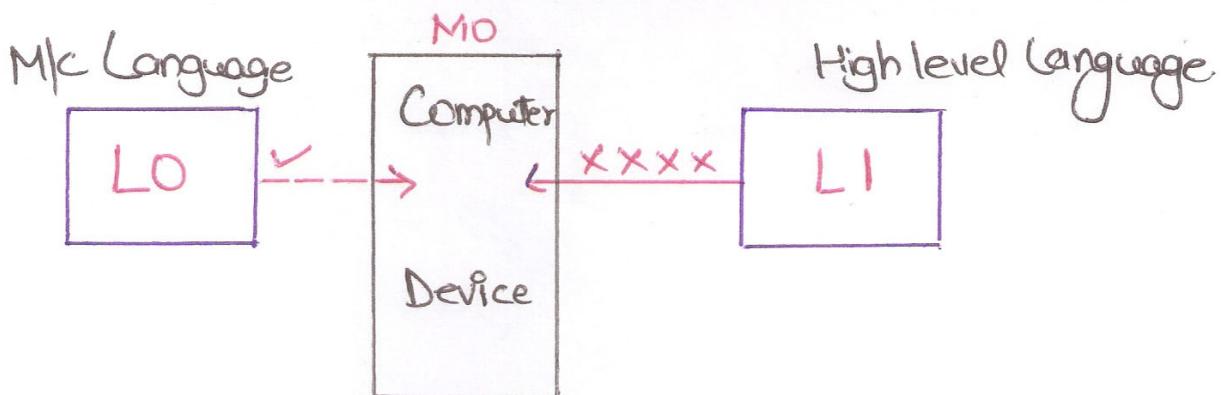


STRUCTURED COMPUTER ORGANIZATION

- * When we entered in the ERA of Designing Computers, a big problem came in existence this was that there is a gap between what is convenient for people and what is convenient for computers because most 'Machine Language's are so simple, it's difficult and tedious for people to use them.
- * So this problem led to a way of structuring computers as a series of abstractions, each abstraction building on the one below it.

By this approach, the complexity can be mastered and Computer System can be designed in a systematic, organized way. And this Approach is called 'Structured Computer Organization'

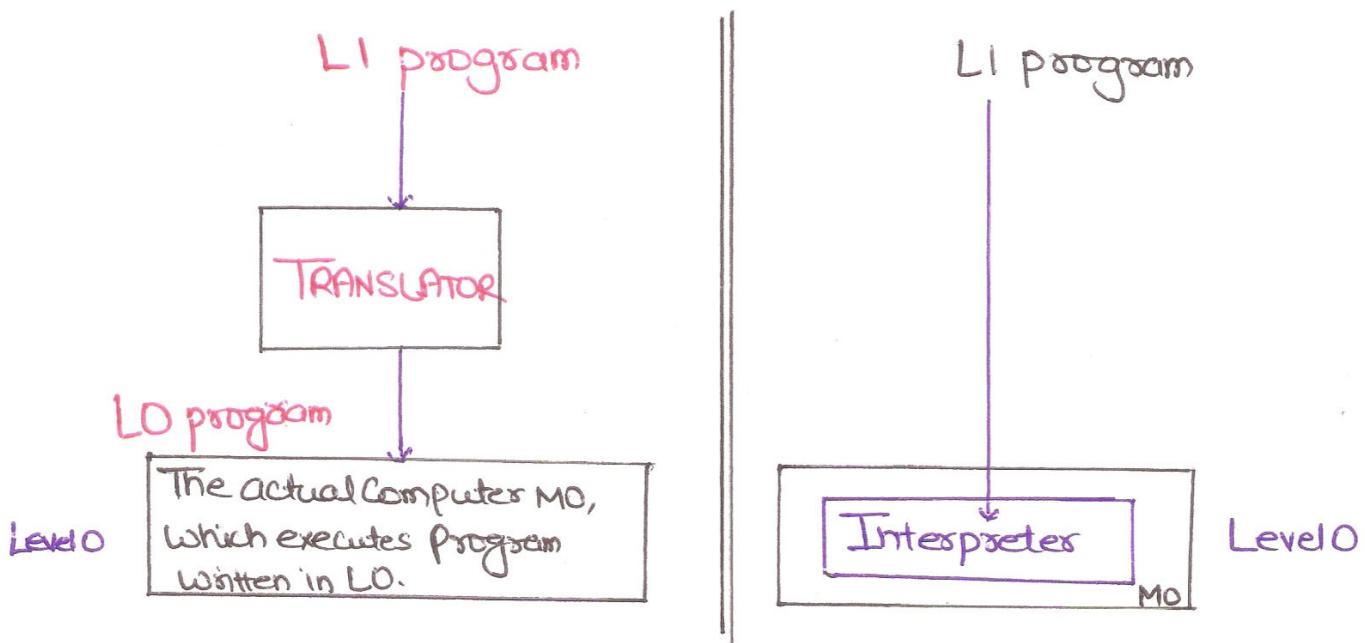
Let Suppose There is two Language LO (Mic Lang) and LI (other non-understandable by machine) by MO



So there are two methods by which LI can be executed on Machine MO.

One Method:- Replace each LI Instruction to equivalent sequence of Instructions in LO. So this Technique is called TRANSLATION.

Second Method:- In this Technique, write a program in LO that takes programs in LI as input data and carries them out by examining each instruction in turn and executing the equivalent sequence of LO instructions directly.
→ This technique does not require first generating a new program in LO. It is called Interpretation and the program that carries it out is called an Interpreter.



So we can imagine a no. of levels each one with its own language L_n and virtual machine M_n .

Level n

Virtual Machine M_n with
M/C Language L_n

L_n is either Interpreted or translated for lower machine, in Machine language.

Level 3

Virtual Machine M_3 , with
Machine Language L_3

Level 2

Virtual Machine M_2
Machine Language L_2

L_2 is either interpreted or translated in L_1 or L_0 for M_0 or M_1

Level 1

Virtual Machine M_1 , with
Machine Language L_1

Level 0

Actual Computer M_0 , with
Machine Language L_0

Program in L_0 can be directly executed by the electronic circuit.

A user of level n has only to know language L_n and can forget about all below layers: to his eyes the computer is the Virtual Machine M_n .

→ So through Interpretation / translation the final result is that a program written in L_n will be executed on M_0 (the actual computer which understand M/C lang).

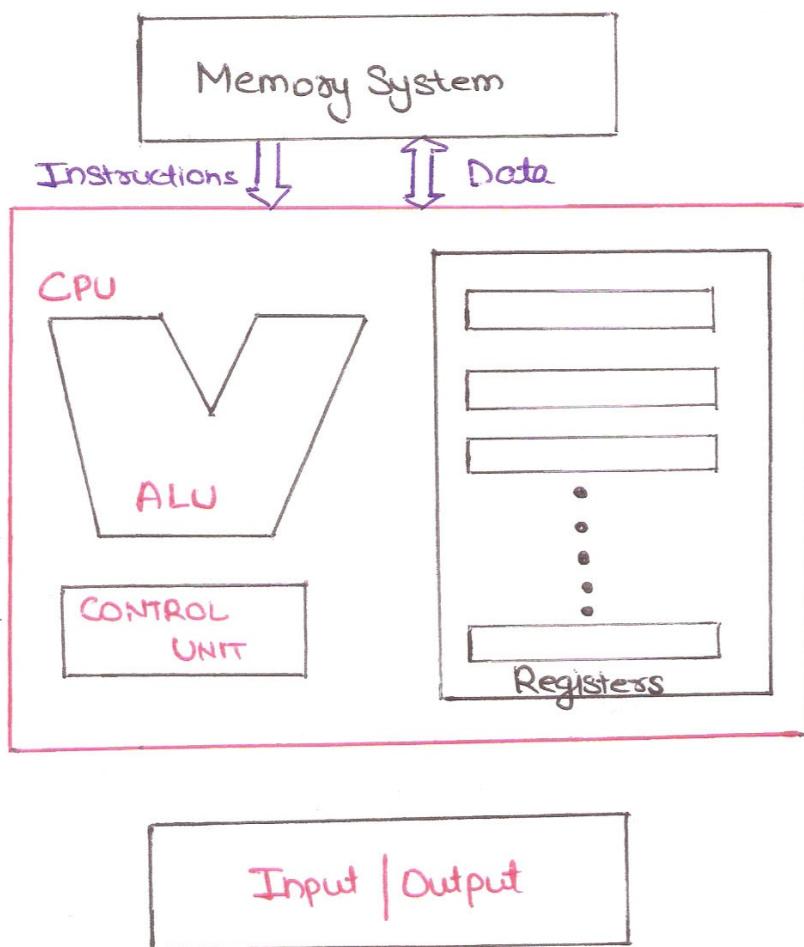
It involves :- CPU, Cache, Main Memory, Secondary Memory, I/O Devices.

Structured Organization - CPU

Role of CPU in Structured Organization

→ A typical CPU has three major components

- a) Register set,
- b) Arithmetic Logic Unit (ALU)
- and (3) Control unit (CU)



Central processing unit main components and interactions with memory and I/O.

* Registers Set differ from one Computer Architecture to another

Registers are mainly combination of General-Purpose-Register and Special-Purpose Registers.

General purpose Registers :- Used for any purpose

Special purpose Registers :- for special purpose in CPU. like PC - Program Counter is used to hold the address of the instruction to be executed next.

IR - Instruction Register :- hold the instruction that is currently executed.

ALU :- The ALU provides the circuitry needed to perform the arithmetic, logical and shift operations demanded of instruction set.

CU : Control Unit is responsible for fetching the instruction to be executed from the main memory and decoding and then executing it.

Instruction Execution Cycle :-

- The next instruction to be executed, whose address is obtained from the PC, is fetched from the memory and stored in the IR.
- The instruction is decoded.
- Operands are fetched from the memory and stored

- The instruction is executed.
- Results are transferred from CPU registers to the memory, if needed.

The actions of the CPU during an execution cycle are defined by micro-orders issued by the Control unit.

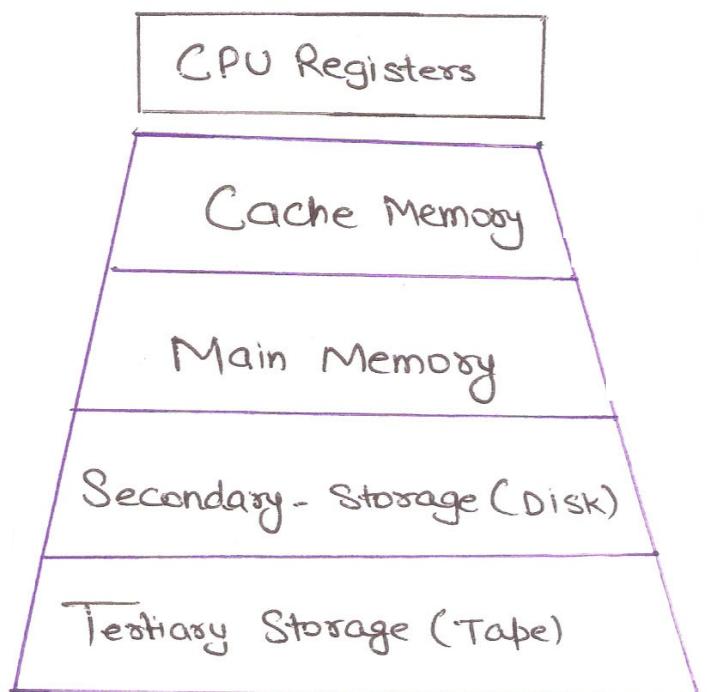
Micro-orders are individual control signals sent over dedicated control lines.

- Let us Assume! - We want to execute an instruction that moves the contents of Register X to Register Y, and both these are connected to Data Bus D.
- Then the Control Unit will issue a control signal to tell Register X to place its contents on the Data Bus D.
- Hardwired or microprogramming control is used to determine the activation of control signals.

Structured Organization- Cache Memory:-

Cache Memory :- The term Cache means a safe place for hiding or storing things.

- Cache Memory (CM) is a small, fast memory which holds copies Recently accessed instructions and data.
- When the processor makes a request for memory Reference the Request is first sought in the Cache.
- If we get that memory Reference which is Requested we call it 'CACHE HIT' . Otherwise Cache Miss:
- In the case of Cache Miss, requested element is brought from a Subsequent memory level from Memory Hierarchy and placed in Cache.



→ A block of elements are transferred from Main Memory to Cache memory by expecting that the next requested element will be residing in the neighboring locality of the current requested element (spatial locality) and this has to happen under one main memory access time.

Some Main Points of Cache Organization:-

- Cache is organized not in bytes, but as blocks of Cache lines, with each line containing some no. of bytes (16-64).
- Cache lines don't have fixed addresses, which enables the Cache System to populate each Cache line with a unique (non-contiguous) address.
- 3 methods for filling a Cache lines.
- ① Fully Associated - The most flexible
② Direct mapped - The most basic
③ Set Associative - A combination of the two.

Structured Organization :- Secondary Memory & Input & Output

Secondary Memory :-

- Secondary memory or Secondary storage device is the Slowest and Cheapest form of memory. It Cannot be processed directly by the CPU.
- It must be Copied into primary storage - also known as RAM

Ex:- CDROM, Magnetic tapes, Floppy Disks , IDE Disks
SCSI Disks

I/O :-

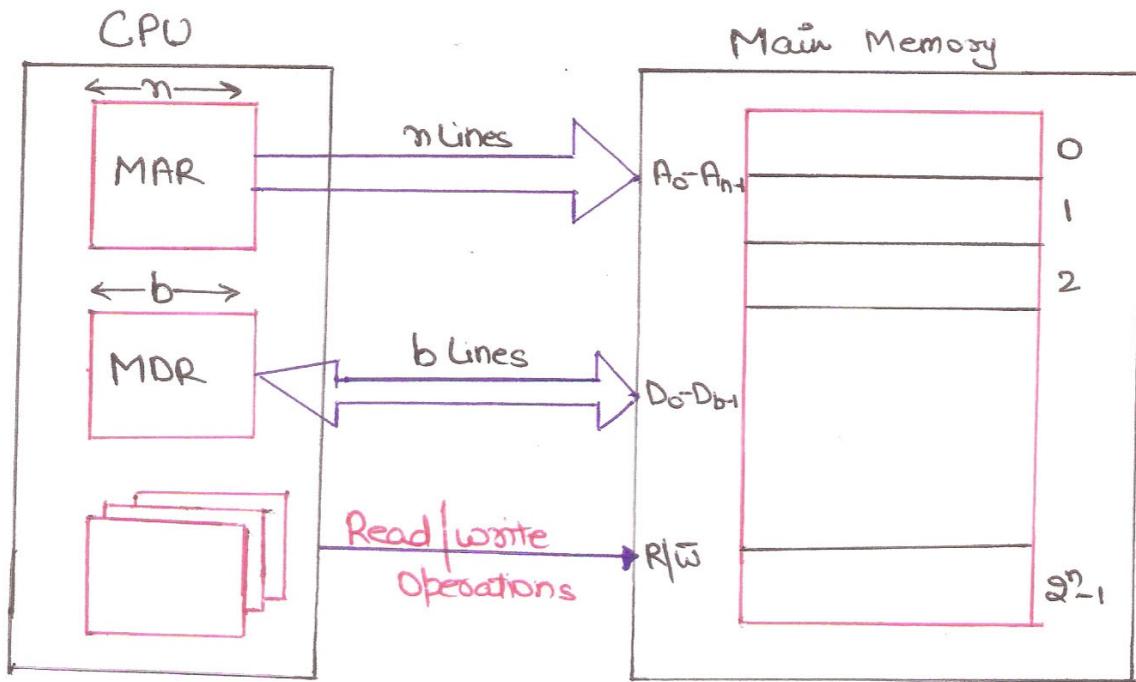
There is both a human - machine interface and a machine - machine interface to I/O

- Examples of the human - machine interface include a Keyboard, Screen or pointer
- Examples of the machine - machine interface include things like mass storage and Secondary Storage devices.

Structured Organization-

Main Memory

- Main Memory provides the main storage for a Computer

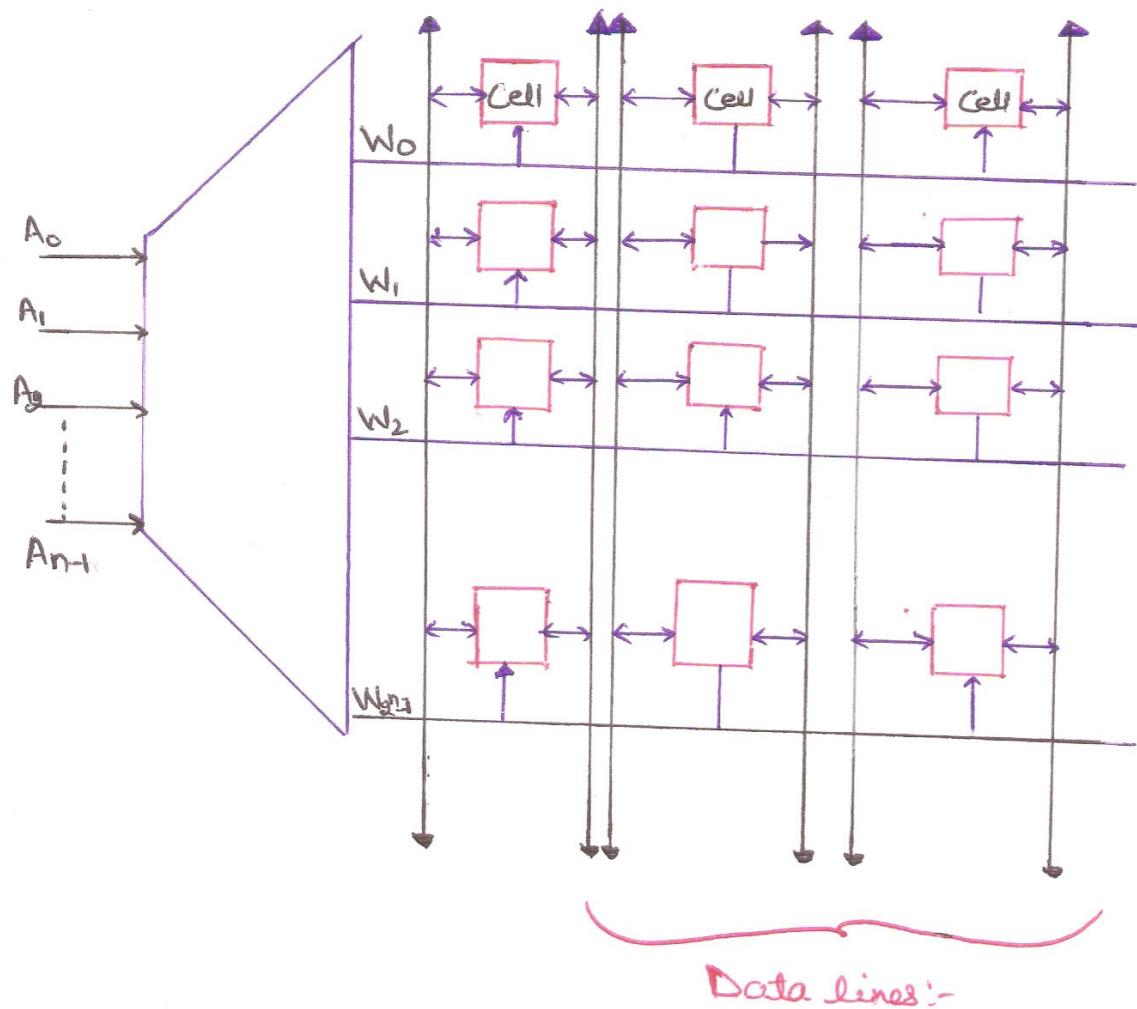


A typical CPU and main Memory Interface:-

- MAR (Memory Address Register) and MDR (Memory Data Register) are two main Registers used to interface the CPU to the main memory.
- MDR is used to hold the Data to be stored and/or retrieved in/from the memory location whose address is held in the MAR.
- Address lines $A_{n-1}, A_{n-2}, \dots, A_1, A_0$ are used as inputs to the address decoder in order to generate the word Select lines $W_{2^{n-1}} \dots W_1, W_0$.

A given word select line is common to all memory cells in the same row.

- At any given time, the address decoder activates only one word select line while deactivating the remaining lines.
- A word select line is used to enable all cells in a row for Read or Write.



Data bit lines are used to input or output the contents of cells. Each memory cell is connected to two data lines. A given data line is common to all cells in a given column.