Suppose that a pgm having 1000000 inst. is executed on a processor w/ a frequency of 1GHz. If the pgm. ~~tho~~ has the foll. inst. mix what is the execution time for the pgm?

Op.	Freq.	No. of clock cycles.
ALU ops	35%	1
Loads	25%	2
~~Sta~~ Stores	15%	2
Branches	25%	3

Problems on CPU time:

CPU Time = IC × CPI × Cycle time.

$$CPI = \sum \text{Frequency of operation} \times \text{Clockcycle}$$

$$= (0.35 \times 1) + (0.25 \times 2) + (0.15 \times 2) + (0.25 \times 3)$$

$$= 1.9$$

$$\text{cycle time} = \frac{1}{\text{processor frequency}} = \frac{1}{10^9}$$

$$= 10^{-9}\ \cancel{Hz}\ sec.$$

$$\text{CPU time} = 10^6 \times 1.9 \times 10^{-9}$$

$$= 1.9 \times 10^{-3}$$

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$\tau \rightarrow$ freq or pipeline cycle time.

Speedup & Efficiency: Derive the speedup & efficien for pipelined and unpipelined; given throughput k stage pipeline process n task in $k+(n-1)$ clock cycle

Total time to process n task $\Rightarrow T_k = [k+(n-1)]\tau$

For non-pipelined processor $\Rightarrow T_1 = nk\tau$.

Speedup Factor $\Rightarrow S_k =$ ~~time w.r.t.~~ $\dfrac{T_1}{T_k}$

$$= \frac{nk\cancel{\tau}}{[k+(n-1)]\cancel{\tau}}$$

$$= \frac{nk}{k+(n-1)}$$

Efficiency with k stage pipeline $\Rightarrow E_k = \dfrac{S_k}{k}$

$$= \frac{n\cancel{k}}{[k+(n-1)]\cancel{k}} = \frac{n}{k+(n-1)}$$

Throughput $= \dfrac{n}{\text{total time}}$

$$= \frac{n}{k+(n-1)\tau} = \frac{nf}{k+(n-1)}$$

where $\dfrac{1}{\tau} = f$.

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Task has 4 subtasks with a time $t_1 = 60$, $t_2 = 50$, $t_3 = 90$ and $t_4 = 80$. ~~Last delay~~ latch delay = 10 nanoseconds. Calculate (i) pipeline cycle time, (ii) cycle time for non-pipeline execution, (iii) pipeline time for 1000 tasks (iv) ~~frequency time~~ sequential time for 1000 task and the throughput.

(i) Pipeline cycle time = $\frac{1}{f}$ 100ns.

Acc. to Amdahl's law, pipeline cycle time depends on the longest ~~task~~ time and the delay.

= 90 + 10.

~~[Incase, it~~

(ii) Non-pipeline execution = $t_1 + t_2 + t_3 + t_4$ + delay

= 280ns.

(iii) Speed up = $\frac{280}{100}$ = 2.8

Pipelined time for 1000 tasks = $[k + (n-1)]\tau$

$= [4 + (1000-1)] \times 100$

= ~~39 96~~

= 100300 ns

(iv) Sequential time = $n k \tau$

= ~~1000 × 4 × 280~~ 280 × 1000

= ~~112 × 10^4 ns~~ = 280000 ns

$k\tau = 280$

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W	M	T	W	T	F	S	S
26	31					1	2
27	3	4	5	6	7	8	9
28	10	11	12	13	14	15	16
29	17	18	19	20	21	22	23
30	24	25	26	27	28	29	30

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(iv) Throughput $= \dfrac{nf}{[k+(n-1)]\tau} = \dfrac{1000}{100300} = 0.08$

Non-linear Pipelining :

Design the collision vector & State transition diagm. for the below case :

	1	2	3	4	5	6
S1	X				X	
S2			X			
S3		X		X		X

Forbidden latencies$_Y$ = 2,4

PL_Y = 1,3,5,6

Collision Vector = 1010

4 3 2 1

$\boxed{1010}$

RS by 1 → 0 1 0 1
OR 1 0 1 0
1 1 1 1

RS by 3 → 0 0 0 1
1 0 1 0
$\boxed{1011}$
3 1 0

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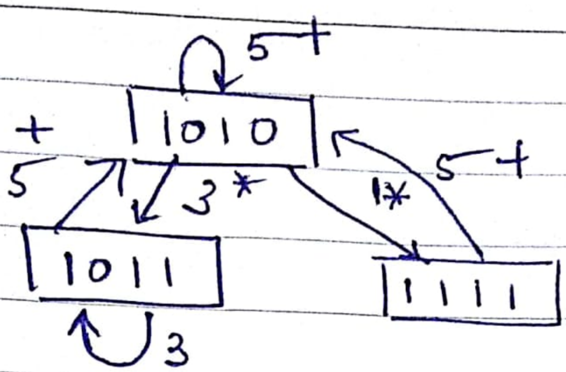
2, 3



$M = 4 + 1$

Simple Cycle = (1,5), (3,5), 3, 5.

Greedy = (1,5), 3

MAL = 3

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