ECE 153a/253  
Homework 2

Due: Wed Oct. 20, 2010

Problems:

1. Consider the following FSM
States: a, b, c, d, e
Transitions:
0, a-> b, 1
1, a-> c, 0
0, b-> b, 0
1, b-> d, 0
0, c-> a, 0
1, c-> c, 0
0, d-> c, 1
1, d-> e, 0
0, e-> a, 0
1, e-> c, 0

Is this a minimal machine? If not, show a smaller equivalent machine.

2. A common method to keep track of spinning shaft is a quadrature encoder. Such an encoder has 2 sensors looking at 4 quadrants of the wheel. Numbering the quadrants clockwise, the encodings are: 1: a=0 b=0; 2: a=0 b=1; 3: a=1 b=1; 4: a=1 b=0 for the two sensors a and b. Turning clockwise, quadrants appear in counting order, with 1 following 4.

Imagine that you need to make a counter that keeps a running total of the number of turns of the wheel -- clockwise increments the counter while counter clockwise decrements it. The counter is an external device, you must only supply the two signals: u for up or increment and d for down or decrement and you need to count exactly once for each rotation of the wheel. Design a FSM with inputs a and b and outputs u and d that implement this function. Draw a bubble chart for your design.

3. Consider a coin acceptor machine that takes 5c, 10c, 25c coins. You need to accept coins in any order, and need to output a ‘paid’ signal when you have received 35c and returned any change. You can only release one coin at a time in returning change. Draw a bubble chart for this machine. Hint: you can change state on detection of events and the change device takes the returned value and an input and it returns a ‘done’ signal when it has dispensed a coin. The done signal can be used to signal transitions of your machine.