ECE 662
Homework #1

Problems:

1. For the simple computer developed in class, consider the following program starting in memory location 0:

   0000000000001101
   0010000000000011
   0001000000000100
   0010000000000010

   Write the state numbers for the first 25 microinstructions executed.

2. For the simple computer developed in class, the register transfers for 3 basic instructions were given. Suppose the memory is increased to 64K words so that 16 address bits are needed. Instructions are now 2 words long each. The first word is the opcode and the second is the address. For each case below, show the state number, register transfer, and the next state. (The control lines activated need not be shown.) Remember that only one word can be read from memory at a time.

   (a) Write the microinstructions for the fetch phase.

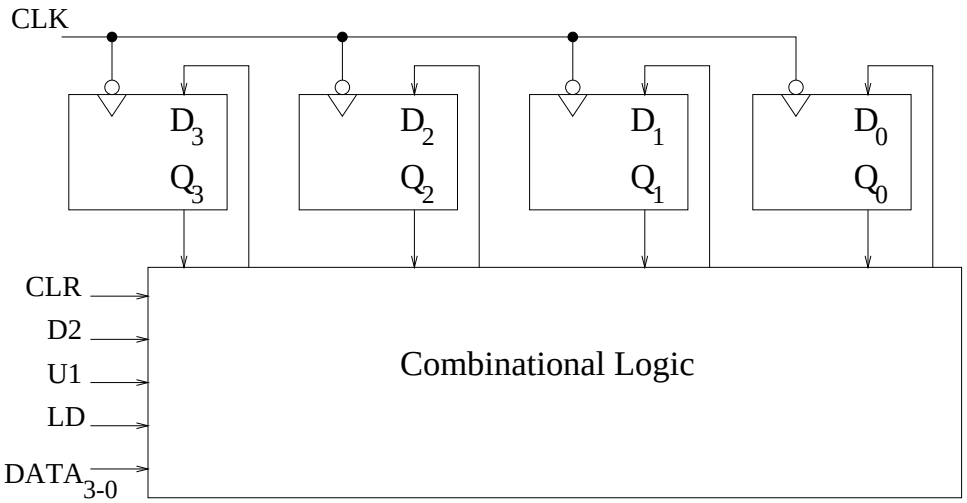
   (b) Write the microinstructions for the execution phase for the `ADD` instruction with direct addressing. Example: the two word instruction 0,40 causes: $AC \leftarrow [AC] + [40]$.

   (c) Write the microinstructions for the execution phase for the `ADD` instruction with indirect addressing. Example: the two word instruction 1,40 causes: $AC \leftarrow [AC] + [[40]]$.

   (d) Write the microinstructions for the execution phase for the `JMP` instruction. Example: the two word instruction 2,40 causes: $PC \leftarrow 40$.

3. Design a 4-bit register with the following control lines: CLR (clear), D2 (count down by two), U1 (count up by one), and LD (load DATA_{3-0}). Assume that only one control line is activated at a time. If no control line is activated, the register holds the old value. Make the design fully synchronous (no clock gating).

   Problem: Give the equations for the combinational logic below ($D_3 =$, etc.). You need not draw the circuit.



4. Repeat Problem 3 using T flip-flops.