Problem Set 5

Justin Ely

605.411 Foundations of Computer Architecture

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1)

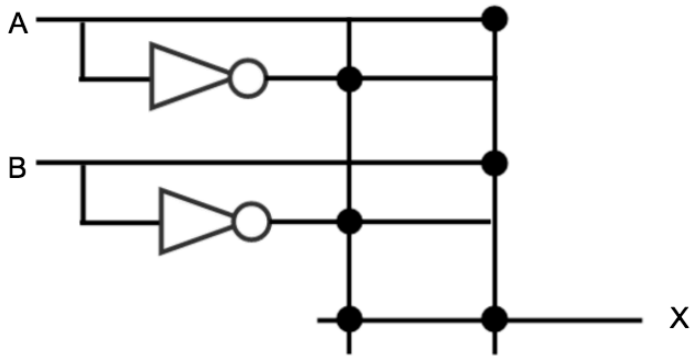
2)

- r-type
- load word
- branch (since it does a subtract)?

3)

A	B	X	Min-term	Max-term
0	0	1	A‘B‘	
1	0	0		A‘ + B
0	1	0		A + B‘
1	1	1	AB	

Figure 1: PLA.



4a)

000100	00000	00100	0000000000001010

The op-code says this is a BEQ instruction. This goes through states 0, 1, 8 on the state diagram.

4b)

0, 1, 2, 6, 8

4c)

4d)

4e)

The branch is comparing register $0 to register $4. Since $0 = $4 = 0, the branch is taken.

5)

X2	X1	X0	a	b	c	d	minterm	maxterm
0	0	0			y		X2‘X1‘X0‘	X2 + X1 + X0
1	0	0		y		y	X2X1‘X0‘	X2‘ + X1 + X0
0	1	0		y	y		X2‘X1X0‘	X2 + X1‘ + X0
1	1	0	y			y	X2X1X0‘	X2‘ + X1‘ + X0
0	0	1		y	y		X2‘X1‘X0	X2 + X1 + X0‘
1	0	1	y			y	X2X1‘X0	X2‘ + X1 + X0‘
0	1	1	y		y		X2‘X1X0	X2 + X1‘ + X0‘
1	1	1				y	X2X1X0	X2‘ + X1‘ + X0‘

5a)

X = (X2X1X0’) + (X2X1‘X0) + (X2‘X1X0)

5b)

X = (X2X1‘X0‘) + (X2‘X1X0‘) + (X2‘X1‘X0)

5c)

X = (X2‘X1‘X0‘) + (X2‘X1X0‘) + (X2‘X1‘X0) + (X2‘X1X0)

5d)

X = (X2X1‘X0‘) + (X2X1X0‘) + (X2X1‘X0) + (X2X1X0)

6)

7)

From the state diagram given in the lectures:

- beq: 3
- j: 3
- or: 4
- add: 4
- lw: 5
- sw: 4
- bne: 3

8)

- lw $2,40($4): Uses the memory system when it is retrieving the specified word, the ALU to calculate the address, and the register file to see in which register to write the loaded word.
- add $3,$6,$7: Uses the ALU do perform the arithmetic, and the register file to read operands and write result.
- slt $5,$6,$7: Uses the ALU to check if one register is less than another, and the register file to read operands and set the result.
- sw $6,44($4): Uses the register file and ALU to retrieve and calculate the address in memory to put the register value.
- and $9,$11,$10: Uses the ALU to perform the AND operation, and the register file to read operands and write result.

- or $21,$27,$8: USes the ALU to perform the OR operation, and the register file to read operands and write result.