CS 2110 Quiz 2

Izaan Kamal

TOTAL POINTS

89.5 / 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 0 / 2

✓ + 0 pts Graded

+ 2 pts Correct: $$0$$

2.4 011 0 / 2

✓ + 0 pts Graded

+ 2 pts Correct: $$1$$

2.5 100 0 / 2

✓ + 0 pts Graded

+ 2 pts Correct: $$0$$

2.6 101 0 / 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 !(A|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 10 / 10

✓ + 0 pts Graded

✓ + 10 pts Correct: XOR

QUESTION 6

6 Bitmasking 13.5 / 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 $$\texttt{num}$$:
- $$\texttt{bitRange}$$: e.g. $$\mathtt{num >> s}$$
- $$\texttt{upperBits}$$: e.g. $$\mathtt{num >> i}$$
- $$\texttt{lowerBits}$$: e.g. $$\mathtt{num}$$

✓ + 3 pts Creates an appropriate mask:
- $$\texttt{bitRange}$$: e.g. $$\mathtt{\sim(\sim0x0 << n)}$$
- $$\texttt{upperBits}$$: e.g. $$\mathtt{\sim(\sim0x0 << (32 - i))}$$
- $$\texttt{lowerBits}$$: e.g. $$\mathtt{\sim(\sim0x0 << i)}$$

✓ + 3 pts Correctly $$\&$$'d together the $$\mathtt{num}$$ 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 $$\sim$$, etc.

- 5 pts Significant syntax problems or used a forbidden operator

Note: Subtraction is allowed for $$\mathtt{upperBits}$$

QUESTION 7

7 Digital Logic: Circuit from Expression 15 / 15

✓ - 0 pts Graded

Note: $$\overline{(\overline{A} \: \vert \: (B \: \& \: \overline{C}))}$$

$$== A \: \& \: \overline{(B \: \& \: \overline{C})}$$

$$== A \: \& \: (\overline{B} \: \vert \: C)$$

- 2.5 pts Deduction: Didn't connect output to $$\mathtt{Z}$$

- 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

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

Full name: Izaan Kamal

GT username: ikamal3

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: Izaan Kamal

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. [16]

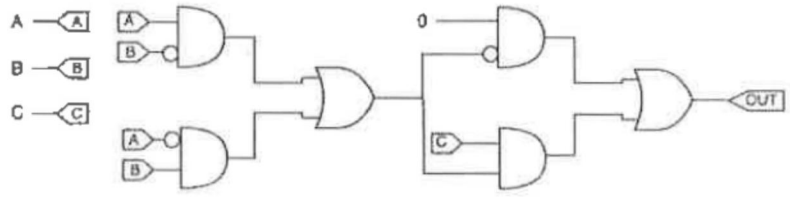
$S = (A \;\&\; B) \mid C$

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

Digital Logic: Truth Table from Circuit

2. Complete the empty entries in the following truth table with respect to the circuit shown below. [16]

Note: The 0 indicates a zero constant.



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

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]

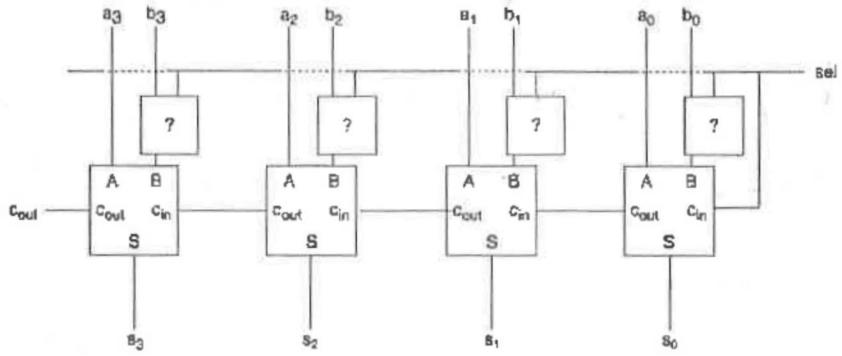
Multiple Choice

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 (~((~0)<<i) & num);
}
```

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.