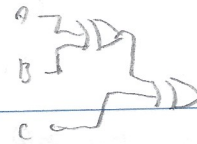
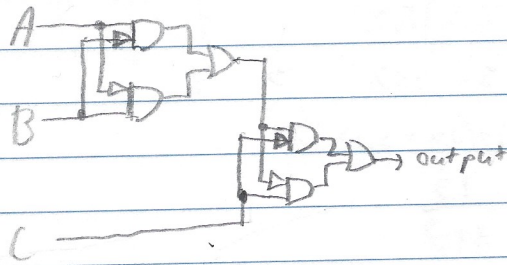


XOR



CSCI 113 Midterm 1 10/5/21

1) a) 3 input XOR

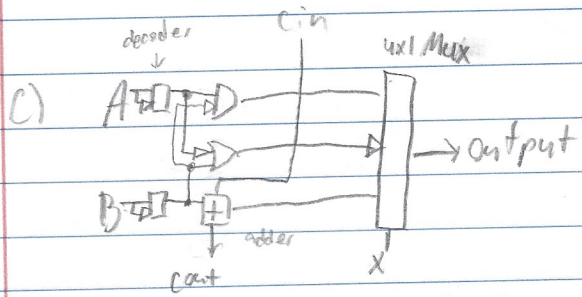


$$b) (A+B) \cdot (\overline{A \cdot B}) \equiv (A \cdot \overline{B}) + (\overline{A} \cdot B)$$

$$((A+B) \cdot \overline{A}) + ((A+B) \cdot \overline{B})$$

$$(\overline{A+B} + A) + (\overline{A+B} + B)$$

$$(\overline{A \cdot B}) + (\overline{A \cdot B}) \checkmark$$



d)  $\log_2 32 = 5$  inputs

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

$$\frac{0.7}{10.9} = 1.6$$

|                       | C1      | C2  |
|-----------------------|---------|-----|
| 2) C1: Rate = 500 MHz | 71% 20% | 2 1 |
| C2: Rate = 800 MHz    | 23 50%  | 1 2 |
|                       | 3 30%   | 3 4 |

$$a) CPU_{avg_1} = IC * ((0.2 * 2) + (0.5 * 1) + (0.3 * 3)) * \frac{1}{5 \times 10^8}$$

$$= IC * (0.4 + 0.5 + 0.9) = \frac{1.8}{5 \times 10^8}$$

$$CPU_{avg_2} = IC * ((0.2 * 1) + (0.5 * 2) + (0.3 * 4)) * \frac{1}{8 \times 10^8}$$

$$= IC * (0.2 + 1 + 1.2) = \frac{2.4}{8 \times 10^8}$$

$$\frac{2.4}{8 \times 10^8}$$

times faster than C1

$$\frac{1.8}{5 \times 10^8}$$

b) MIPS C1  $\frac{5 \times 10^8}{1.8 \times 10^6} = \frac{500}{1.8}$   $\frac{rate}{CPU \times 10^6} = MIPS$

C2  $\frac{8 \times 10^8}{2.4 \times 10^6} = \frac{800}{2.4}$

$$3) Rate_2 = \frac{3 * ClockCycle_1}{10 \text{ sec}}$$

$$ClockCycle_1 = CPU_{avg_1} * Rate_1$$

$$= 20 * 6 \times 10^8$$

$$Rate_2 = \frac{3 * 20 * 6 \times 10^8}{10} = \frac{60 * 6 \times 10^8}{10}$$

|      |                 |                      |
|------|-----------------|----------------------|
| 4) 7 | <del>4</del> 2B |                      |
| 6    | <del>D</del> 4D |                      |
| 5    | <del>O</del> 3C | lw \$t1, 1(\$zero) 2 |
| 4    | <del>B</del> 2B | sw \$t1, 4(\$zero) 1 |
| 3    | 4D              | lw \$t2, 3(\$zero) 2 |
| 2    | 3C              |                      |
| 1    | 2B              | \$t1 = 1A 2B 3C 4D   |
| 0    | 1A              | \$t2 = 2B 3C 4D 2B   |

b) 5 accesses



$\begin{array}{c} 1 \quad 1 \\ 000000 \\ 545210 \\ 32168420 \\ 100011 \end{array}$

$\begin{array}{c} 45715 \\ 00000 \\ 1 \quad 1 \\ 1 \quad 1 \end{array}$

$\begin{array}{c} 00900 \\ 1 \end{array}$

$\begin{array}{c} 0000 \\ 0 \end{array}$

$\begin{array}{c} 2034 \\ 0000 \end{array}$

$\begin{array}{c} 1010 \\ 0000 \end{array}$

$844=12$

5) a) Base/displacement

PC-Relative

0-9 A-F

Immediate

0-9 10-15

Pseudo-Direct

$\begin{array}{c} A \ B \ C \ D \ E \ F \\ 10 \ 11 \ 12 \ 13 \ 14 \ 15 \end{array}$

$\begin{array}{c} 6 \quad 5 \quad 5 \quad 16 \\ \text{b) I type} \quad \text{op} \quad \text{rs} \quad \text{rt} \quad \text{offset} \\ \text{lw} \quad \quad \quad \text{2nd 1st offset} \end{array}$

$\begin{array}{c} 35 \quad 17 \quad 8 \quad 12 \\ 100011 \quad 01001 \quad 01000 \quad 0000 \quad 0000 \quad 0000 \quad 1100 \\ 1000 \quad 1101 \quad 0010 \quad 1000 \quad 0 \quad 0 \quad 0 \quad 0 \\ \boxed{8 \quad D \quad 2 \quad 8 \quad 0 \quad 0 \quad 0 \quad C} \end{array}$

$\begin{array}{c} 6 \quad 5 \quad 5 \quad 16 \\ \text{c) I type} \quad \text{op} \quad \text{rs} \quad \text{rt} \quad \text{offset/mem\#} \\ \text{bne} \quad \quad \quad \text{1st 2nd 3rd} \end{array}$

$\begin{array}{c} 5 \quad 18 \quad 8 \quad 2 \\ 000101 \quad 1010 \quad 01000 \quad 0002 \\ 0001 \quad 0110 \quad 0100 \quad 1000 \quad 0 \quad 0 \quad 0 \quad 2 \\ \boxed{1 \quad 6 \quad 4 \quad 8 \quad 0 \quad 0 \quad 0 \quad 2} \end{array}$

6) a) lw \$s1, 0280h(\$gp);

b) lw \$t1, 8024h(\$gp)

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

$\begin{array}{r} \hookrightarrow 1000 \ 8000 \\ + \text{ffff} \ 8024 \\ \hline 1000 \ 0024\text{h} \end{array}$