CS 2110 — Quiz 2C (35 minutes)
September 12th, 2018

Full name: _____

GT username: _____

This quiz is worth a total of **100 points**.

In accordance with the Georgia Institute of Technology Honor Code, I have neither given nor received aid on this quiz.

Signature: _____

Please make sure all of your answers are contained within the answer boxes or the fill-in lines. Do not write your work in the answer boxes. You have been provided with extra paper for your scratch work. You will **NOT** be given credit for showing work. Having anything except the answer inside the boxes or above the fill-in lines reduces autograder performance and might cause incorrect results.

Make sure to write your name, username, and answers legibly. You will not receive credit for illegible answers.

Digital Logic: Truth Table from Expression

1. Complete the empty entries in the truth table with respect to the following boolean expression.

   $S = (A \ \& \ B) \mid C$

A	B	C	S
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

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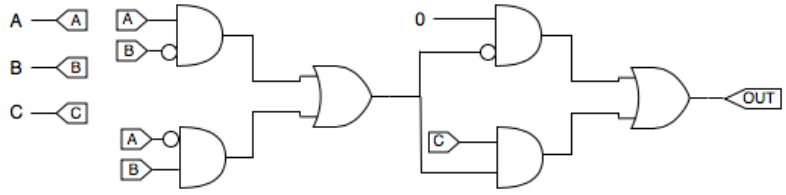
Digital Logic: Truth Table from Circuit

2. Complete the empty entries in the following truth table with respect to the circuit shown below.

   Note: The `0` indicates a zero constant.



A	B	C	OUT
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

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Short Answer

3. For the following questions please answer in the space provided.
   (a) Given a multiplexer with n select bits, what's the maximum number of outputs? `1` 5
   (b) Given a decoder with n select bits, what's the maximum number of outputs? `2^n` 5
   (c) Find an expression equivalent to `(!A & !B)` with ≤ 2 bitwise operators (`!,&,|`) `!(A | B)` 5

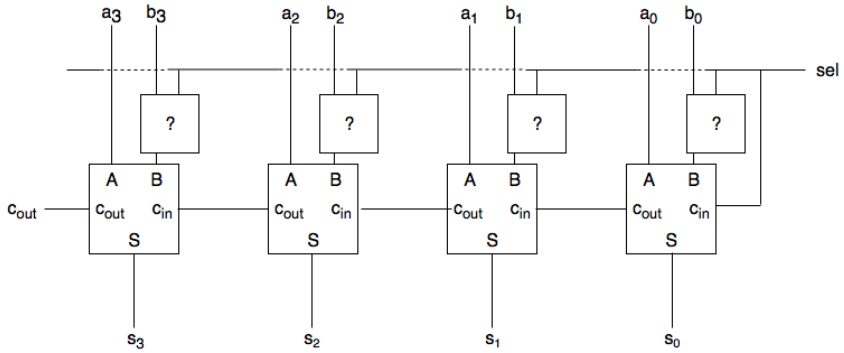
Multiple Choice

4. For the following questions please fill-in the appropriate circle.
   (a) Which operator should one use to set bits? ○ AND ● OR ○ XOR ○ ADD 4
   (b) Which operator should one use to clear bits? ● AND ○ OR ○ XOR ○ ADD 4
   (c) Which operator should one use to toggle bits? ○ AND ○ OR ● XOR ○ ADD 4

Digital Logic: Adding and Subtracting

5. Consider the following diagram of a 4-bit adder-subtractor composed of four 1-bit full-adders. When the `sel` input is `0` the circuit should compute the operation `A + B`. When the `sel` input is `1` the circuit should compute the operation `A - B`. [10]

   Hint: The `sel` input is connected both to the marked components and to the c_{in} of the first adder.



   Which component should be inserted for the boxes with `?`'s: ◯ AND ◯ OR ● XOR ◯ ADD

Bitmasking

6. Write a function which extracts all bits less than and excluding the bit `i` from a 32-bit 2's complement integer such that: [16]

   - `num` is a 32-bit 2's complement integer
   - `i` is the index bit with a range of (0, 32)

   For example, if `i` = 4 you would return the 4-bit number `num[3 : 0]` (i.e. bits {3,2,1,0}).

   This must be completed in one line without multiplication, addition, subtraction, division or modulus. All right shifts must be signed.

   Note: Make sure your answer is of the form "`return ... ;`"

```
public static int lowerBits(int num, int i)
{
   return ((num) & ~(~0x0 << i));
}
```

Digital Logic: Circuit from Expression

7. Consider the following boolean expression with three inputs and one output: $Z = \overline{(\,\overline{A} \mid (\,B \,\&\, \overline{C}\,)\,)}$. [15]

   Draw the corresponding circuit. **You are allowed (but not required) to simplify the expression!**

   You may use any of the following symbols: NOT (▷○) AND (D) OR (⊃) XOR (⊃).

   Warning: If we cannot distinguish between your gates, you will receive NO credit.

A

B

Z

C