

NUMBER OF STAGE												
IF	I1	I2	I3	I4	I5	I6	I7	I8				
ID		I1	I2	I3	I4	I5	I6	I7	I8			
EXE			I1	I2	I3	I4	I5	I6	I7	I8		
MEM				I1	I2	I3	I4	I5	I6	I7	I8	
WB					I1	I2	I3	I4	I5	I6	I7	I8
Clock cycle TIME	1	2	3	4	5	6	7	8	9	10	11	12

Examples pipeline:

1.

Suppose there are 8 instructions in a program.

There are 5 stages in pipeline: IF, ID, EXE, MEM, WB. $CPI = 12/8 = 1.5$

K = number of stages

n = number of instructions total time for pipeline implementation: $5 \times 1 + (8-1) = 5+7=12cc$

for nonpipelined: $5 \times 1 \times 8 = 40cc$

$K \times 1 + (n-1)$

$CPI = \text{total clock cycle} / \text{total number of instructions}$

Speedup = total time in nonpipelined / total time in pipeline

$= 40/12 = ?$

Efficiency: total block in table / total used block = $60/40 = ?$

2. Consider a non-pipelined machine with 6 execution stages of lengths 20 ns, 20 ns, 30 ns, 30 ns, 20 ns, and 20 ns.

i) - Find the instruction latency on this machine.

Ans: instruction latency= $(20+20+30+30+20+20)$ ns=140ns

ii) - How much time does it take to execute 77 instructions?

Ans: time to complete 77 instructions: $140 \times 77 = 10780$ ns.

iii) Suppose we introduce pipelining on this machine. Assume that when introducing pipelining.

- What is the instruction latency on the pipelined machine?
- How much time does it take to execute 77 instructions?

Also calculate the speedup

Latency for pipelined: $30 \text{ns} \times 6 = 180$ ns

Time for 77 instructions in pipelined: $(30 \times 6) + (76 \times 30) = 2460$ ns

Speedup= total time for nonpipelined/total time for pipeline= $10780 \text{ns} / 2460 \text{ns} = 4.3$.

FOR nonpipelined:

Instruction latency: $20+20+30+30+20+20=140$ ns

Time for 77 instructions: $140 \text{ns} \times 77 = 10780$ ns

For pipelined:

Instruction latency: $30 \times 6 = 180\text{ns}$

Time 77 instructions: $180 + 30 \times 77 = 180 + 2310 = 2490\text{ns}$

Speedup = $10780 / 2490 = 4.32$

$30 \times 4 + (n-1)30$

$120 + 90 = 210$

480

i) Speed up = $480 / 210 =$

$60 \times 4 + (4-1)60$

$240 + 180 = 420$

$480 / 420 =$

0H LDA 9H;

9H 0AH;

600 for non pipelined;

$(4 \times 30) + (5-1)30;$

$= 120 + 120 = 240$ pipelined;

Nonpipelined/pipeline = $600 / 240$

$4*60)+4*60$

480

Speed up = $600/480$

0H LDA 9H;

1 ADD 4H;

9H 0A;