CSEE W3827

Fundamentals of Computer Systems

Homework Assignment 1

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Due February 6, 2012 at 1:10 PM

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

10011100

and

01111000,

if they are interpreted as 8-bit

(a) binary numbers;

(b) one's complement numbers; and

(c) two's complement numbers?

2. (10 pts.) Show how to compute $6 + -14$ using 5-bit

   (a) signed-magnitude numbers;
   (b) one's complement numbers; and
   (c) two's complement numbers.

3. (10 pts.) Show how to compute $45 + 57$ in BCD.

4. (10 pts.) Complete the truth table for the following Boolean functions:

$$a = X\overline{Y}\,\overline{Z} + \overline{X}\,\overline{Y}Z + \overline{X}\,\overline{Z}$$
$$b = (X + \overline{Y})(Y + \overline{Z})(X + \overline{Z})$$

X	Y	Z	a	b
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

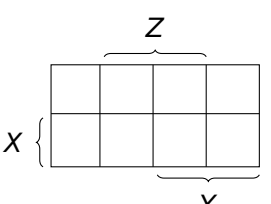
5. (10 pts.) Consider the function F, whose truth table is below.

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

(a) Write F as a sum of minterms and draw the corresponding circuit.

(b) Write F as a product of maxterms and draw the corresponding circuit.

(c) Complete the Karnaugh map for F as shown below. You do not have to simplify it.



6. (10 pts.) Consider the function F whose truth table is shown below

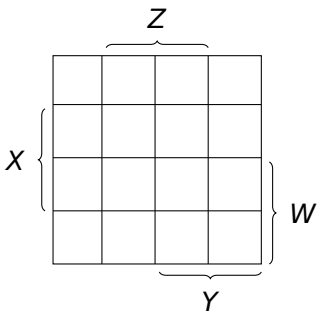
W	X	Y	Z	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

(a) Write the function F in sum-of-minterms form

(b) Minimize the sum-of-minterms expression, justifying each step

7. (10 pts.) Consider the function F from problem 6.

(a) Fill in and minimize the following Karnaugh map for F



(b) Express your minimized Karnaugh map as a Boolean expression

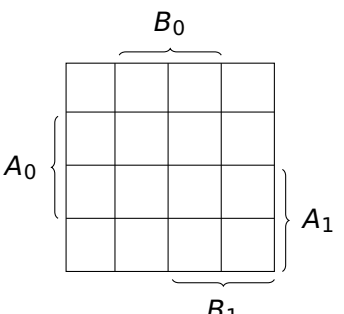
(c) Are your minimized expressions in problem 6 and problem 7 the same? Why or why not?

8. (20 pts.) Design a circuit that takes two two-bit binary numbers (A_1 and A_0, B_1 and B_0) and produces a true output when, in binary, A is greater than or equal to B.

(a) Fill in the truth table

A_1	A_0	B_1	B_0	$A \geq B$
0	0	0	0	
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	

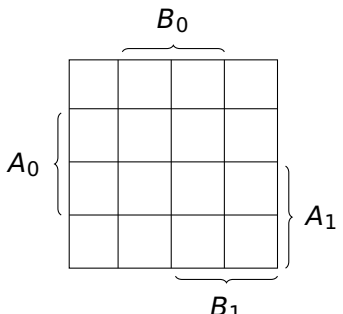
(b) Fill in the Karnaugh map and use it to minimize



(c) Draw the corresponding circuit.

9. (15 pts.)

(a) Minimize the Karnaugh map for the *complement* of the $A \geq B$ function from problem 8.



(b) Use this to draw a circuit for $A \geq B$ (i.e., *not the complement*).