

CS 2110 Quiz 2

TOTAL POINTS

81 / 100

QUESTION 1

Digital Logic: Truth Table from Expression 16 pts

1.1 000 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

1.2 001 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

1.3 010 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

1.4 011 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

1.5 100 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

1.6 101 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

1.7 110 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

1.8 111 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

QUESTION 2

Digital Logic: Truth Table from Circuit 16 pts

2.1 000 2 / 2

- ✓ + 0 pts Graded

✓ + 2 pts Correct: \$\$0\$\$

2.2 001 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

2.3 010 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

2.4 011 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

2.5 100 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

2.6 101 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$1\$\$

2.7 110 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

2.8 111 2 / 2

- ✓ + 0 pts Graded
- ✓ + 2 pts Correct: \$\$0\$\$

QUESTION 3

Short Answer 15 pts

3.1 Multiplexer 5 / 5

- ✓ + 0 pts Graded
- ✓ + 5 pts Correct: \$\$1\$\$

3.2 Decoder 5 / 5

- ✓ + 0 pts Graded
- ✓ + 5 pts Correct: 2^n

3.3 DeMorgan's law 5 / 5

- ✓ + 0 pts Graded
- ✓ + 5 pts $\neg(A \wedge B)$

QUESTION 4

Multiple Choice 12 pts

4.1 Setting bits 4 / 4

✓ + 0 pts Graded

✓ + 4 pts Correct: OR

4.2 Clearing bits 4 / 4

✓ + 0 pts Graded

✓ + 4 pts Correct: AND

4.3 Toggling bits 4 / 4

✓ + 0 pts Graded

✓ + 4 pts Correct: XOR

QUESTION 5

5 Digital Logic: Adding and Subtracting 0 / 10

✓ + 0 pts Graded

+ 10 pts Correct: XOR

QUESTION 6

6 Bitmasking 7 / 16

✓ + 0 pts Graded

+ 3 pts Everything works correctly: No issues with operator precedence, etc.

Note: Can only receive credit for this if other components are all correct, aside from "Small syntax problems"

✓ + 4 pts Written in one line and of the form:

`return \: ... \: ;`

Note: If missing a semicolon, give credit here and deduct from "Small syntax problems"

+ 3 pts Appropriately shifts `num`:

- `num >> s`

- `num >> i`

- `num`

+ 3 pts Creates an appropriate mask:

- `num & (1 << n)`

- `num & (1 << (32 - i))`

- `num << i`

✓ + 3 pts Correctly `num` and mask components

Note: The components need not be independently correct to receive credit for this

- 2.5 pts Small syntax problems: Missing semicolon, uses `!` instead of `~`, etc.

- 5 pts Significant syntax problems or used a forbidden operator

Note: Subtraction is allowed for

`upperBits`

QUESTION 7

7 Digital Logic: Circuit from Expression 15 / 15

✓ - 0 pts Graded

Note:
$$\overline{\overline{A} \vee (\overline{B} \wedge \overline{C})}$$

$$A \wedge \overline{(B \wedge \overline{C})}$$

$$A \wedge (\overline{B} \vee C)$$

- 2.5 pts Deduction: Didn't connect output to

`Z`

- 5 pts Deduction: One gate missing or incorrect

- 10 pts Deduction: Two gates missing or incorrect

- 15 pts Deduction: Three (or more) gates missing or incorrect



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.

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

A & B

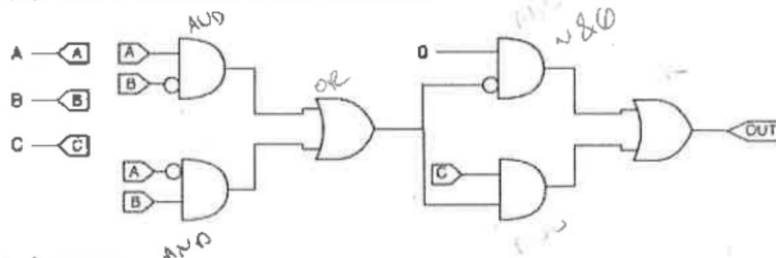
A	B	C	S
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

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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

16

Short Answer

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

5

5

5

Multiple Choice

4. For the following questions please fill-in the appropriate circle.

- Which operator should one use to set bits? ☐ AND ☒ OR ☐ XOR ☐ ADD
- Which operator should one use to clear bits? ☒ AND ☐ OR ☐ XOR ☐ ADD
- Which operator should one use to toggle bits? ☐ AND ☐ OR ☒ XOR ☐ ADD

4

4

4



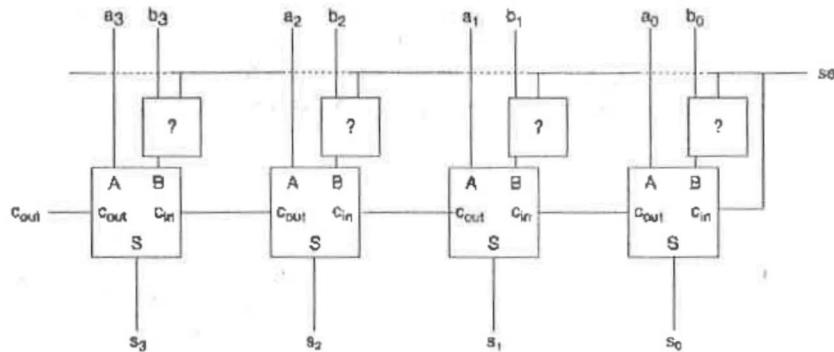


Digital Logic: Adding and Subtracting

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 $A - B$.

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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 greater than and including the bit **i** from a 32-bit 2's complement integer such that:

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- **num** is a 32-bit 2's complement integer
- **i** is the index bit with a range of (0, 31)

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

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

For example, `upperBits(0x98765432, 28) => 0x00000009`

```
public static int upperBits(int num, int i)
{
    ~((0xFFFF << i) & num);
}
```

Digital Logic: Circuit from Expression

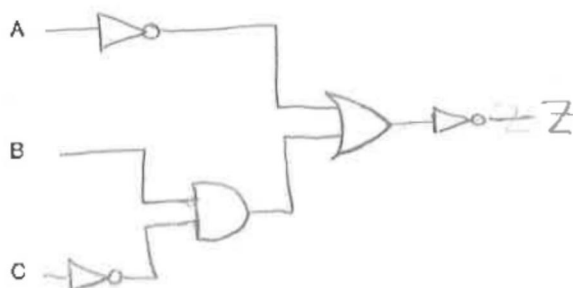
7. Consider the following boolean expression with three inputs and one output: $Z = (\overline{A} \mid (B \& \overline{C}))$.

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

You may use any of the following symbols: NOT (\neg) AND ($\&$) OR (\mid) XOR (\oplus).

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



Z

