Computer Architecture and Organization

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Computer Architecture and Organization

Computer Architecture in general covers three aspects of computer design namely: Computer Hardware, Instruction set Architecture and Computer Organization.

Computer Architecture and Organization

Basic Structure of Computers

Computer hardware consists of electronic circuits, displays, magnetic and optical storage media and communication facilities.
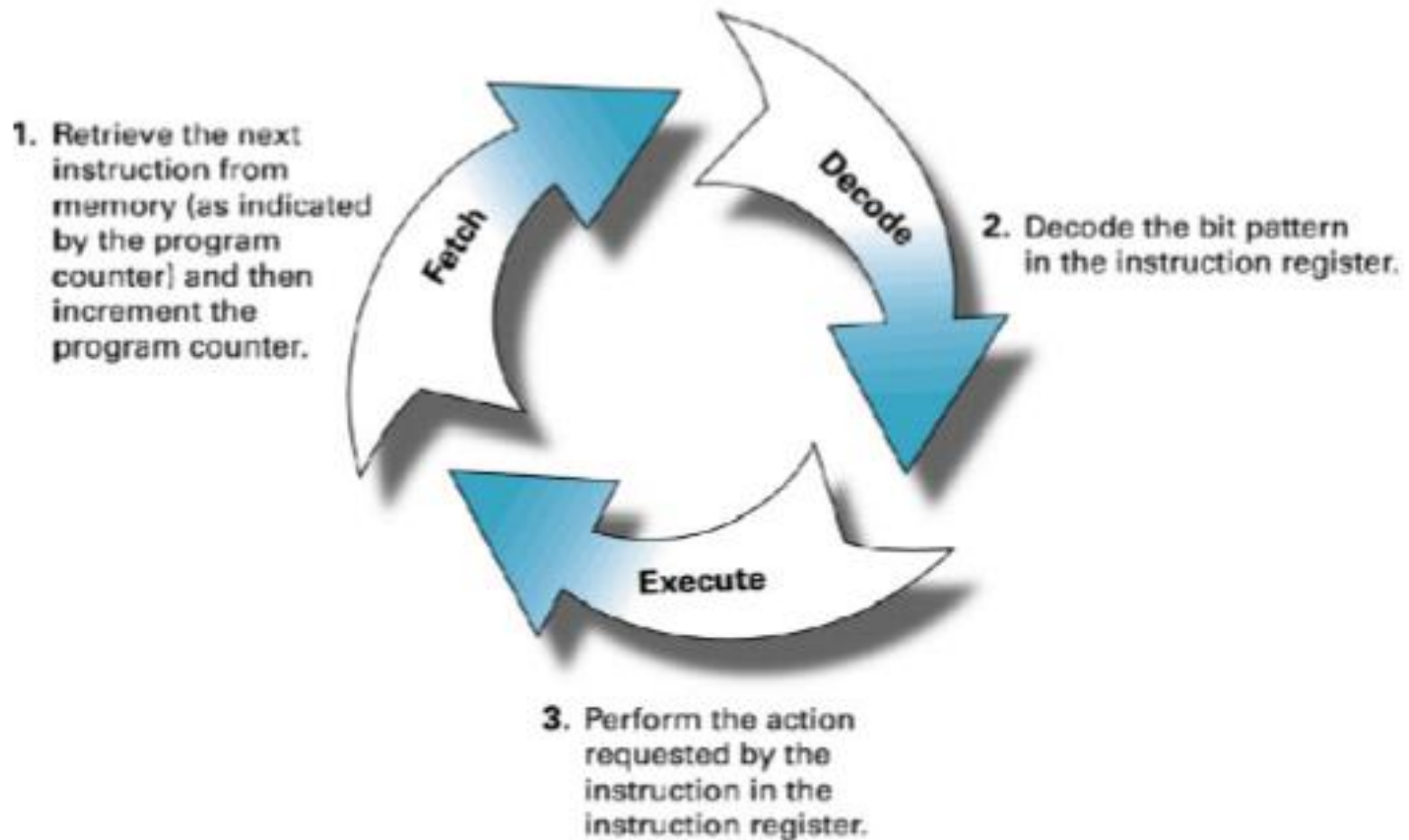
Computer Architecture and Organization

Instruction set Architecture is programmer visible machine interface such as instruction set, registers, memory organization and exception handling. Two main approaches are mainly CISC (Complex Instruction Set Computer) and RISC (Reduced Instruction Set Computer)

Computer Architecture and Organization

Computer Organization includes the high level aspects of a design, such as memory system, the bus structure and the design of the internal CPU.

- The internal operation of the computer can be as depicted in the figure below:

1. Retrieve the next instruction from memory (as indicated by the program counter) and then increment the program counter.

Fetch

Decode

2. Decode the bit pattern in the instruction register.

Execute

3. Perform the action requested by the instruction in the instruction register.

- The computers can be classified into various categoriesas given below:
- • Micro Computer
- • Laptop Computer
- • Work Station
- • Super Computer
- • Main Frame
- • Hand Held
- • Multi

- Micro Computer:

- A personal computer; designed to meet the computer needs of an   individual.

- Provides access to a wide variety of computing applications, such as word processing, photo editing, e-mail, and internet.

Laptop Computer:

- A portable, compact computer that can run on power supply or a battery unit.

- All components are integrated as one compact unit.

- It is generally more expensive than a comparable desktop. It is also called a Notebook.

- Work Station: Powerful desktop computer designed for specialized tasks. Generally used for tasks that requires a lot of processing speed. Can also be an ordinary personal computer attached to a LAN (local area network).

- Super Computer: A computer that is considered to be fastest in the world. Used to execute tasks that would take lot of time for other computers. For Ex: Modeling weather systems, genome sequence, etc (Refer site: http://www.top500.org/)

Main Frame:

- Large expensive computer capable of simultaneously processing data for hundreds or thousands of users.

- Used to store, manage, and process large amounts of data that need to be reliable, secure, and centralized.

Hand Held:

- It is also called a PDA (Personal Digital Assistant).

- A computer that fits into a pocket, runs on batteries, and is used while holding the unit in your hand.

- Typically used as an appointment book, address book, calculator and notepad.
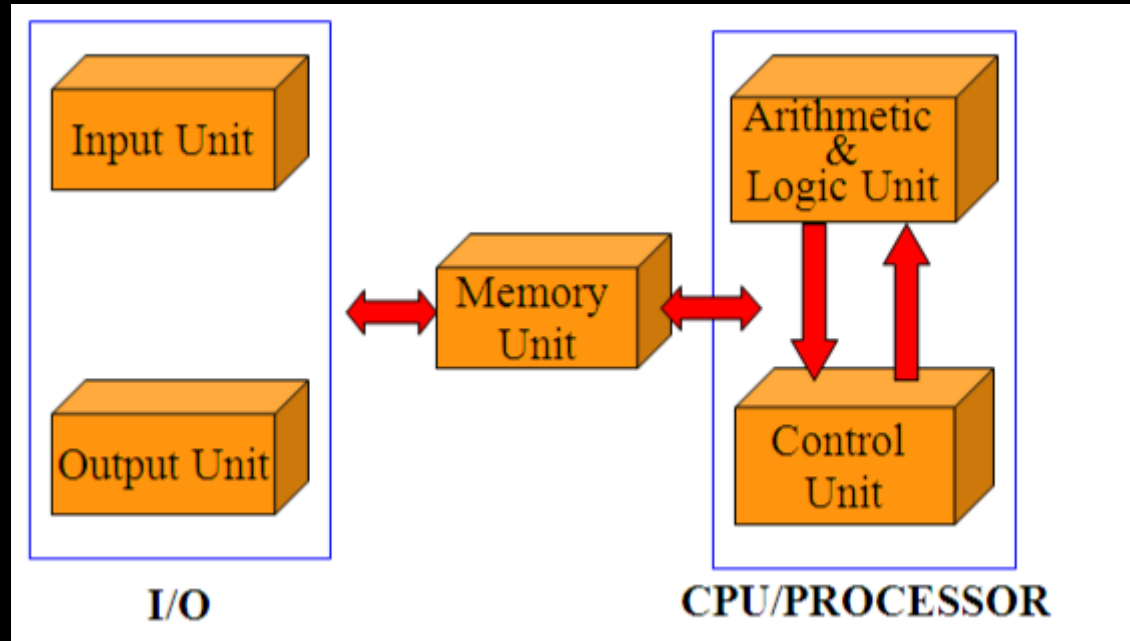
Multi Core:

- Have Multiple Cores – parallel computing platforms.

- Many Cores or computing elements in a single chip.

- Typical Examples: Sony Play station, Core 2 Duo, i3, i7 etc.

Functional Unit

- A computer in its simplest form comprises five functional units namely input unit, output unit memory unit, arithmetic & logic unit and control unit.
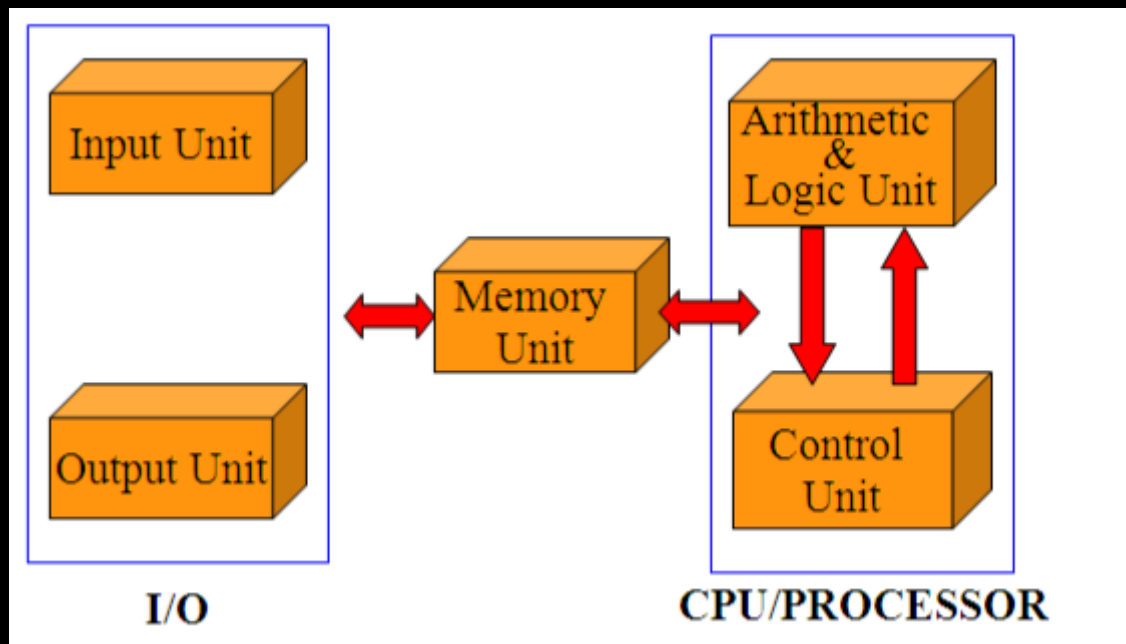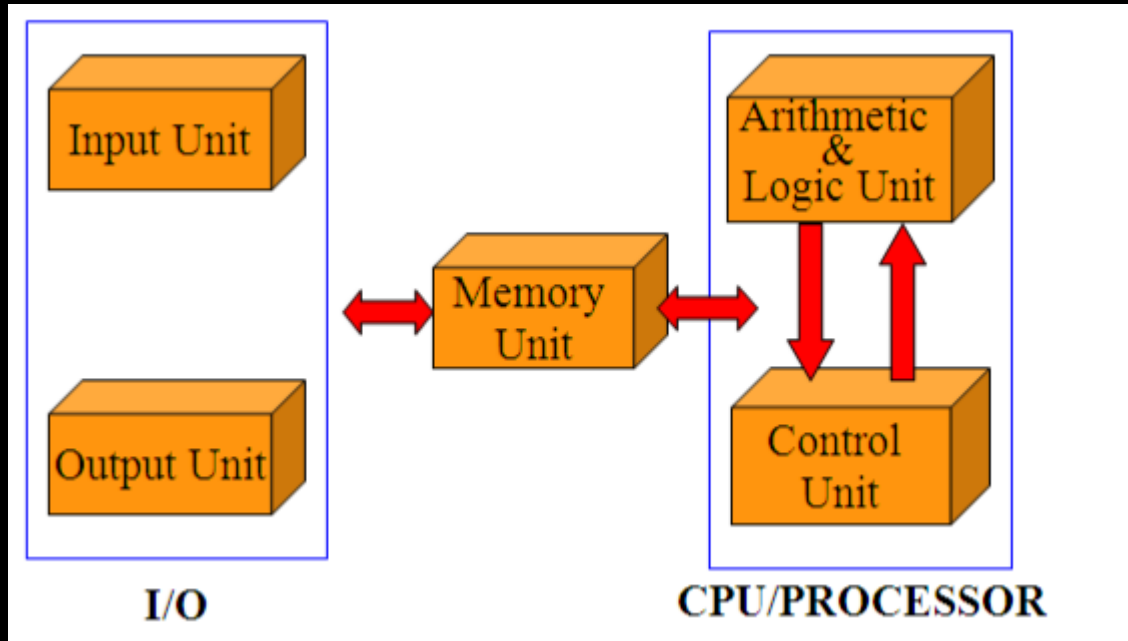
Functional Unit

- Input Unit: Computer accepts encoded information through input unit. The standard input device is a keyboard. Whenever a key is pressed, keyboard controller sends the code to CPU/Memory.

- Examples include Mouse, Joystick, Tracker ball, Light pen, Digitizer, Scanner etc.
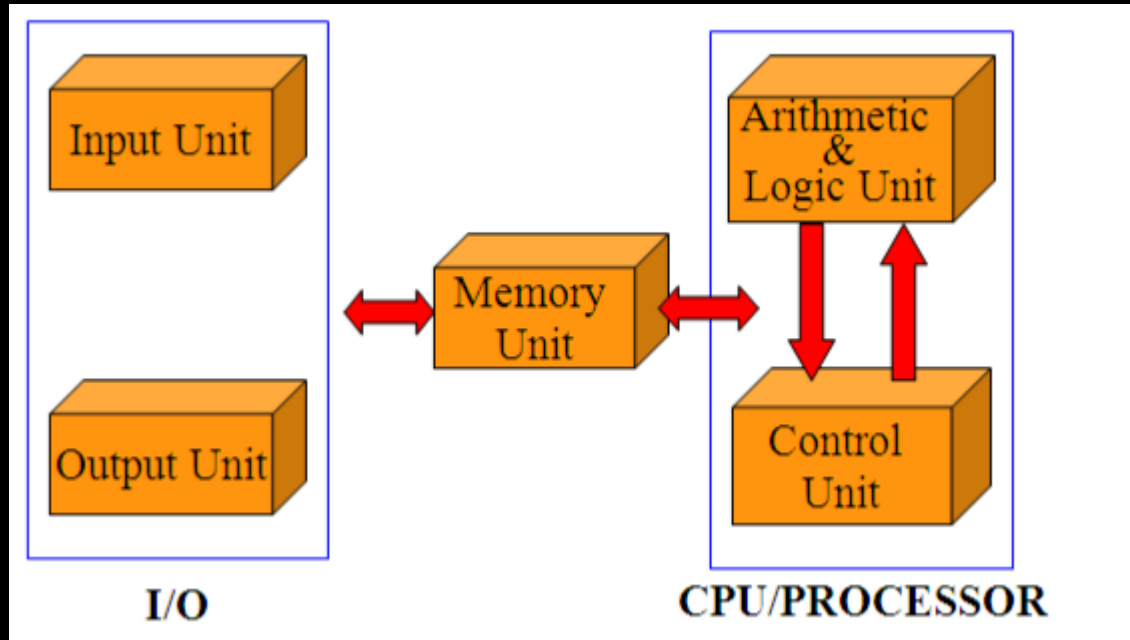
Functional Unit

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- Memory Unit: Memory unit stores the program instructions (Code), data and results of computations etc. Memory unit is classified as:

- • Primary /Main Memory

- • Secondary /Auxiliary Memory

Functional Unit

Primary memory is a semiconductor memory that provides access at high speed. Run time program instructions and operands are stored in the main memory.

Functional Unit

- Main memory is classified again as ROM and RAM. ROM holds system programs and firmware routines such as BIOS, I/O Drivers that are essential to manage the hardware of a computer.

- RAM is termed as Read/Write memory or user memory that holds run time program instruction and data.

- While primary storage is essential, it is volatile in nature and expensive. Additional requirement of memory could be supplied as auxiliary memory at cheaper cost. Secondary memories are non volatile in nature.

Functional Unit

Arithmetic and logic unit: ALU consist of necessary logic circuits like adder, comparator etc., to perform operations of addition, multiplication, comparison of two   numbers etc.

Functional Unit

Output Unit: Computer after computation returns the computed results, error   messages, etc. via output unit. The standard output device is a video monitor, LCD/TFT monitor. Other output devices are printers, plotters etc.

Functional Unit

Control Unit:

Control unit co-ordinates activities of all units by issuing control signals. Control signals issued by control unit govern the data transfers and then appropriate operations take place.

Control unit interprets or decides the operation/action to be performed.

The operations of a computer can be summarized as follows:

1. A set of instructions called a program reside in the main memory of computer.

2. The CPU fetches those instructions sequentially one-by-one from the main memory, decodes them and performs the specified operation on associated data operands in ALU.

3. Processed data and results will be displayed on an output unit.

4. All activities pertaining to processing and data movement inside the computer machine are governed by control unit

Difference between Architecture & Organization

Architecture	organization
"what" It describes what computer does?	"How" It describes How computer Do it?
Deals with High level design issue (system & Comp.)	Deals with low level design issue(Logic & circuit)
Functional Behaviour	Structural Behaviour
Design of computer "First"	Design of computer "Second"
Instruction sets, Addressing modes, Data types	Circuit design signals, ALU, CPU& memory

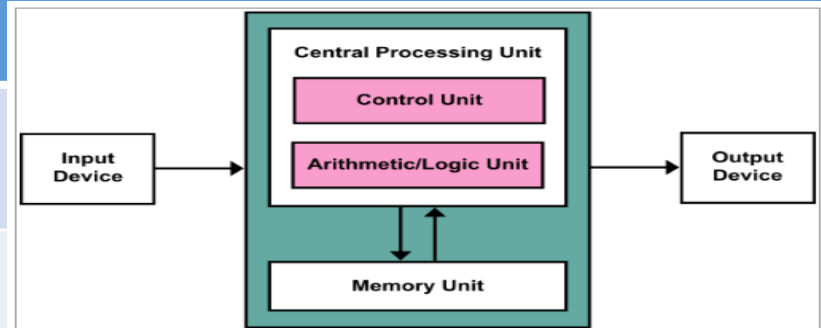# Difference between Von Neumann & Harvard architecture
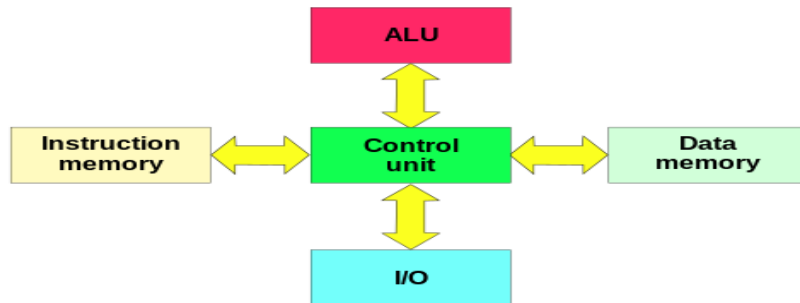
Harvard	Von Neumann
It has separate data & Program Memory	**It has common data & Program Memory**
More hardware or separate Data and address bus for each memory	**Less hardware and require only one Data and address bus**
Require more space	**Require less space**

Difference between Von Neumann & Harvard architecture
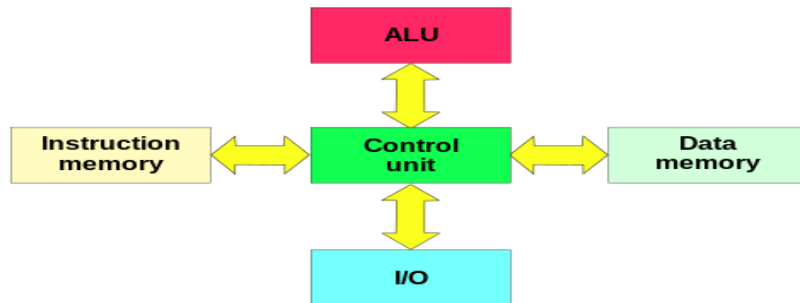
Harvard	Von Neumann
Proper can fetch data and instruction simultaneously	**Only either data or instruction can be fetched at a time**
Empty space in program memory can not be used for data & vice versa.	**Memory size for data & Instruction can be adjusted or interchange.**
Controlling or control unit is complex since data and instruction are fetched simultaneously	**Controlling or control unit is simple**

- **Harvard architecture** is used primary for small embedded computers and signal processing (DSP).

Von Neumann is better for desktop computers, laptops, workstations and high performance computers