R·I·T	Rochester Institute of Technology of Dubai Department of Electrical Engineering and Computing

NSSA-102 Computer System Concepts **Fall 2023/2024**
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Homework 3
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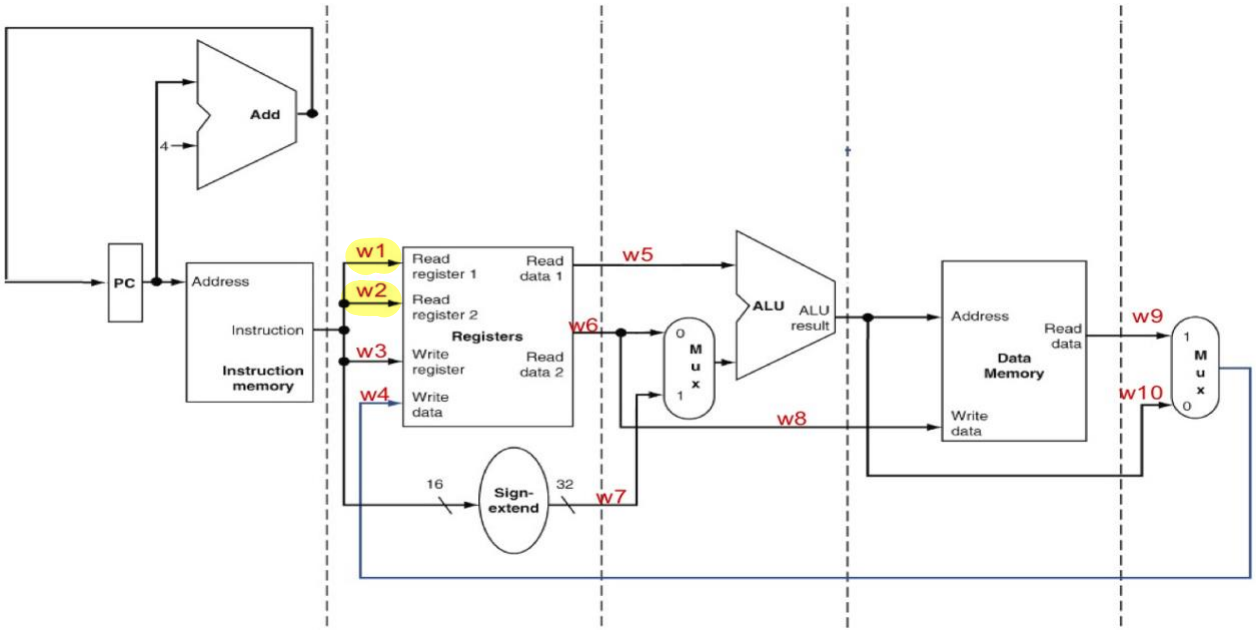
Question1 [2.5 marks].

Consider the below diagram for the CPU we studied in unit07. Note that I assigned names, shown in red color, to some of the wires.



Fill-in the below to determine which wire is selected (i.e., used) during the execution of an **ADD instruction**, elaborate ***why*** for each wire?

wire	Is the wire used (yes or no)? why?	wire	Is the wire used (yes or no)? why?
W1	yes. Because we are getting the values from that wire.	W6	yes. No constants and values are 32 bit register
W2	yes. Because we get value of 2nd register from wire 2.	W7	No. Since we don't have constant
W3	yes. Destination register	W8	yes. Since we are not to anything.
W4	yes To give the final output.	W9	No. Since no load or store operations
W5	yes. Since they are 32 bit values and no constants	W10	Yes.

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Question2 [2 marks].

Assume we have a MIPS assembly program with 20 instructions.
We want to execute this program on two machines: machine A and machine B.
Machine A has a single-cycle processor with frequency = 0.5 GHz.
Machine B has a 5-stage pipelined processor with frequency = 2 GHz.

A. What is the clock cycle time (in nanoseconds) for machine A?
→ 2ns

B. What is the clock cycle time (in nanoseconds) for machine B?
→ 0.5ns

C. Calculate execution time (in nanoseconds) for machine A?
→ 40 ns

D. Calculate execution time (in nanoseconds) for machine B?
→ 2ns

Show your work in the space below for all questions A - D.

A. $T = \frac{1}{f} = \frac{1}{\frac{1}{2}} = 2\,ns$

B. $T = \frac{1}{f} = \frac{1}{2} = 0.5\,ns$

C. Exec Time A $= 2 \times 20 = 40\,ns$

D. Exec Time B $= \frac{0.5 \times 20}{5} = 2\,ns$

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Question3 [2.5 marks].

Assume we have a 1MB cache with 32-byte blocks. How many misses and hits would the below for-loop incur? Assume each array element needs 4 bytes of memory.
Hint: note that the loop has a total of 256 x 3 = 768 accesses.
Hint: recall the example we solved together in slide 13 in unit 08.

```
for (i=0; i < 256; i++)
    A [ i ] = A [ i ] × A[ i ];
```

A. Number of blocks in the cache is 2^{15} Blocks

B. Number of cache misses is 64 Misses

C. Number of cache hits is 704 Hits

$\frac{256}{4} = 64$

$768 - 64 = 704$

Show your work in the space below for all questions A - C.

i=0

while i<256:

A[i] = A[i] × A[i]

8 ← 4 + 4

i += 1

$1MB = 1 \times 2^{10}$

$= 2^5$

Block

4 4 4

0 0 0

arrays in

$\frac{32}{8} = 4$ no. of blocks

$\frac{256}{4} = 64$ blocks for eqn

64 MISSES

704 HITS

$\frac{1 \times 2^{20}}{2^5} = 2^{15}$ blocks

Question4 [1 mark]

Compare between Personal Computer and Super Computers?

Personal Computers
(PC's)

→ For Daily use and minal general purpose uses.

→ They have a cost/performance tradeoff, which means, more cost, more performance.

Super Computers :-

→ Used for high end scientific calculations

→ Enormous capabilities, but have a small market share.

→ Expensive.