Homework #6, due Tuesday Feb 29

1. Page 556, problem 8. Use the same clock and displays as problem 7, page 556. Assume you have available any number of standard 4-bit counters with a reset input and divide-by-10 output, and any number of 7-segment decoders and displays. (Don't design these; just use them as "black boxes.")
   (Don't forget about button debouncing and pulse syncronization from a few weeks ago.) Design the single-button functions in two ways:

   (a) Design the button states as a state machine using D-type flip-flops.

   (b) Use a counter as the state machine. (Don't design the counter; just use one of the 4-bit counters above.)

2. Desgin a synchronous "modulo 5" (*i.e.* $\div 5$) counter which can be switched between up counting and down counting using an input bit. Include a state diagram. Determine an expression for the combinational logic. Show how to implement using D-type flip-flops, but don't bother drawing the combinational logic — draw it as a "black box."

3. Design a control circuit for a vending machine. The product costs 15 cents ($0.15). Either dimes ($0.10) or nickels ($0.05) may be input. Design the control circuit as a state machine. Each valid input coin represents a "clock" cycle. An input bit C determines whether the coin was a nickel ($C = 0$) or a dime ($C = 1$). When 15 cents has been input, your circuit should set an output bit V `HIGH`, which vends the product and collects the coins. A 2nd output bit R refunds all input coins. So $R = 1$ for the following two sequences: dime-dime or nickel-nickel-dime

   Make a state diagram and implement the state machine using D-type flip-flops and standard logic gates. Minimize the logic. Draw your completed circuit.