CSEE W3827

Fundamentals of Computer Systems

Homework Assignment 1

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Due September 20th, 2011 at 10:35 AM

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

This document is formatted for on-screen viewing.

1. What are the values, in decimal, of the bytes

$$10011100$$

and

$$01111000,$$

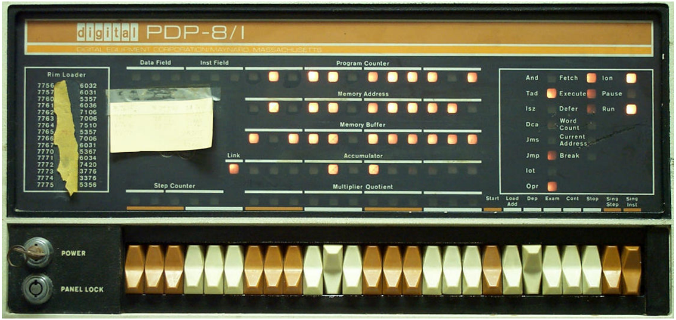
if they are interpreted as 8-bit

   (a) Binary numbers?
   (b) One's complement numbers?
   (c) Two's complement numbers?

2. The DEC PDP-8 used 12-bit words.

   (a) What were the most negative and most positive decimal numbers one of its words could represent using two's complement?

   (b) Assuming a word represented an address in memory, how many different locations could the PDP-8 address?



3. Convert the hexadecimal number “DEAD” into

   (a) Binary
   (b) Octal
   (c) Decimal
   (d) Binary-Coded Decimal

4. Show that $2 + -7 = -5$ is also true when done in binary using

   (a) Signed-magnitude numbers

   (b) One's complement numbers

   (c) Two's complement numbers

5. Show $42 + 49 = 91$ in BCD. Make sure you show when corrections are necessary to normal binary addition.

6. Complete the truth table for the following Boolean functions:

(a) $XY\overline{Z} + X\overline{Y}Z + \overline{X}YZ$

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

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		

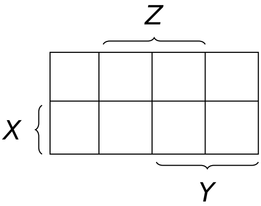
7. Consider the function F, whose truth table is below.

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	1
1	1	0	0
1	1	1	1

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

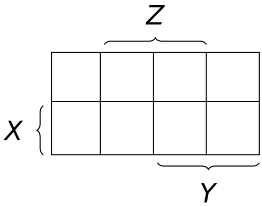
(b) Write F as a product of maxterms and draw the corresponding circuit.

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



8. Consider the function $F = \overline{X}\,\overline{Y}\,\overline{Z} + \overline{X}\,Y\,\overline{Z} + X\,\overline{Y}\,\overline{Z} + X\,Y\,\overline{Z}$

(a) Simplify the function using a Karnaugh map: draw the map F, circle implicants, and write the simplified function in algebraic form.



(b) Show how applying the axioms of Boolean algebra can produce the same result.

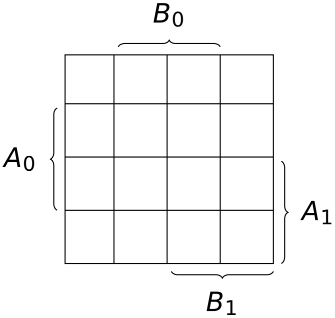
Axioms of Boolean Algebra	
$a \vee b = b \vee a$	$a \wedge b = b \wedge a$
$a \vee (b \vee c) = (a \vee b) \vee c$	$a \wedge (b \wedge c) = (a \wedge b) \wedge c$
$a \vee (a \wedge b) = a$	$a \wedge (a \vee b) = a$
$a \wedge (b \vee c) = (a \wedge b) \vee (a \wedge c)$	$a \vee (b \wedge c) = (a \vee b) \wedge (a \vee c)$
$a \vee \neg a = 1$	$a \wedge \neg a = 0$

9. 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 strictly greater than B.

(a) Fill in the truth table

A_1	A_0	B_1	B_0	$A > B$
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 circuit you derived from the map in part (b).