(4) Pipelining

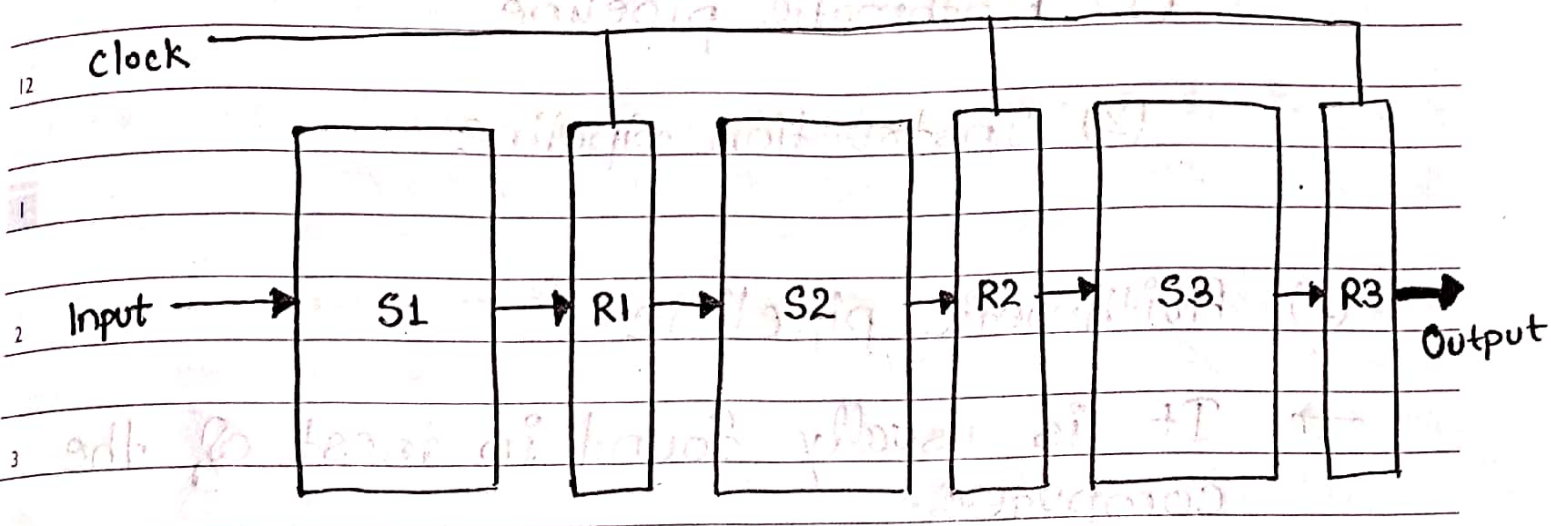
Basic Concepts

- Pipelining is the process of accumulating instruction from the processor through a pipeline. It allows
- It allows storing and executing instruction in an orderly process. It is also known as pipeline processing.
- Pipelining is a technique where multiple instructions are overlapped during execution

	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8
Instruction 1	IF	ID	OF	IE	OS				
Instruction 2		IF	ID	OF	IE	OS			
Instruction 3			IF	ID	OF	IE	OS		
Instruction 4				IF	ID	OF	IE	OS	
Instruction 5					IF	ID	OF	IE	OS

Pipelining of 5 instructions

- Pipeline is divided into stages and these stages are connected with one another to form a pipe like structure. Instructions enter from one end and exit from another end.



- In pipeline system, each segment consists of an input register followed by a combinational circuit.

- The Register is used to hold data and combinational circuit performs operations on it.

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- The Output of combinational circuit is applied to the input register of the next segment.

- Types of pipeline

→ It is divided into 2 categories:

(1) Arithmetic pipeline

(2) Instruction pipeline

(1) Arithmetic pipeline

→ It is usually found in most of the computers.

→ They are used for floating point operation multiplication of fixed point numbers etc.

for ex:- The Input to the floating point Adder pipeline is:

$$X = A * 2^a$$

$$Y = B * 2^b$$

- A & B are mantissa
- a & b are exponents.

(2) Instruction pipeline

→ In this stream of instructions can be executed by overlapping fetch, decode and execute phases of an instruction cycle.

→ This type of technique is used to increase the throughput of the computer system.

→ An instruction pipeline reads instruction from the memory while previous instruction are being executed in other segments of the pipeline. Thus we can execute multiple instructions simultaneously.

→ The pipeline will be more efficient if the instruction cycle is divided into segments of equal duration.

#

Pipeline Conflicts

There are some factors that cause the

pipeline to deviate its normal performance. Some of these factors are given below:

1) Timing Variations

→ All stages cannot take same amount of time. This problem generally occurs in instructions have different operands requirements and thus different processing time.

2) Data Hazards

→ When several instructions are in partial execution, and if they reference same data then the problem arises. We must ensure that next instruction does not attempt to access data before the current instruction, because this will lead to incorrect results.

3) Branching

→ In Order to fetch and execute the next instruction must know what that instruction is. If the present instruction is a conditional branch, and its result will lead us to the next instruction, then the next instruction may not be known until the current one is processed.

4) Interrupts

→ Interrupts set unwanted instruction into the instruction stream. Interrupts effect the execution of instruction.

5) Data Dependency

→ It arises when an instruction depends upon the result of a previous instruction but this result is not yet available.

Advantages of pipelining

1. The Cycle time of the processor is reduced.
2. It increases the throughput of the System.
3. It makes the system reliable.

Disadvantages of pipelining

1. The Design of pipelined processor is complex and costly to manufacture.
2. The Instruction letency is more.

Execution Cycle