[CS M51A Fall 15] Quiz 1

TA: Teng Xu (xuteng@cs.ucla.edu)

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- The quiz is closed book, and closed notes (30mins).
- Please show all your work and write legibly, otherwise no partial credit will be given.
- **This should strictly be your own work; any form of collaboration will be penalized.**

Name : James Wang

Student ID : 904439931

Quiz Problems (50 points total)

Problem 1 (10 points)

Find x and y such that the following conditions are satisfied and show all the steps of your work.

1. **(5 points)** $(818)_9 = (x)_3$

Convert to decimal...

$8 \times 9^1 + 1 \times 9^1 + 8 \times 9^2 = 8 + 9 + 81 \times 8$

$= 72 + 648 = 720_{10}$

$81 \times 8 = 648$

$648 + 72 = 720$

$3 \,|\, 720$
$3 \,|\, 240$ R 0
$3 \,|\, 80$ 0
$3 \,|\, 26$ 2
$3 \,|\, 8$ 2
2 2

$3^5\ 3^4\ 3^3\ 3^2\ 3^1\ 3^0$

$(818)_9 = (222200)_3$

$486 + 162 + 54 + 18$

$486 + 162 = 648$

$54 + 18 = 72$

$= 720$ ✓

$81 \times 3 = 243$

$243 \times 2 = 486$

$\boxed{x = 222200}$

✗ −3

2. **(5 points)** What is the largest number y that can be represented with 4 digit-vector in radix 5. Show y in radix 5 and decimal.

In radix 5:- $\underbrace{4444}_{\text{4 digits - highest rep}}$

$Y_{10} = 4 \times 5^0 + 4 \times 5^1 + 4 \times 5^2 + 4 \times 5^3$

$4 + 20 + 100 + 500$

624 ✓

$$\begin{array}{r} 12 \\ 125 \\ \times \quad 4 \\ \hline 500 \end{array}$$

$\boxed{\begin{aligned} Y_{10} &= 624 \\ Y_5 &= 4444 \end{aligned}} \rightarrow 5^4 - 1$

Problem 2 (16 points)

Solve the following problems using the postulates and theorems of Boolean algebra. **Do not use a truth table.**

1. **(8 points)** The Boolean function f is defined as $f(a, b, c) = ac' + a'b$ and the Boolean function g is defined as $g(a, b, c) = ac + b'c + a'b'$. Show that $g(a, b, c)' = f(a, b, c)$.

$(ac + b'c + a'b')' = ac' + a'b$ → if functions are equivalent, complements are equivalent

$ac + b'c + a'b' = (ac' + a'b)'$

$ac + b'c + a'b' = (ac')'(a'b)'$ de morgan's expand $(a+b)' = a'b'$

$= (a'+c)(a+b')$ de morgan's expand $(ab)' = (a'+b')$

$= \cancel{a'a}^{\,0} + a'b' + ac + b'c$ after we distribute and cancel using complement, it is easy to see that both sides are equal.

2. **(8 points)** Simplify the following expression.

$$xyzw' + xyz' + xy' + x'$$

$xyzw' + xyz' + y' + x'$

$yzw' + yz' + y' + x'$

$zw' + z' + y' + x'$

$x' + y' + z' + w'$

$\boxed{w' + x' + y' + z'}$

$yzw' = b,\ yz' = b$
$x' = a$
$x = a'$

$zw' = b,\ z' = b$
$y' = a$
$y = a'$

$w' = b$
$z' = a$
$z = a'$

$a'b + a = a + b$
Use this several times

Problem 3 (24 points)

F is a function that accepts inputs $x \in \{0, 1, 2\}$, $y \in \{1, 2, 3\}$, and outputs $z = max(x^2, y)$. Suppose you use binary code to encode x, y, and z. x is encoded as x_1x_0, y is encoded as y_1y_0, z is encoded as $z_2z_1z_0$.

1. **(16 points)** Fill in the table below.

minterms	x_1	x_0	y_1	y_0	z_2	z_1	z_0	maxterms
	0	0	0	0		DC		
	0	0	0	1	0	0	1	
2 →	0	0	1	0	0	1	0	← 2
3 →	0	0	1	1	0	1	1	
	0	1	0	0		DC		
	0	1	0	1	0	0	1	
6 →	0	1	1	0	0	1	0	← 6
7 →	0	1	1	1	0	1	1	
	1	0	0	0		DC		
9 →	1	0	0	1	1	0	0	← 9
10 →	1	0	1	0	1	0	0	← 10
11 →	1	0	1	1	1	0	0	← 11
	1	1	0	0		DC		
	1	1	0	1		DC		
	1	1	1	0		DC		
	1	1	1	1		DC		

z_1 (minterms 2, 3, 6, 7)

z_2 (minterms 9, 10, 11)

z_0 (maxterms 2, 6, 9, 10, 11)

3. (8 points) Fill in the sets in the forms specified below.

$$
\begin{aligned}
z_2 &= \sum m(\ 9, 10, 11\ ) \\
z_1 &= \sum m(\ 2, 3, 6, 7\ ) \\
z_0 &= \prod M(\ 2, 6, 9, 10, 11\ ) \\
dc - set\ of\ z_1 &= dc(\ 0, 4, 8, 12, 13, 14, 15
\end{aligned}
$$