Homework six
EECS 203
Due 23 May
Prepared by Robert Dick. Some zero-point problems prepared by previous teaching assistants.

"Mano" is M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals*. Prentice-Hall, NJ, fourth ed., 2008.

Please note that the assigned homework may not be enough for some people. If the concepts are still a little fuzzy after doing the homework, please take advantage of the other problems in Mano and/or see me for more problems.

When you can verify an answer, do so.

Show your work.

1. **(0 pts.)** Review Mano Section 6.6 and do problem 6.31.
2. **(0 pts.)** Mano 7.4, 7.17, and 7.23.
3. **(10 pts.)** For the RSE architecture we started discussing in class, show reasonable encodings for each of the eight instructions. For example, the add instruction might have the following encoding:

instruction	0–2	3–5	6–8	9–11	12–15
add	000	R_D	R_{S1}	R_{S2}	XXXX

4. **(5 pts.)** Write RSE assembly code to multiply the contents of register A by three.
5. **(10 pts.)** Write RSE assembly code to write a value $K \cdots K+n$, into a given memory range, $M \cdots M+n$. For example, if $K = 5$, $M = 24$, and $n = 2$, then $[24] = 5, [25] = 6$, and $[26] = 7$. K is initially in register A, M is initially in register B, and n is initially in register C. Assume your first instruction sits at memory location 2. For each instruction, supply a short comment (perhaps something as simple as "$K = K+1$") explaining the purpose of the instruction. Remember that you have *five* general-purpose registers.
6. **(5 pts.)** How many bits must RSE's PC register have? Justify your answer in two or fewer sentences.
7. **(5 pts.)** If you were permitted to make one or two simple changes to the RSE architecture, what would they be?
8. **(0 pts.)** A state machine is implemented with 3 flip-flops, and has a clock input, 4 data input wires and five output wires. The *FSM* could be implemented as either a Moore or a Mealy machine. Note: each question below, the answer is one of the set 0, 1, 8, 32
   (a) The maximum possible number of states in the machine is:
   (b) The minimum number of transition arrows starting at a given state is:
   (c) The minimum number of transition arrows terminating at a given state:
   (d) The number of unique patterns displayed at the output wires for a Moore machine is:
   (e) The number of unique patterns displayed at the output wires for a Mealy machine is:
9. **(0 pts.)** Consider the state diagram in Figure 1.

   This state machine has one input, J, and two outputs K and L.
   (a) Is this a Mealy or a Moore machine?
   (b) How many flip-flops are needed to implement this state machine?

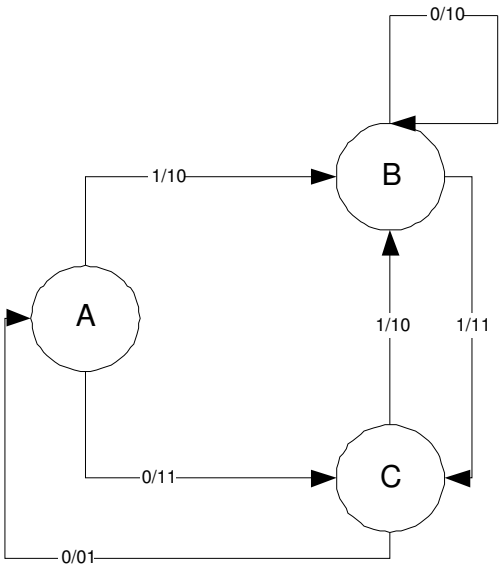

Figure 1: State diagram

(c) Draw the state table

(d) Complete the waveforms in Figure 2, for this state machine, assuming the the state assignments are A (00), B (01), C (10).

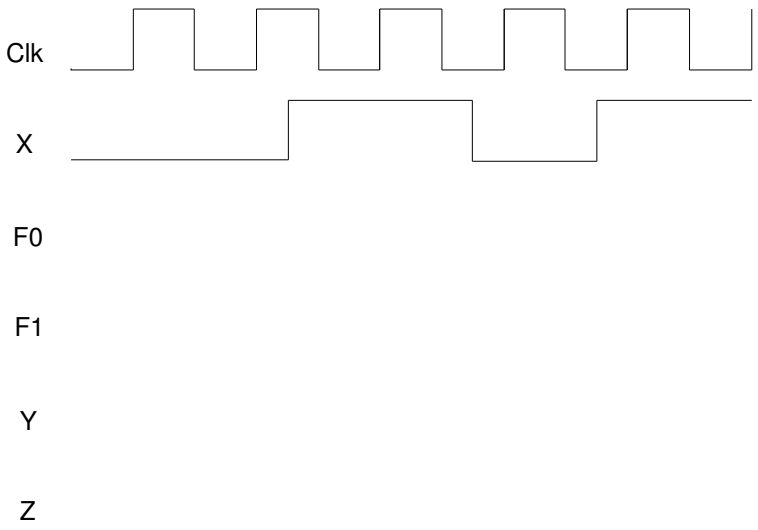

Figure 2: Timing diagram