Homework Set No. 2

1. Read the handout on microprogram control by J. Pugsley and specify the microoperations and register transfer sequences for executing the following machine instructions in a five column table similar to the four column tables shown in the handout. In addition the four columns labeled “Address, Microoperations, Control signals, and Next address,” include a fifth “comment” column on the left to indicate where each instruction’s execution sequence begins. Then fill in the fetch cycle given in the notes as well as each of your execution sequences in the attached control ROM diagram by placing filled circles on the word-line/bit-line cross points where ones must be stored in the ROM.

   a. OP CODE 10₈: COMP, “Complement (AC)”; replaces AC contents with the 1’s complement of the AC contents before execution.

   b. OP CODE 11₈: PUSH, Pushes the content of the AC onto the stack in RAM (memory) using the RT register as a stack pointer that points to the current top of stack location in RAM. Let the assembly language programmer worry about stack limits and the overflow of stack and assume that the stack pointer increments on a push.

   c. OP CODE 12₈: POP, Pops the current top of stack item in RAM into the AC register and adjusts (decrements) the RT (stack pointer) register. (The opposite of push.)

   d. OP CODE 13₈: ARS n, Right shift the algebraic (also called arithmetic right shift) the contents of the AC by n positions where shift count n is specified in the IR adr field of the instruction. (You may use MDR and IR as scratch registers, but only the AC register is seen by the programmer to change.) Provides right shift with sign preservation of data in the AC.

   e. OP CODE 14₈ CRS n, Right shift circular the contents of the AC by n positions where shift count n is specified in the IR adr field of the instruction. (You may use MDR and IR as scratch registers, but only the AC register is seen by the programmer to change.)

Read Chapt. 4 along with its Appendix 4A in Stallings, 7th ed, and work the following textbook problems from Chapter 4:

2. Problem 4-1.
3. Problem 4-2.
4. Problem 4-9.
5. Problem 4-13.
6. Problem 4-20.
7. Problem 4-21.