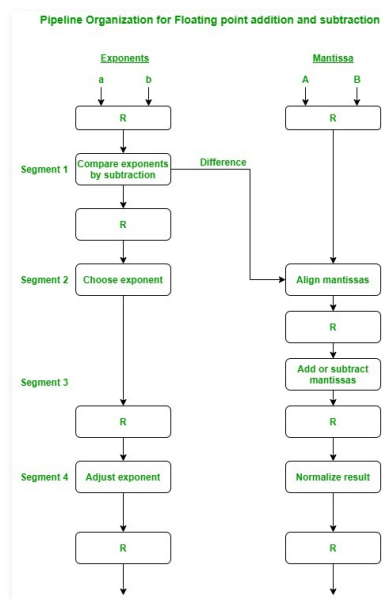


# Arithmetic Pipeline and Instruction Pipeline

Difficulty Level : Hard • Last Updated : 16 May, 2020

## 1. Arithmetic Pipeline :

An arithmetic pipeline divides an arithmetic problem into various sub problems for execution in various pipeline segments. It is used for floating point operations, multiplication and various other computations. The process or flowchart arithmetic pipeline for floating point addition is shown in the diagram.



## Floating point addition using arithmetic pipeline :

The following sub operations are performed in this case:

1. Compare the exponents.
2. Align the mantissas.
3. Add or subtract the mantissas.
4. Normalise the result

First of all the two exponents are compared and the larger of two exponents is chosen as the result exponent. The difference in the exponents then decides how many times we

must shift the smaller exponent to the right. Then after shifting of exponent, both the mantissas get aligned. Finally the addition of both numbers take place followed by normalisation of the result in the last segment.

**Example:**

Let us consider two numbers,

$$X=0.3214*10^3 \text{ and } Y=0.4500*10^2$$

**Explanation:**

First of all the two exponents are subtracted to give  $3-2=1$ . Thus 3 becomes the exponent of result and the smaller exponent is shifted 1 times to the right to give

$$Y=0.0450*10^3$$

Finally the two numbers are added to produce

$$Z=0.3664*10^3$$

As the result is already normalized the result remains the same.

**2. Instruction Pipeline :**

In this a 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 instructions are being executed in other segments of the pipeline. Thus we can execute multiple instructions simultaneously. The pipeline will be more efficient if the

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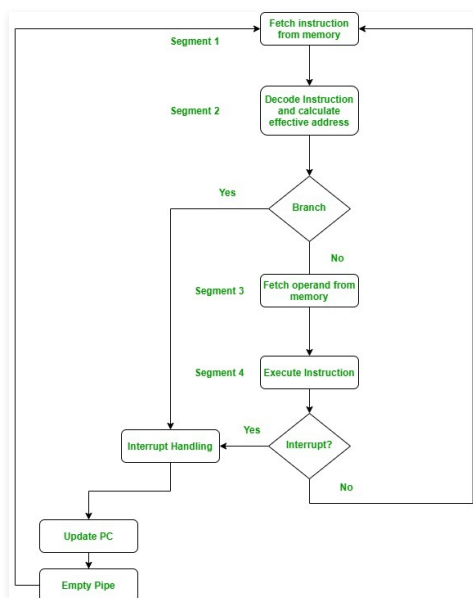
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3. Calculate the effective address
4. Fetch the operands from memory (FO)
5. Execute the instruction (EX)



## 6. Store the result in the proper place

The flowchart for instruction pipeline is shown below.



Let us see an example of instruction pipeline.

### Example:

Stage	1	2	3	4	5	6	7	8	9	10	11	12	13
Instruction	FI	DA	FO	EX									
Branch		FI	DA	FO	EX								
			FI	DA	FO	EX							
				FI	---	---	FI	DA	FO	EX			
								FI	DA	FO	EX		
									FI	DA	FO	EX	
										FI	DA	FO	EX

are the instruction is fetched on first clock cycle in segment 1.

Now it is decoded in next clock cycle, then operands are fetched and finally the

instruction is executed. We can see that here the fetch and decode phase overlap due to

