CSEE W3827

Fundamentals of Computer Systems

Homework Assignment 1

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Due September 16, 2014 at 10:10 AM

Write your name **and UNI** on your solutions

Show your work for each problem; we are more interested in how you get the answer than whether you get the right answer.

1. (5 pts.) What are the values, in decimal, of the bytes

110110

and

010001,

if they are interpreted as 6-bit

(a) binary numbers;

(b) two's complement numbers?

2. (10 pts.) Show how to compute $79 + 25$ in *binary*.

3. (10 pts.) Complete the truth table for the following Boolean functions:

$$f = \overline{W}XY + \overline{X}\,\overline{Y} + \overline{W}\,\overline{Y}$$
$$g = (W + \overline{Y})(\overline{W} + Y)(\overline{Y} + \overline{X})$$

W	X	Y	f	g
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

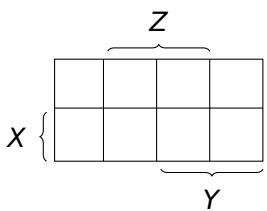
4. (20 pts.) Consider the function F, whose truth table is below.

X	Y	Z	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

(a) Write F as a sum of minterms.

(b) Write F as a product of maxterms.

(c) Complete the Karnaugh map for F as shown below.



(d) Give a simplified expression for F.

(e) Draw a schematic for F.

5. (20 pts.) For each pair of A and B below, prove either that $A = B$ or $A \neq B$.

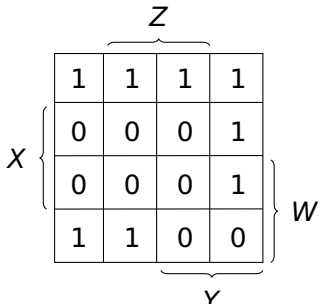
(a)

$$A = \overline{Y}Z + Y\overline{Z}$$
$$B = X\overline{Y}Z + \overline{X}\,\overline{Z} + Y\overline{Z}$$

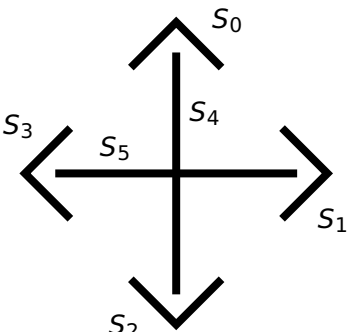
(b)

$$A = XZ + XY$$
$$B = XY + X\overline{Y}Z$$

6. (5 pts.) Give a minimal boolean expression for the function below.



7. (15 pts.) Design a minimal circuit that takes four one-bit inputs corresponding to button presses (*UP*, *DOWN*, *LEFT*, *RIGHT*), and illuminates this 6-segment display according to which buttons are pressed.



(a) Fill in the rest of the truth table.

UP	*DOWN*	*LEFT*	*RIGHT*	S_0	S_1	S_2	S_3	S_4	S_5
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	1
0	0	1	0						
0	0	1	1						
0	1	0	0						
0	1	0	1						
0	1	1	0						
0	1	1	1						
1	0	0	0						
1	0	0	1						
1	0	1	0						
1	0	1	1						
1	1	0	0						
1	1	0	1						
1	1	1	0						
1	1	1	1						

(b) Give minimal boolean expressions for S_0, S_1, ..., S_5.

8. (15 pts.) Give a minimal circuit for *F* that uses only NAND2 gate(s) and inverter(s).

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	X
1	0	0	0
1	0	1	1
1	1	0	X
1	1	1	1