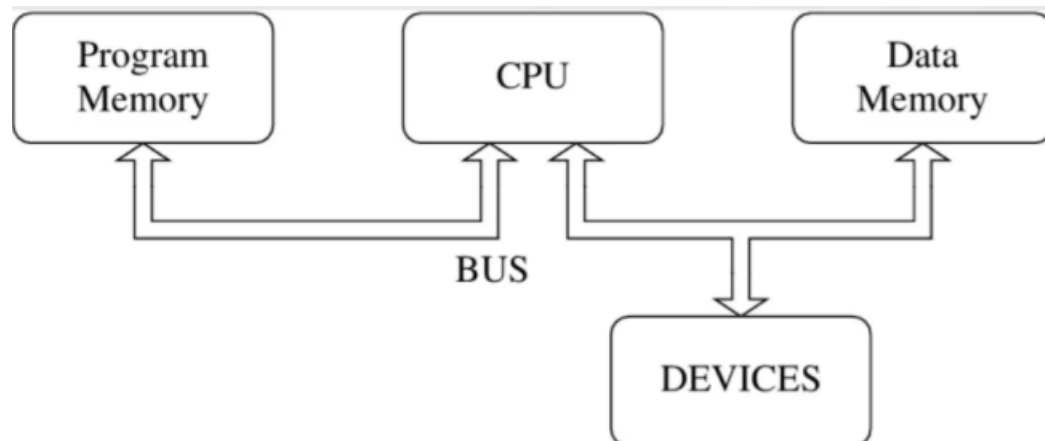
- The control unit gets data and instructions in the same way from one memory. It simplifies design and development of the Control Unit.
- Data from memory and from devices are accessed in the same way.
- Development of Control unit is cheaper and faster than Harvard.
- Easy memory organisation for the user.
- Memory organization is in the hands of programmers.
- It is better for desktop computers, laptops, workstations and high-performance computers.
- The programs can be optimised in smaller size.
- The code is executed serially and takes more clock cycles.

Disadvantages of Von Neumann Architecture

- Bottlenecking is an issue because only one bit of information can be accessed at once.
- One bus is a bottleneck. Only one information can be accessed at the same time.
- Confusion between data and instructions can lead to a system crash.
- Instruction stored in the same memory as the data can be accidentally rewritten by an error in a program.
- Serial Instruction processing does not allow parallel execution of the program. Parallel execution is stimulated later by the Operating System.
- Only handles one task at a time.

Harvard Architecture

- MARK II computer was finished at Harvard University in 1947. It wasn't so modern as the computer from von Neumann team. But it introduced a slightly different architecture. Memory for data was separated from the memory for instruction. This concept is known as the Harvard Architecture.



- Harvard is a computer hardware with physically separate storage and signal pathways for instructions and data.
- The idea of the Harvard architecture is to split the memory into two parts. One part for data and another part for programs. Each part is accessed with a different bus. This means the CPU can be fetching both data and instructions at the same time.
- This architecture is sometimes used within the CPU to handle its caches, but it is less used with main memory because of complexity and cost.
- It is used primary for small embedded computers and signals processing (DSP).

Advantages of Harvard Architecture

- Since it has two memories with two buses, this allows a parallel access to data and instructions.
- Development of the Control Unit is expensive and needs more time.
- Data and instructions are accessed in the same way.
- Both memories can use different cell sizes.

Disadvantages of Harvard Architecture

- Free data memory cannot be used for instructions and vice-versa.
- The program cannot write itself.
- Development of the control unit is expensive and needs more time.
- Less chance of program corruption.
- Instead of one data bus there are now two which means pins on the CPU, a more complex motherboard and doubling up on RAM chips as well as more complex cache design. This is why it is rarely used outside the CPU.
- Production of a computer with two buses is expensive and needs more time.