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ICS 232 Computer Organization & Architecture
Homework 3 - Chapter 3 - 10 points
Due Date: 6/7/2023

Name:

Note: Please post your homework to ICS232 D2L on or before the due date.

Chapter 3 – Boolean Algebra and Digital Logic

Essential Terms and Concepts

2. Which Boolean operation is referred to as a Boolean product?

AND

3. Which Boolean operation is referred to as a Boolean sum?

OR

12. Describe the operation of a ripple-carry adder. Why are ripple-carry adders not used in most computers today?

- ripple carry adder : output is known after the carry generated by the previous stage is produced
- too slow

18. How are sequential circuits different from combinational circuits?

- sequential : output is depended on the current and previous input
- combinational : output is independent of time and relies on input at the particular instance

20. What do we mean when we say that a sequential circuit is edge triggered rather than level triggered?

- because the circuit is active at the positive/negative edge of the clock signal

24. Which flip-flop give a true representation of computer memory?

Data flip-flop / D flip-flop

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Exercises

2. Construct a truth table for the following:

a) xyz + x(yz)' + x'(y+z) + (xyz)'
b) (x + y')(x' + z')(y' + z')

4. Using DeMorgan's Law, write an expression for the complement of F if

`F(x,y,z) = (x'+y)(x+z)(y'+z)'`

y' + z + x'

10. Show that x = xy + xy'
a) Using truth tables
b) Using Boolean identities

A) $2^2 = 4$

x	y	y'	xy	xy'	xy+xy'
0	0	1	0	0	0
0	1	0	0	0	0
1	0	1	0	1	1
1	1	0	1	0	1

compare the equation's results with one another for each other

B) R.H.S. = xy + xy'
= x(y + y') [y + y' = 1 (complementarity law)]
= x(1) = (x.1) [x.1 = x (property of 0 & 1)]
= x = L.H.S
L.H.S = R.H.S

17. Simplify the following functional expressions using Boolean algebra and its identities. List the identity used at each step.

A) (xy + xz)(x' + z')
(xx'y + xx'z + xyz' + xzz')
xyz'

a) `x(y + z)(x' + z')`
b) `xy + xyz + xy'z + x'y'z` B) xy + y'z
c) `xy'z + x(y + z')' + xy'z'` xy'

23. The truth table for a Boolean expression is shown below. Write the Boolean expression in sum-of-products form.

2. Construct a truth table for the following:

a) xyz + x(yz)' + x'(y+z) + (xyz)'

num

$2^3 = 8$

X	Y	Z	xyz	x'	y+z	x'(y+z)	yz	(yz)'	x(yz)'	(xyz)'	output
0	0	0	0	1	0	0	0	1	0	1	1
0	0	1	0	1	1	1	0	1	0	1	1
0	1	0	0	1	1	1	0	1	0	1	1
0	1	1	0	1	1	1	1	0	0	1	1
1	0	0	0	0	1	0	0	1	1	1	1
1	0	1	0	0	1	0	0	1	1	1	1
1	1	0	0	0	1	0	0	1	1	1	1
1	1	1	1	0	1	0	1	0	0	0	1
every 4th	every 2nd	every other									

b) (x + y')(x' + z')(y' + z')

$2^3 = 8$

X	Y	Z	y'	x'	z'	(x+y')	(x'+z')	(y'+z')	output
0	0	0	1	1	1	1	1	1	0
0	0	1	1	1	0	1	1	1	1
0	1	0	0	1	1	0	1	1	0
0	1	1	0	1	0	0	1	0	1
1	0	0	1	0	1	1	1	1	1
1	0	1	1	0	0	1	0	1	1
1	1	0	0	0	1	1	1	1	0
1	1	1	0	0	0	1	0	0	0

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x	y	z	F
0	0	0	1
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	0

$f = x'y' + xy' + x'yz'$

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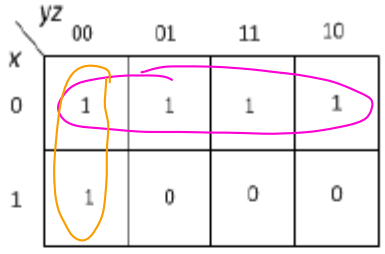
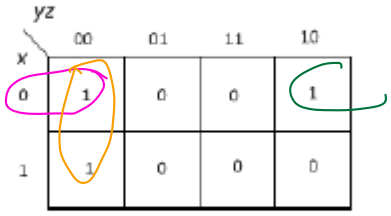
29. Write a simplified expression for the Boolean function defined by each of the following Kmaps.

a)



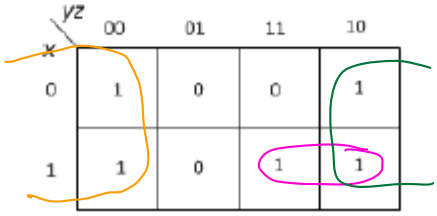
x'+y'z'

b.



y'z'+x'z'

c.



z'+xy

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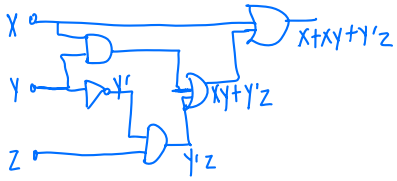
46. Draw the combinational circuit that directly implements the following Boolean expression:

F(x,y,z) = x + xy + y'z



51. How many inputs does a decoder have if it has 64 outputs?

$2^n = 64 \quad n = 6$

52. How many control lines does a multiplexer have if it has 32 inputs?

5

Write a simple C program to sum the entries in an array and print out the sum and the average. The following may be used as a template:

```
#include <stdio.h>
#include <string.h>

int main(int argc, char ** argv)
{

      int average;
      int i;
      int size;
      int sum;

      static int numbers[] = {1, -1, 100, 32, 64, -96};

      for (i = 0; i < size; i++) {
      }

      printf("Sum = %d, Average = %d\n", sum, average);

      return (0);
```

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```
}
```

Prepare for next class by reading Chapter 4 – MARIE: An Introduction to a Simple Computer