

COMP262-01      LAB3  
CH12.4-PROCESSOR STRUCTURE/FUNCTION  
PIPELINE Execution Performance and Analysis

A certain Processor has the following relevant specs:

Clock cycle: 1 time unit

Pipelined: yes

Pipeline Stages: 6

Assume that the **Pipeline STAGES** are **NOT** all of equal duration, with the following values

per stage duration: **FI, FO, WO = 3 cycles, EI = 2 cycles, DI, CO = 1 cycle.**

Memory access: **MULTIPLE PORTS**, thus allowing for multiple memory access operations to occur (overlap), per clock cycle.

Instructions: assume ALL instructions go through ALL stages, stalling (causing a pipeline bubble) if necessary

Registers: N/A

Cache: N/A

Bus: N/A

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Given the following program segment written in (a certain) Assembly language:

```
SUB A, B, C      (subs operand B from A and stores result in operand C)
SUB D, E, F
SUB G, H, I
BRNEG ISNEG      (branches, conditionally, to 'location' if the 'negative' status flag is on)
SUB J, K, L
SUB M, N, O
SUB P, Q, R
BR CONT          (branches, unconditionally, to 'location')
ISNEG: SUB S, T, U
SUB V, W, X
SUB Y, Z, AA
CONT: NOOP        (no operation, place holder)
```

1) Assume that the **CONDITIONAL BRANCH IS TAKEN**.

Complete the provided MS-EXCEL BOOK, LAB3, sheet1 by filling out the rows (instructions) with the six stages.

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Given the following program segment written in (a certain) Assembly language:

```
BEG: SUB A, B, C      (subs operand B from A and stores result in operand C)
SUB D, E, F
SUB G, H, I
BRNEG ISNEG      (branches, conditionally, to 'location' if the 'negative' status flag is on)
SUB J, K, L
SUB M, N, O
SUB P, Q, R
BR BEG           (branches, unconditionally, to 'location')
ISNEG: SUB S, T, U
SUB V, W, X
SUB Y, Z, AA
BR BEG           (branches, unconditionally, to 'location')
```

- 2) Assume that the conditional branch (BRNEG) occurs (the branch takes) 20% of the time(one out of five).  
**SHOW ALL THE STEPS NEEDED TO CALCULATE** the '**AVERAGE**' TOTAL number of cycles used by the pipelining, assuming that the code segment (LOOP) is executed 10 times...  
i.e.: 20% at X cycles + 80% at Y cycles. Use the provided MS-EXCEL BOOK, LAB3, sheet2 and paste the calculations and result on sheet3.

**NOTE:** because the number of instructions is RELATIVELY small, DO NOT DISMISS/DISREGARD the initial filling and emptying of the pipeline...