CSEE W3827

Fundamentals of Computer Systems

Homework Assignment 3

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Due Feb 26, 2016 by 5:00 PM

- Write your name **and UNI** on each page of your solutions.
- Note your collaborators.
- For each machine use as few states as you can.
- Show your work (i.e., state transition diagram, logic expressions, and a schematic using any gates).
- Turn in to the CSEE 3827 dropbox in the TA room.

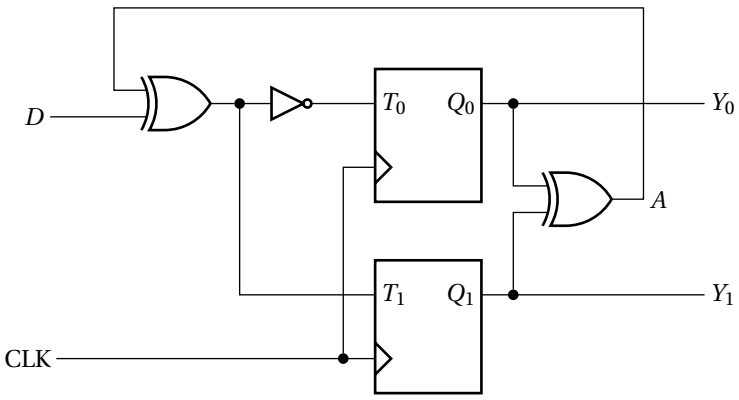
1. (20 pts.) Give a schematic for a Moore counter that counts in the following sequence: 0, 1, 3, 6, 10, 15, 0, 1, 3 etc. Call the outputs $c_{3:0}$.

2. (20 pts.) Give a schematic for a Moore recognizer that recognizes an input sequence that has three or more consecutive 1s or three or more consecutive 0s. The recognizer has a single input, x, and a single output, y, that it sets and holds at 1 once either streak has been seen. The output is reset to 0 only on machine reset. Give a schematic for your design.

3. (20 pts.) Design a machine that implements a Mealy serial 2's complement negator. The machine takes in serial 4-bit values x_0, x_1, x_2, x_3 and produces serial four bit outputs y_0, y_1, y_2, y_3 such that $y_{3:0} = -x_{3:0}$. Assume that a new four bit value begins every four cycles after reset, and there is no need to detect overflow. Call the input bit x and the output bit y and provide a complete design (i.e., state encoding and expressions for combinational logic). No need to draw the schematic.

4. (20 pts.) Give a state transition diagram for a Mealy machine with a single input, a, and a single output, b. The input bitstream is a series of serial two-bit values. For example the values x, y, and z would appear to the machine as a $a = x_1, x_0, y_1, y_0, z_1, z_0$. After each two-bit value, the machine should indicate when the most recent value was larger than the previous value by setting $b = 1$. For the first value arriving after reset, when there was no previous value, the machine should set $b = 0$.

5. (20 pts.) Reverse engineer the state transition diagram for the FSM below.



Note that this machine uses T flip flops, or "toggle" flip flops, whose behavior is as follows.

T	Q^+
0	Q
1	$\overline{Q}$