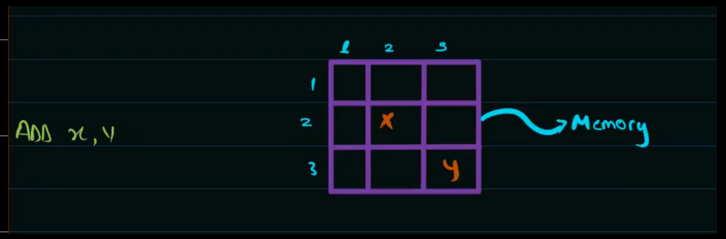
Hardware And Virtual Machines

RISC And CISC Processors

- But due to advancement in computer technology → led to more complex processor design.

CISC (Complex Instruction Set computer)

- It is designed to carry out a given task with as few lines of assembly code as possible.
- CISC processor is based on single instruction but complex instructions are converted by the processor into a number of sub-instructions to carry out the required operation.



Q- Difference between Fixed length Instructions and Variable length Instructions.

Fixed length Instructions: Instructions that can occupy a limited amount of memory space. e.g: 16 bits, 24 bits

Variable length Instructions: Instructions that can occupy as much memory space as they want

Q- Difference b/w Hardwired Control Unit and Programmable Control Unit.

Hardwired Control Unit:	Programmable Control Unit
· Uses logic Circuits	· Use programs, code will compile, run, generate output.
· Flip-Flop	

Features of CISC Processors

· CISC has more instructions → Simple instructions can be used to make complex instructions

· CISC has fewer registers. → Because most of the processing is done in memory

· CISC instructions are more complex.

· CISC has many instruction format. → One thing can be done in other formats as well

- CISC uses multicycle instructions.
- CISC uses variable length instructions.
- CISC has poor pipelinebility
- CISC requires more complex circuit. → To deal with complex instructions.
- CISC has more addressing modes. → e.g: immediate, direct, indirect, index
- CISC makes less use of RAM.
- CISC has programmable control unit.

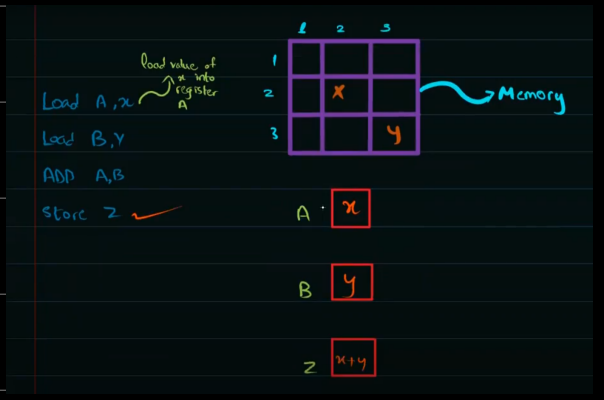
Note: CISC emphasizes on hardware

RISC (Reduced Instruction set Computer)

- Less instructions => so better performance from the processor, does not need to break complex instructions.

- Assembly code is broken into a number of single cycle instructions.

Features of RISC



- RISC has fewer instructions
- RISC has many registers
- RISC instructions are simpler
- RISC has few instruction format
- RISC uses single cycle instructions
- RISC uses fixed length instructions
- RISC has better pipelineability
- RISC requires less complex circuit
- RISC has fewer addressing modes
- RISC makes more use of RAM.
- RISC has hardwired control unit.

Note: Emphasize on Software

Pipelining

- It is a way of improving computer performance

Explanation

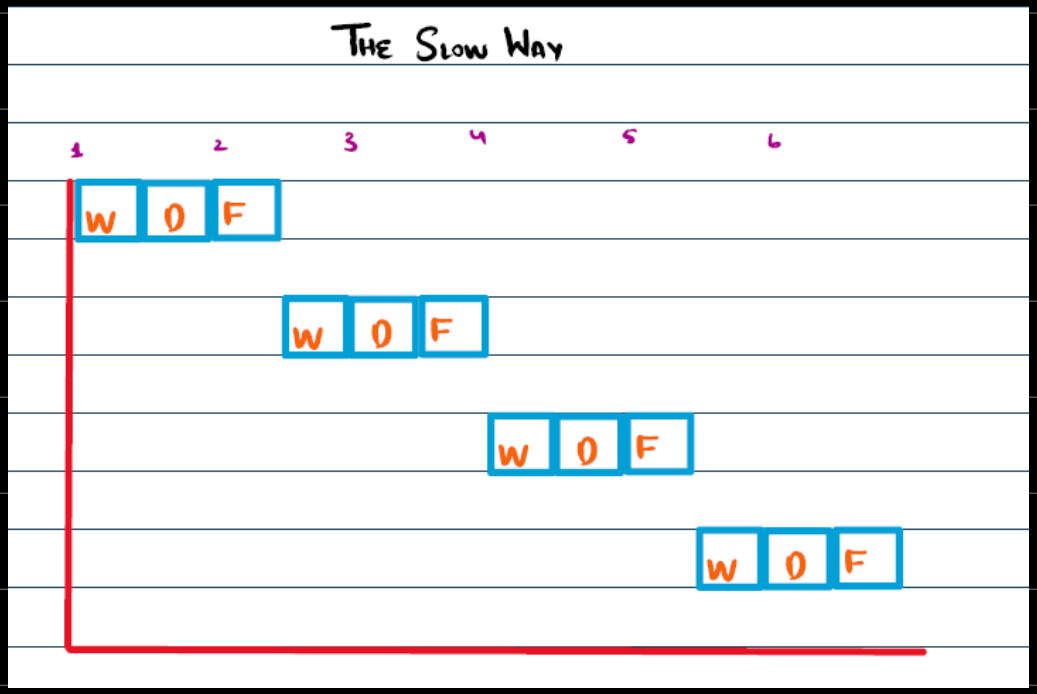
Q- Lets assume we are doing laundry

- One Washer (takes 30 min)
- One drier (takes 40 min)
- One Folder (takes 20 min)

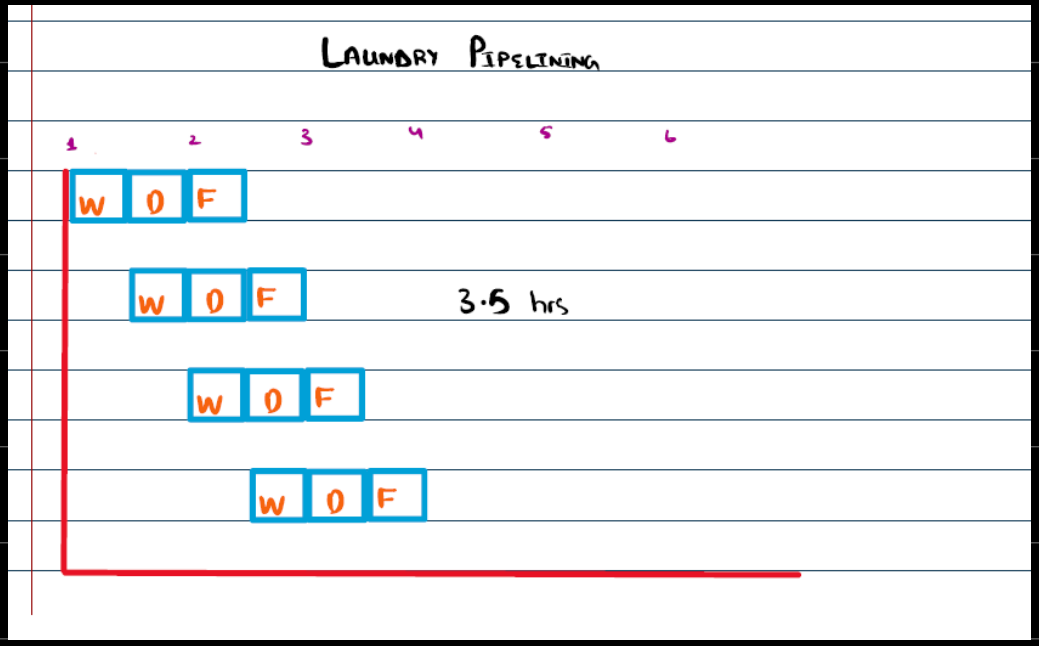
→ It takes 90 minutes to wash, dry and fold 1 load of laundry.

Q- How long do 4 loads take?

- 360 minutes



- If each load is done sequentially.



Q- What is pipelining?

- Pipelining is instruction-level parallelism → Multiple operations are performed in a single cycle.
- Execution of an instruction is split into number of stages
- When first stage for an instruction is completed, the first stage of the next instruction can start executing
- Another instruction can start executing before the previous one is finished
- Processing a number of instructions can be done simultaneously

5 stages of Processor:

1. Fetch Instruction
2. Decode Instruction
3. Execute Instruction (The operation)
4. Access Operand in memory
5. Write result to register

Opcode: Decoded Instruction (What do we need to do?)

Operand: Data (on what to perform)

There are 4 instructions.

ABCD

Without Pipeline

Stage	Time interval								
	1	2	3	4	5	6	7	8	9
Fetch instruction	A					B			
Decode instruction		A					B		
Execute instruction			A					B	
Access operand in memory				A					B
Write result to register					A				

10

B

Means 1 instruction is taking 5 cycles each.

so if there are 4 instructions = 5 × 4 = 20

① ②

With Pipelining

Stage	Time interval								
	1	2	3	4	5	6	7	8	9
Fetch instruction W	A	B	C	D					
Decode instruction D		A	B	C	D				
Execute instruction F			A	B	C	D			
Access operand in memory				A	B	C	D		
Write result to register					A	B	C	D	

By the help of pipeline only 8 cycles were used.

How many cycles were saved. 20 − 8 = 12

Interrupt

- In pipelining, there is one added complexity; as the interrupt is received, there could be a number of instructions still in the pipeline

- The usual way to deal with this is to discard all the instructions in the pipeline

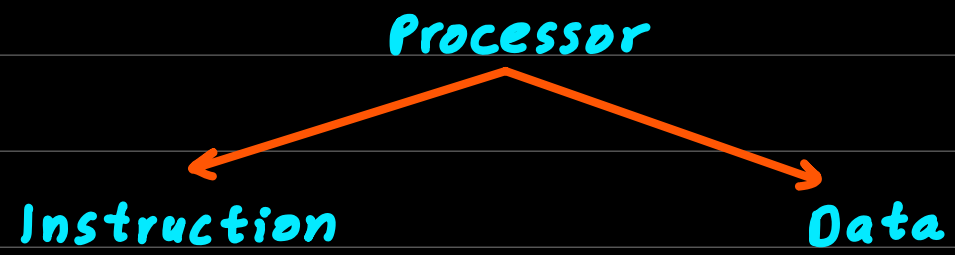
except for the last instruction in the write-back stage.

- Then interrupt handler routine can be applied to the interrupt and the interrupt is serviced. The processor can restart with the next instruction

Alternate Method

- The content of five stages can be stored in register
- Then the processor can be restored to its previous state once the interrupt has been serviced.

Four Basic Computer Architecture



Instruction Stream: Sequence of instructions executed by the processing unit

Data Stream: Sequence of data or temporary result called by instruction stream

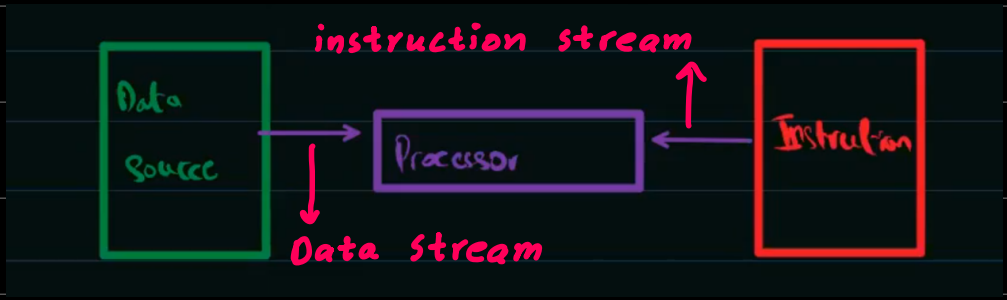
SISD: Single Instruction Single Data

SIMD: Single Instruction Multiple Data

MISD: Multiple Instruction Single Data

MIMD: Multiple Instruction Multiple Data

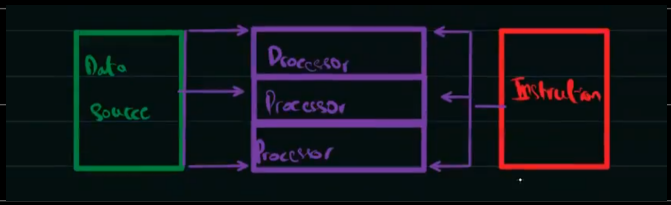
Single Instruction Single Data



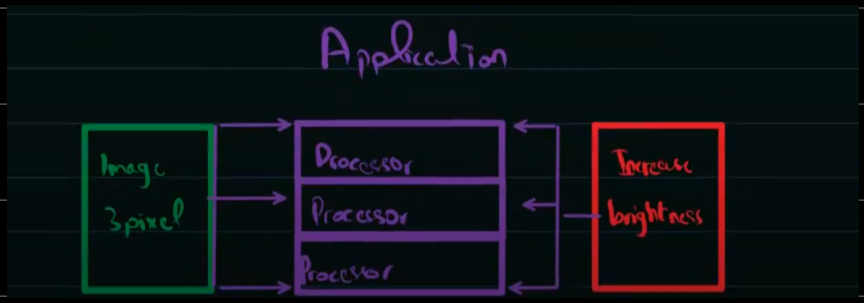
- There is only one processor
- The processor executes one set of instructions on one set of data

Note: Each task is processed in a sequential order. Does not allow parallel processing

Single Instruction Multiple Data



- Uses many processors
- Each processor has several ALU.
- Each ALU executes same set of instructions on different sets of data at the same time.

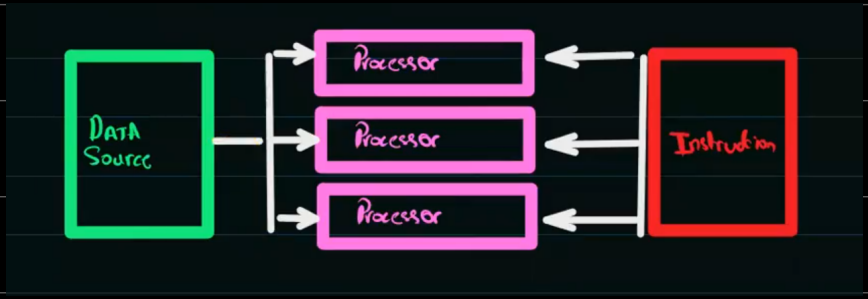


3 pixels = 3 processor

Each processor will increase brightness of each pixel

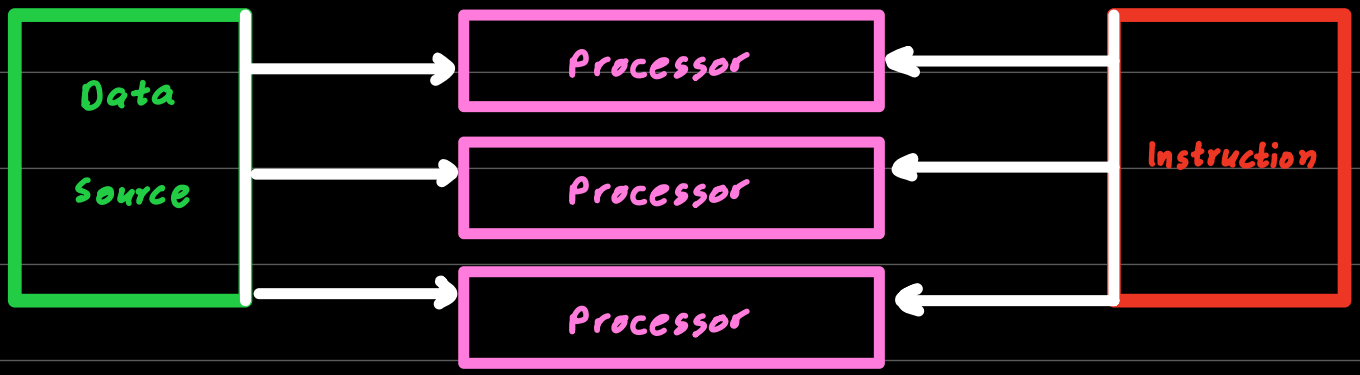
Multiple Instruction Single Data

- There are several processors
- Each processor executes different sets of instruction on one set of data at the same time



Multiple Instruction Multiple Data

- There are several processors
- Each processor executes a different set of instructions
- Each processor operates on a different set of data.



Massively Parallel Computers

Massive: Large Number of processors

Parallel: To perform a set of co-ordinated computations simultaneously

Q- Describe what is meant by Massively Parrallel Computers?

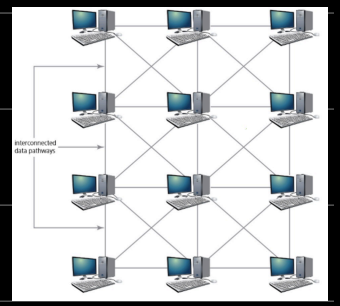
- Large Number Of Processors
- Working collaboratively on the same program
- Working together simultaneously on the same program
- Communicating via message interface

Issues

Hardware:

- Processors need to be able to communicate with each other
- So that processed data can be transferred from one processor to another

- So, its a very challenging topology



Software:

- Appropriate programming language should be used
- which allows data to be processed by multiple processors simultaneously

Q- Explain one of the hardware issues in massively parallel computers

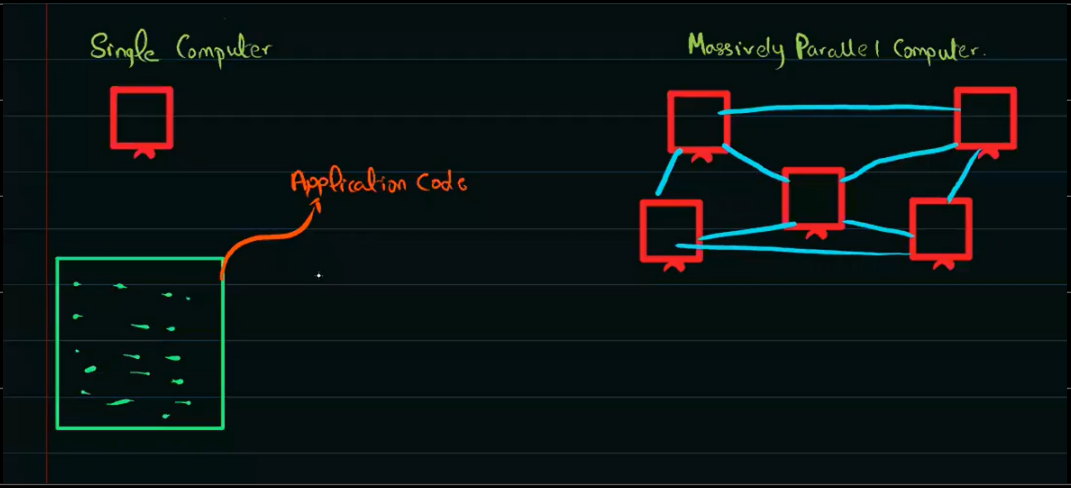
- Communication b/w the processors is the main issue
- As each processor needs a link to every other processor
- So, its a very challenging topology.

Q- Characteristics of Massively Parallel Computers

- Large Number of processors
- Collaborative and simultaneous processing
- Network Infrastructure
- Communicating by sending messages

Q- Conditions for massively parallel computers.

- No single processor
- Should have seperate buses (links)



Q- What changes would be required to this program code in order to transfer it to Massively Parallel Computer

- Split into blocks of code, so that it can be performed simultaneously instead of sequentially

- Each block is processed by a different processor which allows each of the processor to simultaneously process the different blocks of code independantly. Requires

both parallelism and coordination → organization of computers

multiple simultaneous operations e.g: Topology

Virtual Machines

Q- What is a virtual machine manager?

· It is a type of software that allows us to run an operating system within another operating system

Q- Explain the difference b/w guest operating system and host operating system?

Host operating System: The operating system that is actually controlling the physical hardware or the operating system running the virtual machine software.

Guest operating System: An operating system running in a virtual machine and controls virtual hardware

· Guest operating system is running under the host operating system software

Note: A virtual machine is a software that emulates a different computer system. A virtual machine allows multiple guest operating systems to run on one computer using a host operating system

APP Testing

Q- Describe the role of virtual machine software in testing of an app.

- By virtual machine software, you can create and manage virtual machine
- Translate instructions used by guest operating system to that required by host operating system.
- Emulates hardware
- Protect each virtual machine, so instances of the app can be tested together.

Benefits And Drawbacks

Benefits:

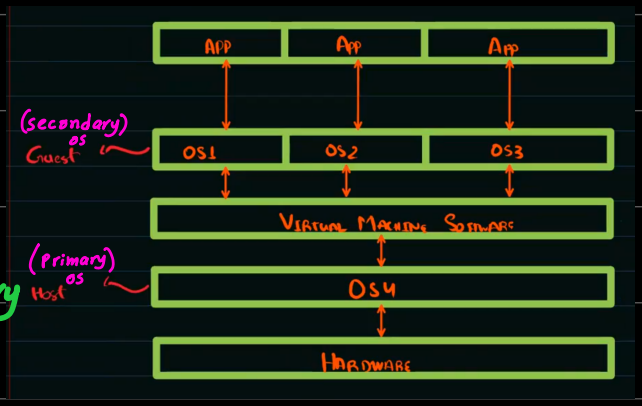
- Multiple OS can exist simultaneously allowing for testing using the same hardware
- Only one set of hardware is required
- Reduces cost of producing the app as there will be no need to set up more than one computer

Drawbacks:

- Execution of extra code (running multiple OS simultaneously) processing time increases
- So, performance is degraded, and more time taken to execute the app, and can not make judgements about response time

Q- Describe the role of the four operating systems

- OS 1, OS 2, OS 3 are the guest operating systems, secondary to one installed on the hardware.



- OS 4 is the host operating system which interacts directly with the computer hardware
- My App needs to run on all three guest operating systems with identical results.

Note: To identify host operating system look for OS which is in direct contact with the hardware.

Software Production

Q- State benefits of V.M (Virtual Machine) to produce software.

- Software can be tried on different OS using same hardware
- No need to purchase different types of hardware
- Easier to recover if software causes system crash
- V.M provides protection to other software in host operating system

Q- Limitations in producing software by V.M

- Using V.M means execution of extra code, so processing time is increased due to which speed of real performance can not be tested accordingly

- A virtual machine might not be as efficient because it might not be able to access sufficient memory

- V.M may not be able to emulate some hardware due to which hardware can not be tested using a virtual machine.

Q- What happens if guest OS receives the data request from an application

- Guest OS handles the request as if it were running on its own physical machine and guest OS is not aware that it is running on virtual machine
- Guest OS handles the request as usual
- I/O requests are translated by virtual machine software into instruction executed by host OS.

- Host OS acquires the data from the file
- Host OS passes the data to V.M software
- The virtual machine software passes the data to guest OS
- Guest OS passes the data to the application.

Q- What are the tasks performed by VM software?

- Creates VM
- Hardware emulation (existing hardware is made available to guest OS)
- Controls virtual hardware
- Ensures each virtual machine is protected from actions of another VM.

Web Server

Q- Describe uses of VM by webserver company

- Could use alternative OS to identify possible problems and it is much easier to create a VM with a new operating system rather than creating a new computer

system.

- Could provide a safe environment during testing which does not disrupt the web server services
- Could use alternative replacement web-server software to identify possible problems in the web-server on different OS. It is easier to try different webserver and OS combination