

CENG 3420 Quiz 1

Solutions

Q1 Consider three different processors P1, P2, and P3 executing the same instruction set with the clock rates and CPIs given in the following table.

Processor	Clock Rate	CPI
P1	2 GHz	0.8
P2	3 GHz	1.2
P3	4 GHz	1.8

1. Which processor has the highest performance expressed in instructions per second?
2. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions.

A1 1. $IPS = \frac{\text{clock rate}}{CPI}$.

- $IPS_1 = \frac{2 \times 10^9}{0.8} = 2.5 \times 10^9$;
- $IPS_2 = \frac{3 \times 10^9}{1.2} = 2.5 \times 10^9$;
- $IPS_3 = \frac{4 \times 10^9}{1.8} \approx 2.2 \times 10^9$.

Therefore, P1 and P2 both have the highest performance.

2. Number of cycles ($C\#$) are calculated as follows:

- $C\#_1 = 2 \times 10^9 \times 10 = 2 \times 10^{10}$;
- $C\#_2 = 3 \times 10^9 \times 10 = 3 \times 10^{10}$;
- $C\#_3 = 4 \times 10^9 \times 10 = 4 \times 10^{10}$;

3. Number of instructions ($I\#$) are calculated as follows:

- $I\#_1 = \frac{C\#_1}{0.8} = 2.5 \times 10^{10}$;
- $I\#_2 = \frac{C\#_2}{1.2} = 2.5 \times 10^{10}$;
- $I\#_3 = \frac{C\#_3}{1.8} \approx 2.2 \times 10^{10}$;

Q2 Dividing 1001011 by 1001

A2 $1001011/1001 = 1000$, and the remainder is 0011. (011, 11 is also correct)

Q3 In a **Big Endian** machine, given the following code sequence and memory state:

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add $s2, $zero, $zero
lb  $t0, 2($s2)
sb  $t0, 5($s2)

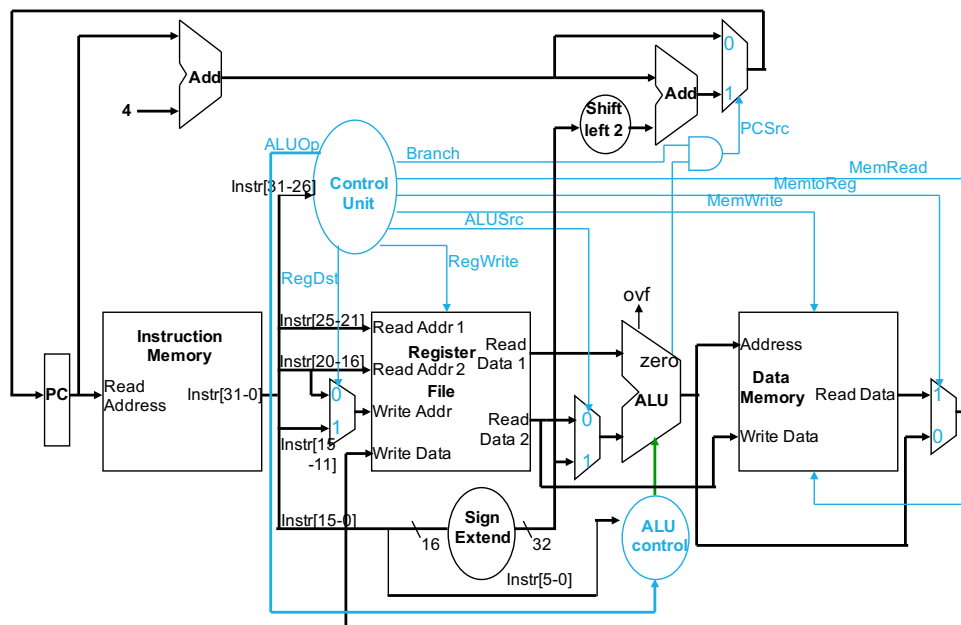
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Memory	
0x00000000	24
0x00000000	20
0x00000000	16
0x10000010	12
0x01000402	8
0xFFFFFFFF	4
0x009012A0	0
Data	

1. What value is left in $\$t0$?
2. What word is changed in Memory and to what?
3. What if the machine was **Little Endian**?

- A3**
1. $\$t0 \leftarrow 0x00000012$;
 2. $mem(5) \leftarrow 0xFF12FFFF$;
 3. $\$t0 \leftarrow 0x00000090$, and $mem(5) \leftarrow 0xFFFF90FF$.

Q4 Given following datapath, provide the control signal for R-type instruction (in the following table). Branch & ALUOp signals have been in the table.



RegDst	ALUSrc	MemReg	RegWr	MemRd	MemWr	Branch	ALUOp
1	0	0	1	0	0	0	10