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CECS 225 – DD&CA Fall 2020
Assignment #05 Sequential Logic Due: 29 OCT 2020 (8am)

Please download the software Logisim from http://www.cburch.com/logisim/download.html and install in your computer. Then open Logisim. Read the tutorials in the HELP tab if needed.

1. Design and implement a 3-bit sequential logic circuit using D flipflops that will perform a GRAY code count, i.e. a count of 0,1,3,2,4,5,7,6,0,1,3,2 … Employ an asynchronous RESET to force the counter to 0 when asserted. Set the simulation clock of the counter at 1 Hz and check its operation. Include a *picture* (not the ***.circ*** Logisim code) of the Logisim implementation of your counter in the pdf of this assignment.

3-bit Gray Code Counter
Logic Table

	Input			Output		
#	S2	S1	S0	S2'	S1'	S0'
0	0	0	0	0	0	1
1	0	0	1	0	1	1
2	0	1	1	0	1	0
3	0	1	0	1	1	0
4	1	1	0	1	1	1
5	1	1	1	1	0	1
6	1	0	1	1	0	0
7	1	0	0	0	0	0

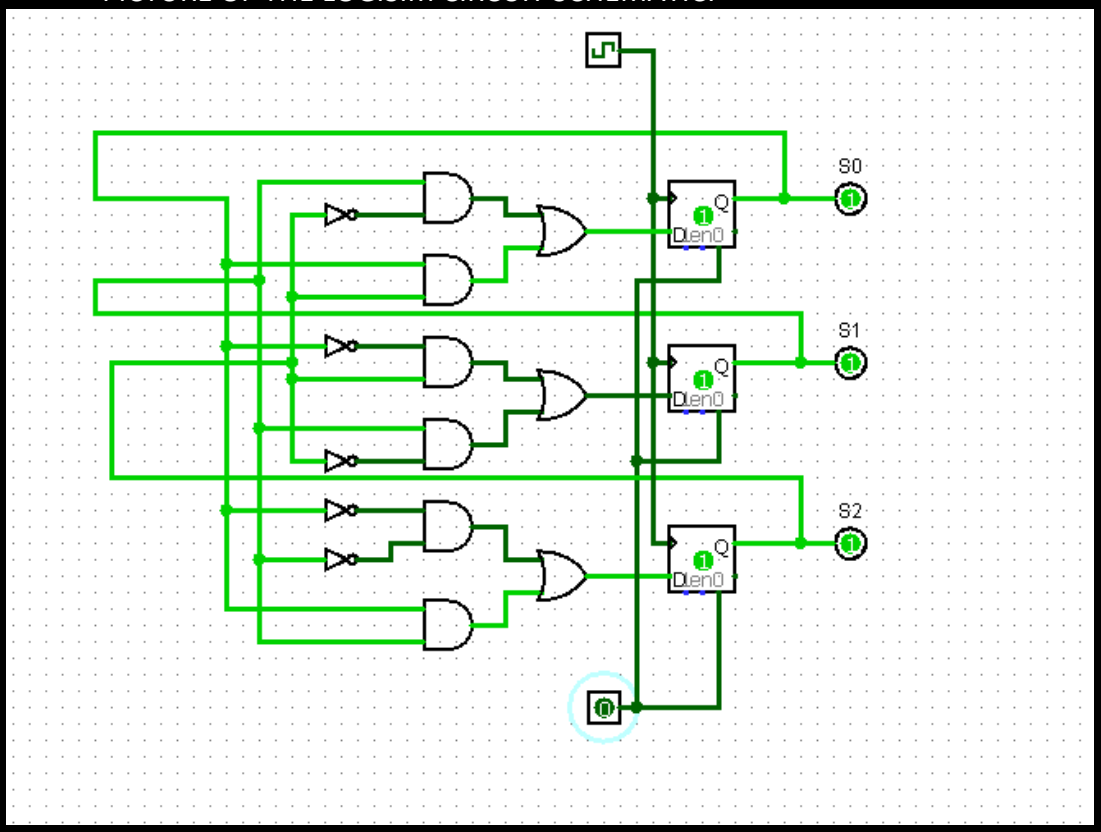
Simplified Logic Equations:

S2' = s1~s0 + s2s0

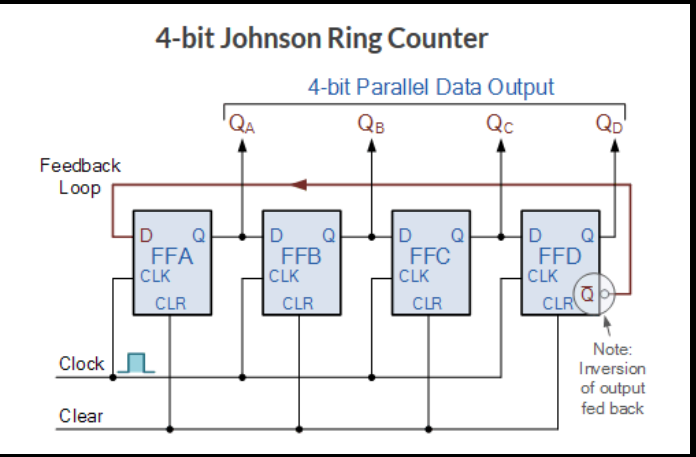
S1'= ~ s2 s0 + s1 ~s0

S0'= ~s1 ~s2 + s2s1

PICTURE OF THE LOGISIM CIRCUIT SCHEMATIC:



2. Using Logisim, build this counter and determine its 4-bit output and complete the logic table below. Submit a picture of your Logisim logic circuit. The *Clear* input is asserted to reset the counter. The clock frequency for the FFs should be 1 Hz. Find the cycle time of the count before it repeats.



Logic Table for Johnson Counter

Cycle time of the count = 8

	Current State				Next State			
M	Q_A	Q_B	Q_C	Q_D	Q_A'	Q_B'	Q_C'	Q_D'
0	0	0	0	0	1	0	0	0
8	1	0	0	0	1	1	0	0
12	1	1	0	0	1	1	1	0
14	1	1	1	0	1	1	1	1
15	1	1	1	1	0	1	1	1
7	0	1	1	1	0	0	1	1
3	0	0	1	1	0	0	0	1
1	0	0	0	1	0	0	0	0
2	0	0	1	0	x	x	x	x
4	0	1	0	0	x	x	x	x
5	0	1	0	1	x	x	x	x
6	0	1	1	0	x	x	x	x
9	1	0	0	1	x	x	x	x
10	1	0	1	0	x	x	x	x
11	1	0	1	1	x	x	x	x
13	1	1	0	1	x	x	x	x

Minimized Logic Equations:

Q_A' = ~Qd

Q_B' = Qa

Q_C' = Qb

Q_D' = Qc

PICTURE OF THE LOGISIM CIRCUIT SCHEMATIC: