CMP 301 23/01/024

**Pipelining**

Here you have to overlap the number of execution of instructions in order to increase the output e.g. Job A,B,C,D. In pipelining, start with A, if it is in the center, start B and the same for C and D by the time A is complete, B, C, and D would have almost been done

1. **None pipelining / latency of a sequential machine.**

|  |  |  |
| --- | --- | --- |
| Wash | Dry | Press |
| 10 | 15 | 5 |

Starting at 10am,

Clothes; A, B, C, D

Total: 10:30, 11:00, 11:30, 12:00

with 10 minutes to wash

15 to dry

5 to press

>>> total time per clothe is 30 minutes.

1. **Pipelining**

Alternatively based on the time the current person leaves.

|  |  |  |
| --- | --- | --- |
| Wash | Dry | Press |
| 10:00 - 10 | 10:10 - 25 | 10:25 - 30 |
| 10:10 - 20 | 10:25 - 40 | 10:40 – 45 |
| 10:20 - 30 | 10:40 - 55 | 10:55 – 11: 00 |
| 10:30 - 40 | 10:55 – 11:10 | 11:10 – 11:15 |

With an overhead of 1 minute after action

|  |  |  |
| --- | --- | --- |
| Wash | Dry | Press |
| 10:00 - 10 | 10:11 - 26 | 10:27 - 32 |
| 10:10 - 20 | 10:26 - 41 | 10:42 – 47 |
| 10:20 - 30 | 10:41 - 56 | 10:57 – 11: 02 |
| 10:30 - 40 | 10:56 – 11:11 | 11:12 – 11:17 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1F | 1D | 0F | EX | WB |
| 1ms | 2ms | 1ms | 3ms | 1ms |

Latency in pipelining is the time taken to execute a single instruction.

Latency = 1+2+1+3+1 = 8

Latency of sequential machine + overheard \* (number of stages – 1)

* 8 + (1 \* (5 -1))
* 9 + 4
* 12

Time taken for pipeline making = LP + ( stage + overhead) + (n-1)

* 12 + (3+1) \*(100-1)
* 12 + 4\*99
* 12 + 396
* 408

Time taken for LS

Speedup = time taken by =800/408 = 1.96

Time taken by

Efficiency

Example 2: Assume a computer with 6 execution stages 50ns, 25ns, 30ns, 30ns, 65ns, 40ns.

1. Calculate the latency of this machine.
2. Calculate the time taken to execute 100 instructions (sequential machine).
3. Assume you introduce pipelining to this machine and while the pipeline is introduced, the clock skewed at 2ns, i.e. the overheard at each stage. Calculate the latency of the pipelining.
4. Calculate the time to execute 100 instructions(pipelining).
5. Calculate the speedup attained by introducing pipelining.
6. Calculate the true put and efficiency.

SOLUTION

1. Ls = 50 + 25 + 30 + 65 + 40 + 30 = 240
2. Time taken (sequential) = 240 \* 100 = 24000
3. Lp = 240 + (2\*(6 – 1)).

=> 240 + (10)

=> 250

1. Time taken (pipelining) = 250 + ((65 + 2) \* (100 – 1)

=> 250 + (67 \* 99)

=> 250 + 6633

=> 6883

5. speedup = 24000 / 6883 ~ 3.49

6. throughput = 100/6883 = 0.0143

7. efficiency = 3.49/6 = 0.58