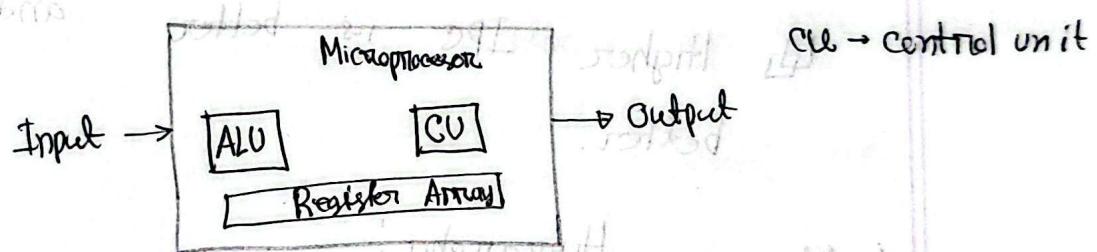


### Problem-1

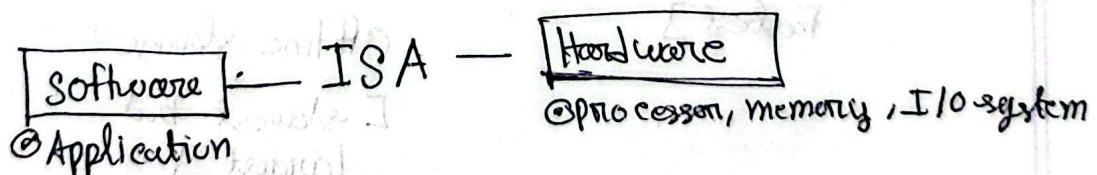
1. Microprocessor :- is a central processing Unit of a computer on a single chip.

Microcontroller :- Microcontroller is a small computer, it's integrated with circuit and it's contain processor, memory and programmable input/output.

CPU :- Central processing Unit. A brain of a computer.



2. ISA : Instruction set Architecture. It's define how software control a computer's CPU.



3. CPI : Cycles per instruction. It's measures the average number of clock cycles need to run a single instruction.

$$CPI \rightarrow \frac{\text{Total CPU Clock Cycles}}{\text{Number of Instruction Run}}$$

IPC :- Instruction Per Cycle. It's measures the average number of instructions a processor can run in a single clock cycle.

$$IPC \rightarrow \frac{\text{number of Instruction Run}}{\text{Total CPU clock cycles}}$$

Higher IPC is better and lower CPI is better.

#### 4. Memory Hierarchy :-

[ DRAMs ]

CPU Register → Cache Memory → Main memory

[ SRAMs ]

[ smallest but ]

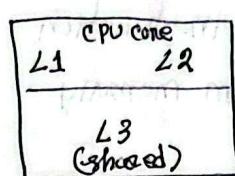
[ fastest ]

Offline storage ← Secondary memory /

[ slowest but ]  
[ largest ]

storage

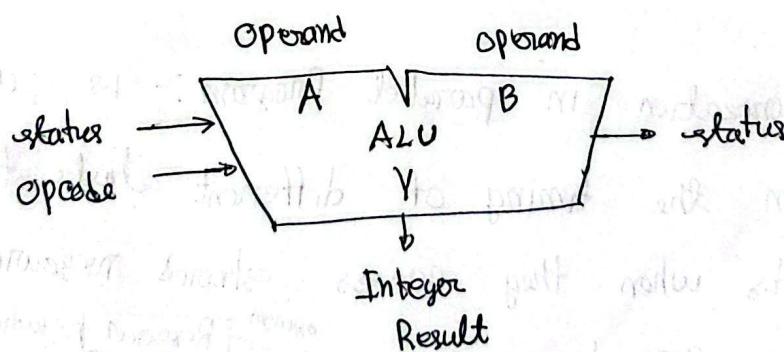
5. Cache memory: Cache memory is a small and high-speed temporary storage. It's a intermediary between CPU and RAM.



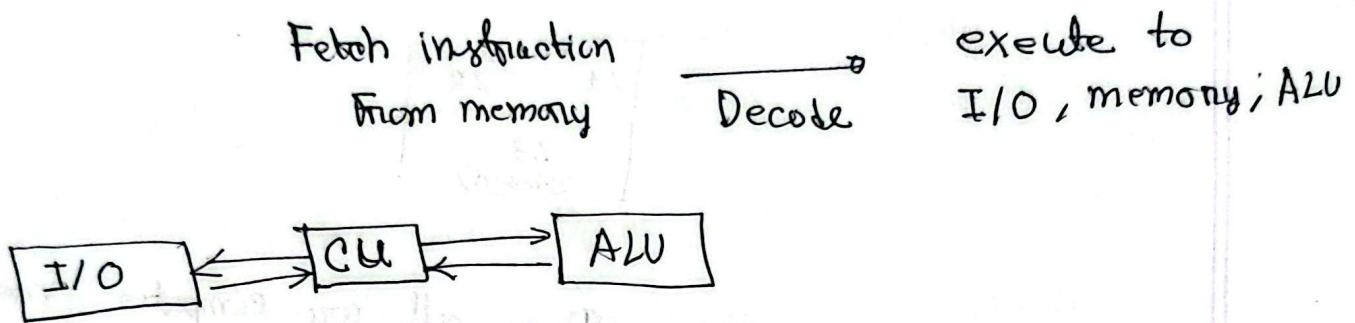
6. Register, SRAM and DRAM: These are computer memory. Register is the fastest memory. Size is very small in bits. Then SRAM it's size in MB. Most Large memory is DRAM in GB.

- Register → Temporary storage for CPU operations
- SRAM → CPU Cache (L2, L3)
- DRAM → Main system memory (RAM)

7. ALU: Arithmetic Logic Unit. It's mainly done calculation in CPU.

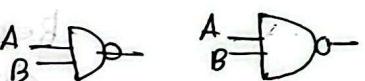


8. Control Unit :- It is a component of the CPU that directs and coordinates most of computer operations.



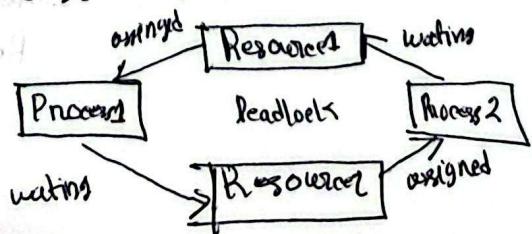
9. Universal Gate :- It's digital logic gates that can use for any boolean functions or construct logic gates like AND, OR, NOT.

Universal gate are → 1. NAND 2. NOR

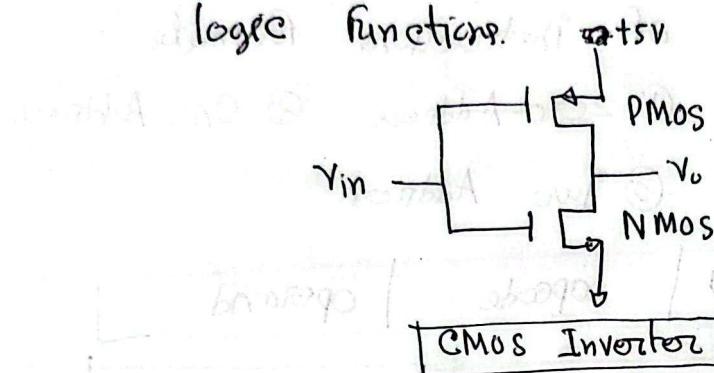


10. Pipelines :- In computer architecture is a strategy that helps a processor execute multiple instructions at the same time.

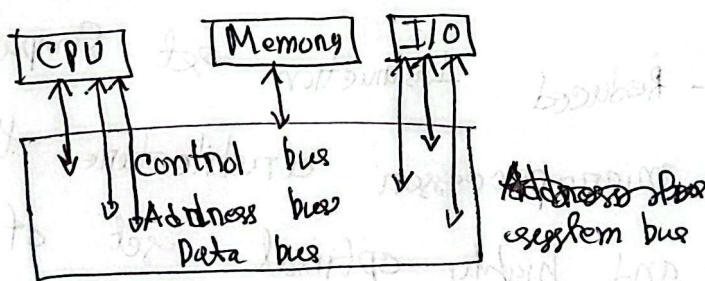
11. Synchronization in parallel Program :- is a way that maintain the timing of different tasks to prevent conflicts when they access shared resources . and ensuring program correctness.



12. CMOS : Complementary Metal-Oxide-Semiconductors. CMOS circuit uses both P-type and N-type transistors to create logic functions.



13. Address Bus : A set of parallel electrical conductors in a microprocessor system that transmits physical memory or I/O from CPU to other components.

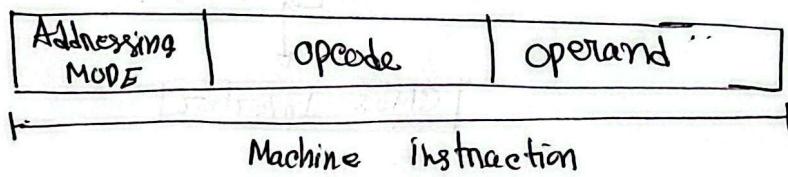


14. Data path :- Datapath is the hardware components where data is processed. Example: Register, address, multiplexers

Control path :- It is the logic that directs the flow of data through the datapath by creating control signals.

15. Instruction formats :- It's define how instruction are encoded in bits. There are 3 types of instructions formats

- ① zero Address
- ② One-Address
- ③ Two Address



16. CISC :- Complex Instruction set Computer. It's a computer architecture that use a single instruction to perform multiple low level operations.

17. RISC :- Reduced Instruction set Computer, it is a microprocessor architecture that uses a small and highly optimal set of instruction to complete tasks.

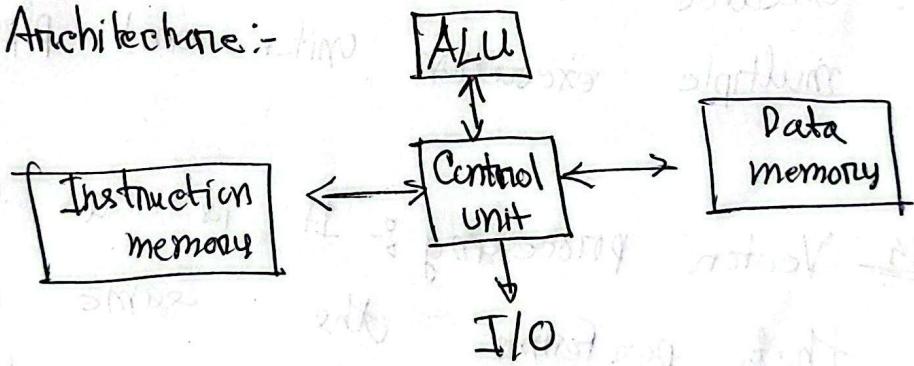
18. MIPS and ARM :- Both are Reduced Instruction set computing (RISC) processor architectures

- MIPS focuses on high-clock speed
- ARM known for its low power consumption.

19. Data hazard and Beta control → Data hazards occur when an instruction depends on the result of a previous one that has not yet completed, and control hazard arise from delays in execution of conditional branches and jumps.

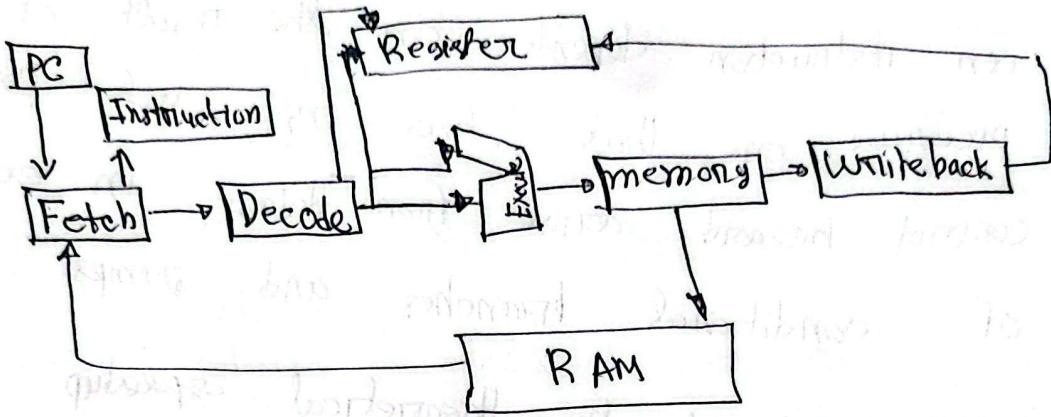
20. Amdahl's Law : the theoretical speedup of task when a portion is optimized is limited by the time spent on the non-optimized portion.

21. Harvard Architecture :-



It is a computer design where instruction and data memory are physically separate, with their own dedicated buses.

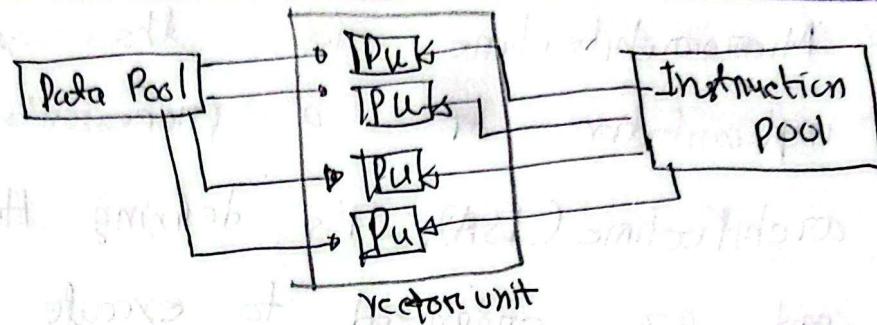
22. Fetch-decode-execute-memory-Writeback Cycle →



23. Superscalar Architecture :- It is a processor design that allows multiple instruction to be executed in same clock cycle by using multiple execution units and pipelines.

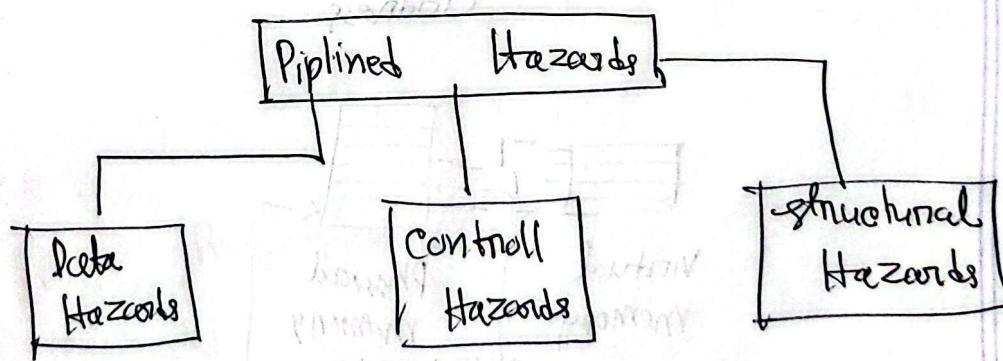
24. Vector processing :- It is a computing method that performs the same operation on multiple data elements simultaneously using a single instruction.

25. SIMD:



36. Branch Prediction: - It is a technique used by CPUs to guess the outcome of a conditional branch instruction.

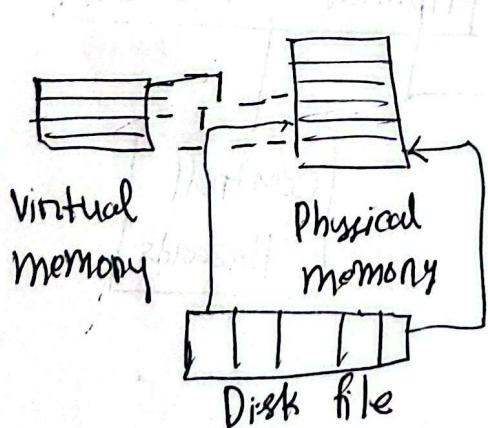
37. Pipelined processor hazards are situations where the next instruction cannot execute in the next clock cycle, requiring the pipeline to stall. flush or use other methods.



28 Microarchitecture :- is the specific hardware implementation of a processor's instruction set architecture (ISA), it's defining how ALU, CU and are organized to execute.

29 Floating Point Unit (FPU) :- It is a specialized hardware component in a computer that performs mathematical calculations on floating-point numbers.

30 Memory mapping :- Memory mapping is the process done by OS to translate Virtual memory addresses to physical address.



31 Memory interleaving is a technique that distributes memory address across multiple memory banks to improve performance by allowing for parallel access.

32 DMA: It is a feature in computer system that allows hardware devices to transfer data directly to or from main memory without needing the CPU involvement.

33 Moore's Law: - The observation that the number of transistors on an integrated circuit will double every two years with minimal rise in cost.

34 FPGA: - Field Programmable Gate Array, is an integrated circuit that can be configured and reconfigured by a user after manufacturing.

38. Control Unit :- see from Question 8

38 Combinational logic :- It's a type of a digital circuit where the output depends solely on the present inputs, without any memory of past states.

39 ① Logic synthesis ② Floorplanning ③ Placement  
④ Clock tree synthesis ⑤ Routing

40 Latch and flip-flop :- These are the fundamental digital circuits that store one bit of information, but they differ in how they change their output.

41 Clock Edge :- A clock edge is a transition in a digital signal, occurring when it moves from a low to high state or from a high to low state.

43 Chip packaging :- The process of enclosing a semiconductor chip and its die in a protective case that connects it to a circuit board.

44 Logic synthesis :- It is the process of converting a high-level description of digital circuit's behavior into an optimized technology-specific implementation made of logic gates.

45 Chip layout :- Defined as the arrangement of circuit blocks and pads on a semiconductor chip.

- ① Purifying silicon
- ② Creating a silicon wafer
- ③ Patterning the wafer
- ④ Building the chip
- ⑤ Testing and packaging

47. Finite state Machine → A mathematical Model for a system that can be in only one of a finite number of states at a time.

48. Multiplexer and encoder → A multiplexer directs data based on selection bus on the other hand an encoder translates the state of multiple inputs into a compact binary code.

49. Direct mapped Cache: It is a cache architecture where each main memory block can only be stored in one specific location in the cache.

50. HDL :- A separate module of HDL code designed to verify the functionality of another HDL module.

