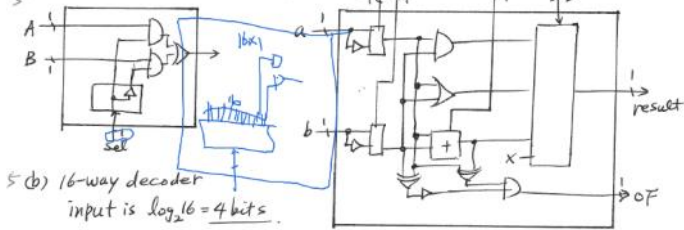


SP21 CS113 Exam1 Key

#1. (a) 2×1 Mux



5 (b) 16-way decoder
input is $\log_2 16 = \underline{4 \text{ bits}}$

#3. $\text{rate of } M_2 = \frac{\text{Clock cycles } M_2}{\text{CPU time } M_2} = \frac{2 * \text{Clock cycles } M_1}{5 \text{ sec}}$

$$\text{clock_cycles}_{M1} = \underbrace{\text{CPU}_{\text{exe}}}_{15\text{Sec}} M1 * \underbrace{\text{rate}_{M1}}_{600\text{MHz}} = 15 * 600\text{M}$$

$$\Rightarrow \text{rate of } \mu_2 = \frac{2\pi(15 \times 600 \text{ M})}{5} = 6 \times 600 \text{ M} = \frac{3600 \text{ MHz}}{(= 3.6 \text{ GHz})}$$

(20) #5. (a) 2nd (lw) — base/displacement
3rd (brr) — pc-relative

(b) 1st (cell) - R

0	0	9	17	2	0
---	---	---	----	---	---

memory $t_1 \quad s_1$

$\Rightarrow \underline{\phi\phi\phi9888\phi}_{Hex}$

Binary representation: 0000000000001000100010

Grouped binary: $\underbrace{000000}_\phi \underbrace{0000}_\phi \underbrace{0100}_9 \underbrace{1000}_8 \underbrace{1000}_8$

Final hex result: $\underline{\phi\phi\phi9888\phi}_{Hex}$

8 (C) 3rd (bne) — I

5	20	8	2
---	----	---	---

 $\xrightarrow{\substack{16 \\ 8 \\ 8 \\ 8}} 00010101000100000000$
 $\Rightarrow 16880002_{Hex}$

(20) #2. $\begin{matrix} & \text{CPI} (M1) & (M2) \\ \text{type 1} & - 30\% - 2 & - 2 \\ \text{type 2} & - 50\% - 3 & - 1 \\ \text{type 3} & - 20\% - 1 & - 4 \end{matrix} \quad \begin{matrix} M1 : 600 \text{ MHz} \\ M2 : 500 \text{ MHz} \end{matrix}$

$$1/2. (a) \text{ CPU}_{M1} = IC \pi (0.3 \times 2 + 0.5 \times 3 + 0.2 \times 1) \times \frac{1}{600M}$$

$$CPU_{M2} = \frac{IC * (0.3 * 2 + 0.5 * 1 + 0.2 * 4) * \frac{1}{500M}}{500M} = 0.3833$$

$$\Rightarrow M_2 \text{ is } \frac{\frac{500M}{(IC \times 2.3) / 600M}}{\frac{(IC \times 1.9) / 500M}} = \frac{\left(\frac{2.3}{6}\right)^{0.38}}{\left(\frac{1.9}{5}\right)^{0.38}} \text{ times faster than } M_1.$$

8 (b) $MIPSE_1 = \frac{\text{rate}}{CPI \times M} = \frac{600M}{2.3M} = \frac{600}{2.3} = 260.869...$
 $MIPSE_2 = \frac{\text{rate}}{CPI \times M} = \frac{500M}{1.9M} = \frac{500}{1.9} = 263.157...$

(15) #4. (a) t_1

56	4D	B3	C4
----	----	----	----

 t_2

4D	B3	C4	6E
----	----	----	----

5 (b) 5 accesses

7	6E	}	
6	5D C4		
5	C4 B3		
4	B3 4D		→ lw ① access
3	4D 56	← sw ② accesses	
2	56	→ lw ② accesses	
1	B4		
0	23		

(15) #6. (a) lw \$t1, 8080h(\$gp); offset = data@ - gp

$$\begin{array}{r} 10000080 \\ - 10008000 \\ \hline 5558080 \end{array}$$

8 (b) $00000014)_{Hex}$

$$\text{data} @ = \text{gp} + \text{offset}$$

$$\begin{array}{r} 10008060 \\ + \underline{\underline{ffff8014}} \\ \hline 00000014 \end{array}$$