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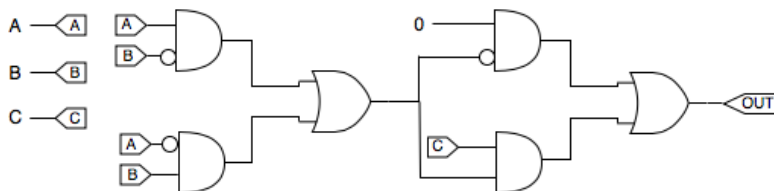
$S = (A \,\&\, B) \mid C$

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

16

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

16

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? ___$2\hat{}n$___ 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
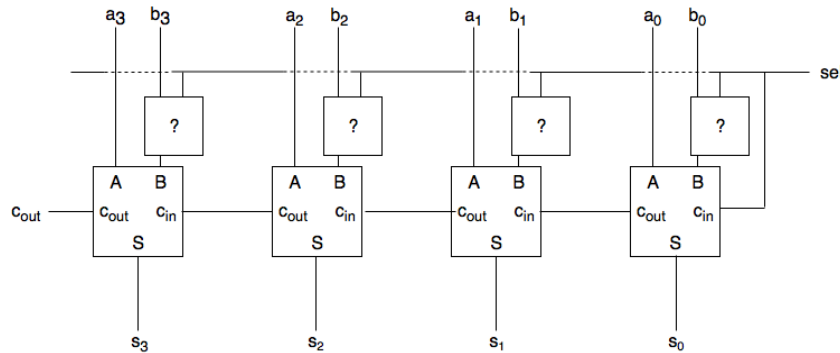
Digital Logic: Adding and Subtracting

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`.

   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 a range of bits from a 32-bit 2's complement integer such that:

   - `num` is a 32-bit 2's complement integer
   - `s` is the starting bit to grab
   - `n` is the number of bits to return

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

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

   ```
   public static int bitRange(int num, int s, int n)
   {
       return ((num >> s) & ~(~0x0 << n));
   }
   ```

Digital Logic: Circuit from Expression

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

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

   You may use any of the following symbols: NOT ($\rhd\!\circ$) AND ($\sqsupset\!D$) OR ($\rhd$) XOR ($\rhd\!\!\!)$).

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

   A

   B   Z

   C