COMP2270 Lab 3

Due September 30 at beginning of lab

Write out solutions in a text file called 'lab3.txt' and a Logisim file called 'lab3.circ'. Submit the homework by adding the files to your git repository.

In Git Bash, create the text file with:

```
cd ~/COMP2270-2015
touch lab3.txt
```

Rule	Form	Dual form
Identity	a * 1 = a	a + 0 = a
Commutative	a * b = b * a	a + b = b + a
Associative	(a * b) * c = a * (b * c)	(a + b) + c = a + (b + c)
Identity	a * 0 = 0	a + 1 = 1
Distributive	a * (b + c) = a * b + a * c	a + (b * c) = (a + b) * (a + c)
Idempotence	a * a = a	a + a = a
Absorption	a + a * b = a	a * (a + b) = a
Complement	a * a' = 0	a + a' = 1
DeMorgan's	(a + b)' = a' * b'	(a * b)' = a' + b'

Use the rules above to simplify expressions. Label the rules that you apply as you apply them (no more than one rule per line).

1. Show (a * b)' * (a' + b) * (b' + b) = a'

2. Show c + (b * c)' = 1

3. Show (a + c) * (a * d + a * d') + a * c + c = a + c

4. Simplify a' * (a + b) + (b + a * a) * (a + b')

5. Show (a' * b') + (a' * b) + (a * b') = (a * b)'

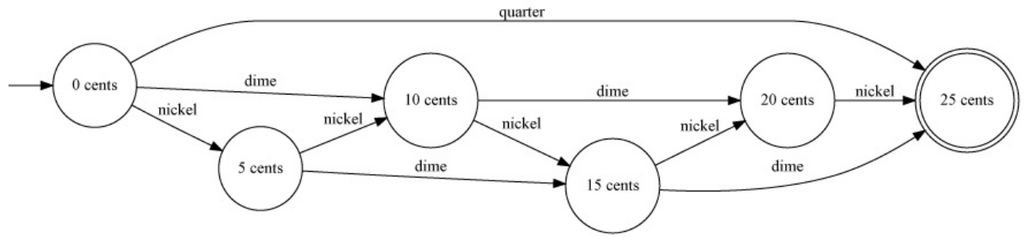
Complete the following exercises using Logisim. Save lab4.circ in your local git repository folder.

6. Implement the majority (of 3 input bits) circuit using a 4-1 multiplexer.

X	Y	Z	Majority of X Y Z true
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	1
1	1	1	1

7. Implement a full adder (a + b + cin) using two 4-1 multiplexers (one multiplexer for carry out, one multiplexer for sum, using the same input variables).

Carry-in	A	B	Sum (A+B)	Carry-out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



Answer the last three questions about the above finite state machine.

8.

a. How many bits do you need to represent the states?
b. How many bits do you need to represent the input?

9. Write a mapping from states to bits and inputs to bits.

10. Write out a state transition table that represents the machine. What happens if we dispense more than 25¢? Add a state and transitions that represent this.

In Git Bash, submit your files with:

```
cd ~/COMP2270-2015
git add lab3.txt lab3.circ
git commit -m "added lab3 files"
git push
```