[CS M51A Fall 15] Quiz 1

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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.**

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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)** $(818)_9 = (x)_3$

$8_9 = 22_3$

$1_9 = 01_3$

$(x)_3 = 220122_3$ ✓

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.

$y = (4444)_5$

$= 4 \cdot 125 + 4 \cdot 25 + 4 \cdot 5 + 4$

$= 500 + 100 + 20 + 4$

$= 624$

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 $g(a, b, c)' = f(a, b, c)$.

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

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

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

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

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

$= ac' + a'b + bc'$ -2

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

$= bc' + a'b = a'b + ac' = f(a,b,c)$

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

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

$$= xy(zw' + z') + xy' + x'$$

$$= xy((zw)') + (xy)'$$

$$= (xyzw)'$$

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

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.

x_1	x_0	y_1	y_0	z_2	z_1	z_0
0	0	0	0	–	–	–
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	–	–	–
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	–	–	–
1	0	0	1	1	0	0
1	0	1	0	1	0	0
1	0	1	1	1	0	0
1	1	0	0	–	–	–
1	1	0	1	–	–	–
1	1	1	0	–	–	–
1	1	1	1	–	–	–

2. **(8 points)** Fill in the sets in the forms specified below.

$$z_2 = \sum m(\ m_9 + m_{10} + m_{11}\ )$$
$$z_1 = \sum m(\ m_2 + m_3 + m_6 + m_7\ )$$
$$z_0 = \prod M(\ M_2 M_6 M_9 M_{10} M_{11}\ )$$
$$dc - set\ of\ z_1 = dc(\ 0, 4, 8, 12, 13, 14, 15\ )$$