CDA 3201 Homework 4
Chapter 7: Finite State Machines

Due to: Tuesday 07/15/2014

Turn in as hardcopy format in class

10 bonus points for typed homework

1) (10 pts) **Design a 4-bit mod-10 up-counter that counts in the following sequence:**
0000, 0001, 0010, 0011, 0100, 0101, 0110, 0111, 1000, 1001, 0000…(wraps around)

a) Draw the **Moore** state diagram and next-state table

b) Implement the counter using T flip-flops (derive the simplified next-state equations)

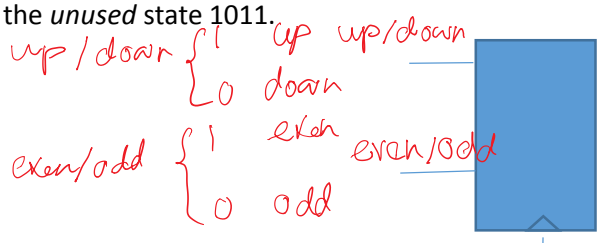
c) Is this a self-starting counter or a non-self-starting counter? Justify your answer.

d) Draw another state diagram for this circuit which starts in the *unused* state 1011.

2) (10 pts) Implement a base 13 up-counter using 74163

3) (10 pts) Implement a base 26 up-counter using only one 74163

4) (20 pts) Implement a 5-bit up/down, even/odd counter



odd sequence: 1, 3, 5, 7, ...

even sequence: 0, 2, 4, 6, 8, ...

5) (10 pts) **Given the following specifications of a Moore machine with inputs X_1 and X_2 and output Z, provide the state diagram:**

- The input sequence X_1X_2 == 01, 11 causes the output z to become 0
- The input sequence X_1X_2 == 10, 11 causes the output z to become 1
- The input sequence X_1X_2 == 10, 01 causes the output z to toggle

6) (10 pts) **Given the following specifications of a sequential circuit with one input X and one output Z, provide the Mealy state diagram for each of the following cases (3 diagrams total):**

- Output z toggles if the total number of ones is odd.
- Output z = 1 if and only if the total number of 1's is divisible by 2 (ex: 0, 2, 4 ….)
- Output z = 1 if the total number of 0's is divisible by 3 (ex: 0, 3, 6 ….)

7) (10 pts) **A finite state machine has one input and one output. The output becomes 1 and remains one after at least three logic '0's and at least one logic '1' has occurred as input. Order does not matter. Implement this as a Moore machine. Provide the following:**

- Moore state diagram
- State transition table

8) (20 pts) **Design a controller for a newspaper vending machine to the following specification. The newspaper costs 25 cents. The vending machine accepts nickels, dimes, and quarters. The customer will press a START button and begin inserting coins (assume after each coin is inserted, your FSM will move to the next state). If exact change is entered, a control signal (UNLATCH) is asserted and the machine is unlocked - the customer can take a newspaper. After this, a control signal (REL) will be asserted indicating the money should be deposited in the main repository. If the customer overpays for the paper, the deposited coins are refunded to the customer by asserting a (REF) signal (assume once the coins are inserted, they are held in a separate location and do not have to be released individually). Provide the following:**

- **Mealy** state diagram
- State transition table