16.317: Microprocessor Systems Design I

Spring 2012

Homework 4
Due Friday, 5/4/12

Note: *Since we do not have a lecture on the due date, you may turn in your homework in the lab from 8-10 AM that day, to my office before 1 PM, or via e-mail directly to me.*

1. ***(30 points)*** Show the values of all changed registers (SFRs or GPRs) for each of the PIC 16F684 instruction sequences below.

a.
```
cblock  0x20
    A
    B
endc

clrf    A
movlw   0x11
movwf   B
addlw   0x34
subwf   A, F
comf    A, W
swapf   A, F
```

b.
```
cblock 0x40
    var1
endc

movlw   0x1E
movwf   var1
rrf     var1, F
xorwf   var1, W
btfss   var1, 4
iorlw   0x06
andwf   var1, F
bcf     var1, 0
```

2. ***(40 points)*** For each of the following 80386 instructions, write a sequence of PIC 16F684 instructions that performs an equivalent operation.

   Assume that variables are defined for all 8-bit 80386 registers so that you can use the same register names (for example, part (a) should use variables "AL" and "BL"). If an operation uses a 16-bit register (e.g., AX), remember that you can address each byte within that 16-bit register (e.g. AH and AL).

   Also, note that shift or rotate operations should not be done by simply writing copies of the PIC rotate instructions—for example, the solution to part (g) shouldn't just be 5 copies of the "rlf" instruction. Use the shift amount provided as a literal value that will help determine the number of times you shift or rotate.

a. MOV AL, BL
b. INC AX
c. AND AX, BX
d. ADD AX, BX
e. SHL AL, 4
f. SAR AL, 3
g. RCL AL, 5
h. ROR AL, 2
i. JNC Label
j. JL Label

3. ***(30 points)*** Write a short PIC program to solve each of the following problems.

a. Given a series of four LEDs (LED0-LED3) connected to bits 0-3 of Port A (which must be configured as outputs), write a program to turn on those LEDs using the sequence below. Assume that:

- The upper four bits of Port A must remain unchanged throughout the program.
- Writing a value of 1 to the appropriate bit will turn the corresponding LED on.
- One step should be executed every 10 ms.
- The sequence returns to Step 1 after Step 6.
- If the program reaches an error state (i.e., an invalid combination of LEDs are on), it should return to Step 1.

Step 1: Only LED0 on

Step 2: LED1 and LED2 both on

Step 3: Only LED3 on

Step 4: LED0 and LED1 both on

Step 5: LED1 and LED3 both on

Step 6: LED0 and LED2 both on

b. Configure Port A so that all bits are outputs, and configure Port C so that all bits are inputs. Repeatedly read a byte from Port C, doing the following operations based on the input values:

- If bit 0 is set, increment the working register.
- If bit 0 is clear and bit 1 is set, decrement the working register.
- If bits 0-1 are clear and bit 2 is set, clear the working register.
- If bits 0-2 are clear and bit 3 is set, output the current value of the working register to Port A.
- If bits 0-3 are clear and bit 4 is set, end the program.