

21W-COMSCIM51A-1 Homework 10

CHARLES ZHANG

TOTAL POINTS

90 / 90

QUESTION 1

1 40 pts

1.1 1a 10 / 10

✓ - 0 pts Correct (OK to just combine them together)

![Screen_Shot_2021-03-12_at_7.23.57_PM.png](/files/1478f790-65da-4689-b95e-4f62905bad9d)

- 2 pts Minor error
- 4 pts Major error
- 10 pts Blank

1.2 1b 15 / 15

✓ - 0 pts Correct

![Screen_Shot_2021-03-20_at_2.34.46_PM.png](/files/67be1f7a-2b8a-49e1-81df-106e48009103)

- 3 pts Minor error in S
- 5 pts Major error in S
- 7.5 pts Blank in S
- 3 pts Minor error in O
- 5 pts Major error in O
- 7.5 pts Blank in O

1.3 1c 15 / 15

✓ - 0 pts Correct

![Screen_Shot_2021-03-13_at_10.35.47_PM.png](/files/8b549c57-5d77-4dd2-ab43-c0901bdc26f5)

- 2 pts Minor error in m2
- 3 pts Major error in m2
- 5 pts Blank in m2
- 2 pts Minor error in m1
- 3 pts Major error in m1
- 5 pts Blank in m1
- 2 pts Minor error in m0

- 3 pts Major error in m0

- 5 pts Blank in m0

QUESTION 2

2 2 10 / 10

✓ - 0 pts Correct

![Screen_Shot_2021-03-12_at_7.34.59_PM.png](/files/d7d53deb-f47e-4221-8931-c94f7c7b98bc)

- 3 pts Missing the output ($x > y == G/z_G$, $x < y == S/z_S$, $x = y == E/z_E$)
- 3 pts Other minor error
- 4 pts Major error
- 10 pts Blank

QUESTION 3

3 3 10 / 10

✓ - 0 pts Correct

![Screen_Shot_2021-03-12_at_7.37.07_PM.png](/files/65a7efa8-aa9a-4415-b14f-fc781c38f9e4)

- 3 pts Wrong direction (i.e. NOT gate on the left-most pin)
- 5 pts Wrong decoding (other than the wrong direction)
- 10 pts Blank

QUESTION 4

4 4 10 / 10

✓ - 0 pts Correct

![4.PNG](/files/1cc3c429-5b25-4aad-85cd-03782849cee3)

- 3 pts Detected pattern in opposite direction
- 5 pts Detected wrong pattern
- 10 pts Blank

QUESTION 5

5 5 10 / 10

✓ - 0 pts Correct

![[5.PNG]](/files/4181ba80-bc7d-442e-891c-5d8301df77cb)

S0' is not required as input to AND gate

- 0.5 pts X should also go into the AND gate
- 1 pts Minor error
- 2 pts Error
- 3 pts Wrong input into LD
- 3 pts Wrong input into I3-I1
- 10 pts Blank

QUESTION 6

6 6 10 / 10

✓ - 0 pts Correct

![[6.PNG]](/files/b5c7081e-159d-4089-aad3-670ddcb156e0)

Only one of S2' or S3' is required.

- 0.5 pts X should also go into the AND gate
- 3 pts Missing either S2' or S3' (the counter goes back to 14 when 15 (1 1 **1 1**) is reached)
- 3 pts Wrong input into LD
- 3 pts Wrong input into I3-I0
- 10 pts Blank

CS M51A, Winter 2021, Assignment 10

(Total Mark: 90 points, 9%)

Due: Wed Mar 17rd, 10:00 AM Pacific Time

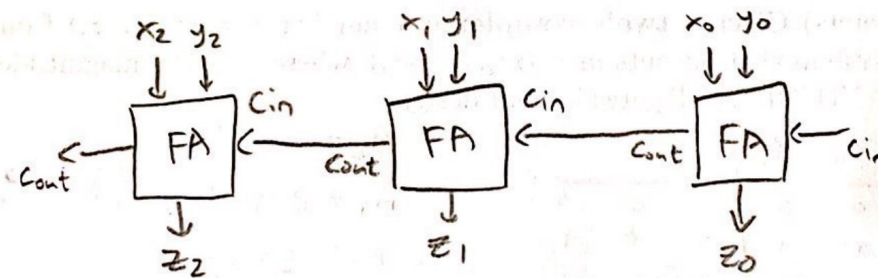
Student Name: Charles Zhang

Student ID: 305413659

Note: You must complete the assignments entirely on your own, without discussing with others.



1. (a) (10 Points) Using only full adders, design a system that adds two 3-bit 2's complement numbers, $x = (x_2, x_1, x_0)$ and $y = (y_2, y_1, y_0)$, and outputs the sum $z = (z_2, z_1, z_0)$. Assume that the addition will not overflow and label the inputs and outputs of the system.



1.1 1a 10 / 10

✓ - 0 pts Correct (OK to just combine them together)

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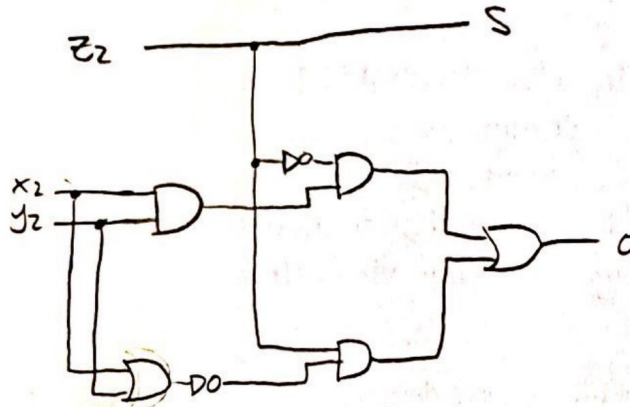
- 2 pts Minor error

- 4 pts Major error

- 10 pts Blank

(b) (15 Points) Given 2's complement numbers $x = (x_2, x_1, x_0)$, $y = (y_2, y_1, y_0)$, and the sum $z = (z_2, z_1, z_0)$ from part (a), design a system that has two outputs, s and o . The output $s = 1$ when the sign of z is negative, and the output $o = 1$ if the addition from part (a) has overflow. You may use AND/OR/NOT gates in your design.

$S = 1$ when $z_2 = 1$ $o = 1$ if $x_2, y_2 = 0, z_2 = 1$
 or $x_2, y_2 = 1, z_2 = 0$
 or carry in \neq carry out



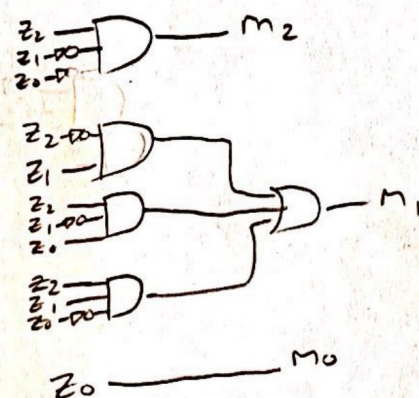
(c) (15 Points) Given a two's complement number $z = (z_2, z_1, z_0)$ from part (a), design a system that outputs $m = (m_2, m_1, m_0)$, where m is the magnitude of z . You may use AND/OR/NOT gates in your design.

z_2	z_1	z_0	m_2	m_1	m_0
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	0	1	1
1	1	0	0	1	0
1	1	1	0	0	1

$$m_2 = z_2 z_1' z_0'$$

$$m_1 = z_2' z_1 + z_2 z_1' z_0 + z_2 z_1 z_0'$$

$$m_0 = z_0$$



1.2 1b 15 / 15

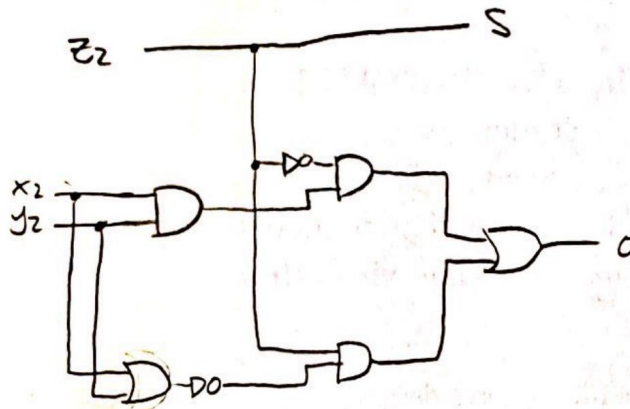
✓ - 0 pts Correct

![Screen_Shot_2021-03-20_at_2.34.46_PM.png](/files/67be1f7a-2b8a-49e1-81df-106e48009103)

- 3 pts Minor error in S
- 5 pts Major error in S
- 7.5 pts Blank in S
- 3 pts Minor error in O
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(b) (15 Points) Given 2's complement numbers $x = (x_2, x_1, x_0)$, $y = (y_2, y_1, y_0)$, and the sum $z = (z_2, z_1, z_0)$ from part (a), design a system that has two outputs, s and o . The output $s = 1$ when the sign of z is negative, and the output $o = 1$ if the addition from part (a) has overflow. You may use AND/OR/NOT gates in your design.

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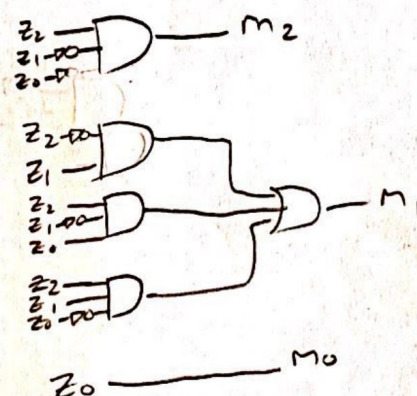
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z_2	z_1	z_0	m_2	m_1	m_0
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	0	1	1
1	1	0	0	1	0
1	1	1	0	0	1

$$m_2 = z_2 z_1' z_0'$$

$$m_1 = z_2' z_1 + z_2 z_1' z_0 + z_2 z_1 z_0'$$

$$m_0 = z_0$$



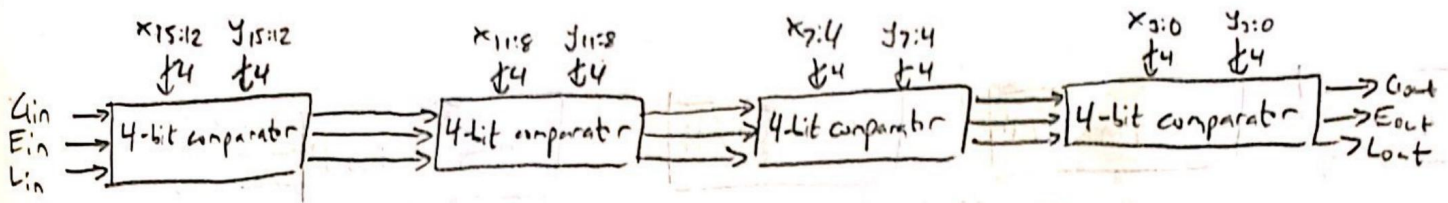
1.3 1C 15 / 15

✓ - 0 pts Correct

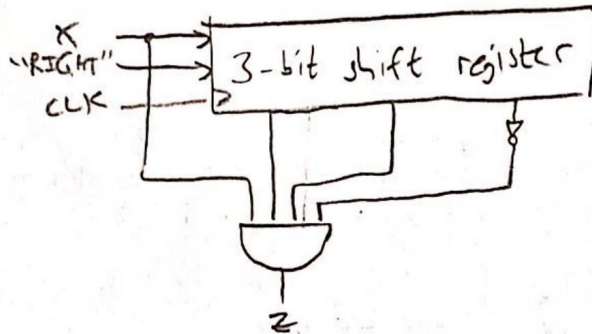
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- 5 pts Blank in m0

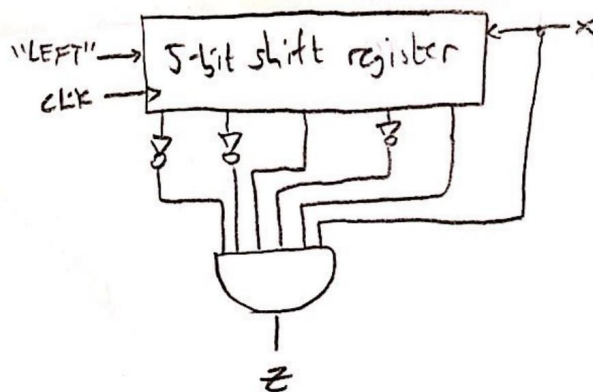
2. (10 Points) Design a 16-bit comparator using 4-bit comparators only.



3. (10 Points) Design a pattern recognizer that outputs 1 if pattern 0111 is detected. You may use serial-in/parallel-out shift register and AND/OR/NOT gates in your design. The shifting direction should be to the right.



4. (10 Points) Design a pattern recognizer that outputs 1 if pattern 001011 is detected. You may use serial-in/parallel-out shift register and AND/OR/NOT gates in your design. The shifting direction should be to the left.



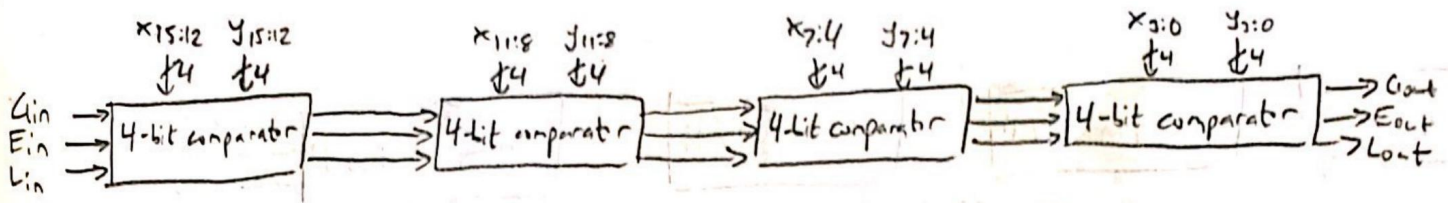
2 2 10 / 10

✓ - 0 pts Correct

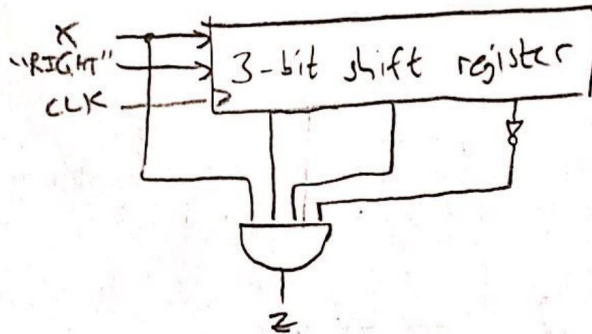
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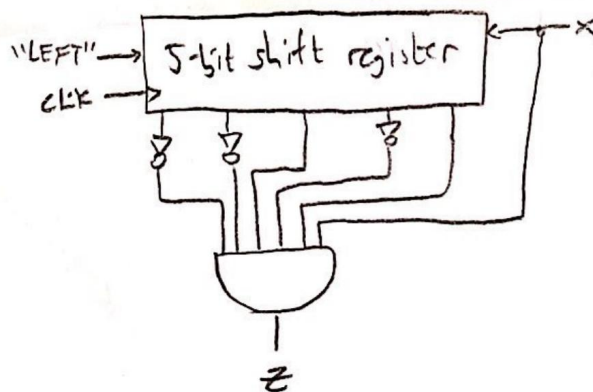
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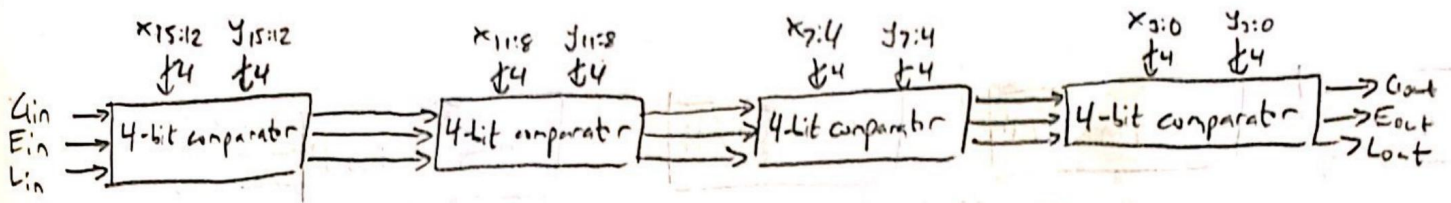
3 3 10 / 10

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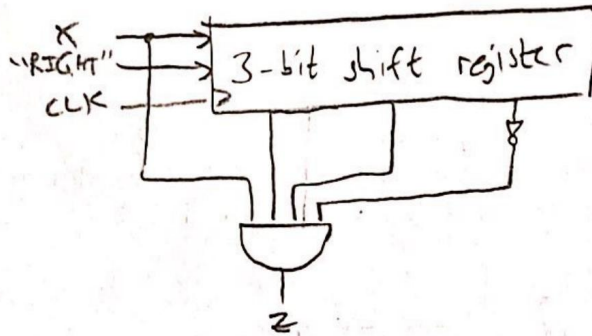
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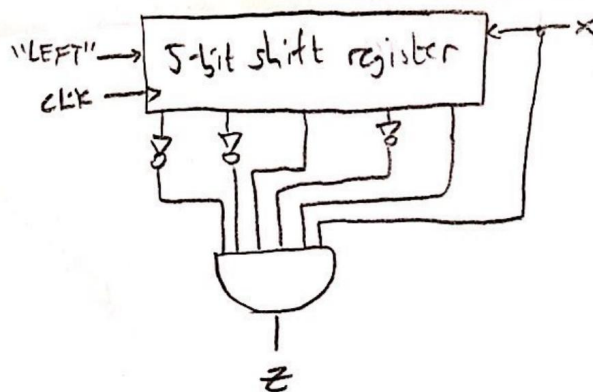
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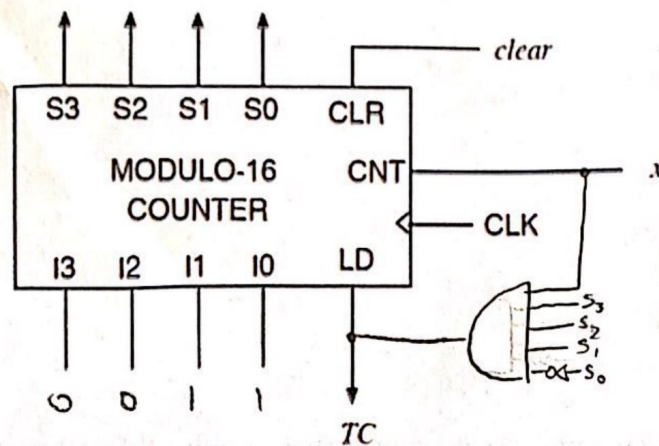
4 4 10 / 10

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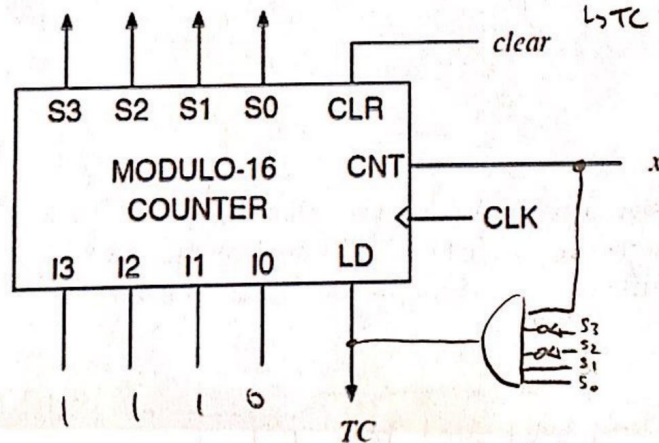
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- 3 pts Detected pattern in opposite direction
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5. (10 Points) Using a modulo-16 counter and AND/OR/NOT gates, design a counter that counts from 3 to 14. $\rightarrow 1110$



6. (10 Points) Using a modulo-16 counter and AND/OR/NOT gates, design a counter that outputs the following count: 14, 15, 0, 1, 2, 3, 14, 15, 0, 1, 2, 3, 14, 15, 0 ...



5 5 10 / 10

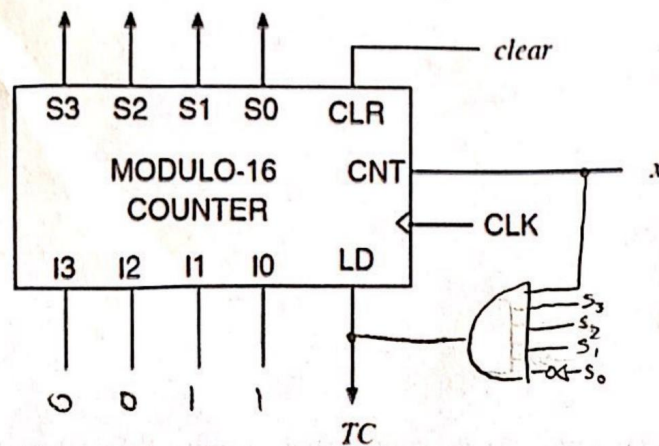
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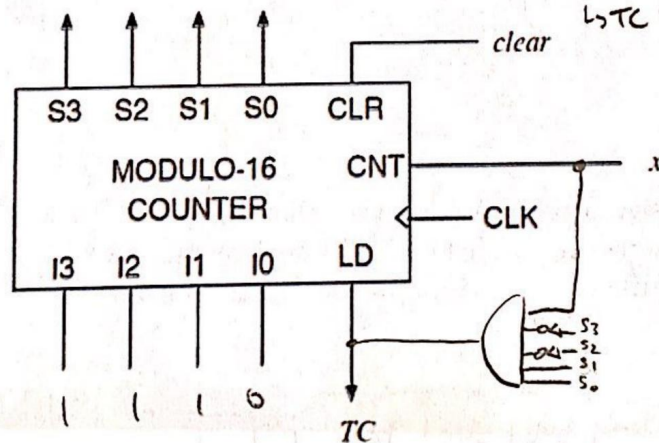
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