

# Homework 5

Wednesday, October 27, 2021

12:46 PM

- #1
- (A) memory Read = 0  
memory Write = 0  
Register Write = 1  
Branch = 0  
ALU MUX = 1  
ALU OP = AND  
MUX Reg = 1
- (B) Blocks  
↳ Fetch, Decode, execute, Write Back
- (C) data Memory is not used, Branch Add produces unused output

- #2
- (A) Data Memory →  $ldur + stur$   
↳  $25\% + 10\% \rightarrow 35\%$
- (B)  $Rtype + IType = 24\% + 28\% = 52\%$
- (C)  $Itype + Ldur + stur + CBZ + B = 28\% + 25\% + 10\% + 11\% + 2\% = 76\%$
- (D) output is ignored

- #3
- (A) Mem to Reg = 0 means you can't read from memory so load instructions don't work
- (B) ALU is always set to 0 so no immediate instructions will work
- (C) Reg to Loc = 0 All read instructions will not work

- #4
- (A)
- |  |      |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|------|
|  | F    | 8    | 0    | 1    | 4    | 0    | 6    | 2    |
|  | ↓    | ↓    | ↓    | ↓    | ↓    |      |      |      |
|  | 1111 | 1000 | 0000 | 0001 | 0100 | 0000 | 0110 | 0010 |
- Sign ext → 0000 0000 0000 0000 0100 0000 0110 0011
- ↳ Shift 0000 0000 0101 0000000 11 0001000

- (B) hex conversion  
ALU OP 11110 = 62<sub>16</sub> → 3E<sub>16</sub>

- (C) PC+4 → next sequential instr.

- (D) write Register = 0  
ALU MUX → don't care  
ALU MUX → 20  
Jump → PC+4  
Branch → PC+4

- (E) ALU → 20, -3  
Add → PC+4  
Branch → PC+4

- (F) Read 1 = 3  
Read 2 = 2  
Reg Write = 0  
data = 1

- #5
- (A) None

- (B) Read Reg 2 → 0  
unconditional Branch → 0  
Branch 0 → 0  
Memory Read → 0  
Mem to Reg → 0  
ALU OP → 0  
Memory Write = 0  
ALU → 1 taking in immediate  
Reg Write → 1 write result

- #6
- (A) P1 →  $2 \times 10^9$  IPS       $\frac{GHz}{CPI} = IPS$   
P2 →  $2.5 \times 10^9$  IPS  
P3 → 1.8 IPS

- ① P2  
② P1  
③ P3

- (B) clock speed (GHz) × t (10 sec)  
P1 →  $3 \times 10^{10}$   
P2 →  $2.5 \times 10^{10}$   
P3 →  $4 \times 10^{10}$

$$(clock \times time) / CPI = instr.$$

$$P1 = 2 \times 10^{10}$$

$$P2 = 2.5 \times 10^{10}$$

$$P3 = 1.82 \times 10^{10}$$

$$P1 = \frac{(1 \times 10^5)(.1 \times 3) + (1 \times 10^5)(.3 \times 2) + (1 \times 10^5)(.4 \times 2) + (1 \times 10^5)(.2 \times 1)}{(1 \times 10^5)}$$

$$P1 = 2.5 CPI$$

$$P2 = \frac{(1 \times 10^5)(.1 \times 2) + (1 \times 10^5)(.3 \times 2) + (1 \times 10^5)(.4 \times 2) + (1 \times 10^5)(.2 \times 2)}{(1 \times 10^5)}$$

$$P2 = 2 CPI$$

$$P1 \Rightarrow \frac{(1 \times 10^5)(2.5)}{2.5 \times 10^9} = 83 \times 10^{13}$$

$$P2 = \frac{(1 \times 10^5)(2)}{3 \times 10^9} = 6.6 \times 10$$

P2 is faster