16.317: Microprocessor Systems Design I

Spring 2015

Lecture 24: Key Questions
April 3, 2015

1. Describe how to work with multi-byte data.

2. Translate these x86 operations to PIC code. Assume that there are registers defined for each x86 register (e.g. AL, AH, BL, BH, etc.). 16-bit values (e.g., AX) must be dealt with as individual bytes

- MOVZX AX, BL

- MOVSX AX, BL

- INC AX

- SUB BX, AX

- RCL AX, 5

3. Describe the operation of the given subroutine, which implements a 10 ms delay loop.

```
;*************************************************************************
; TenMs subroutine and its call inserts a delay of exactly ten milliseconds
; into the execution of code.
; It assumes a 4 MHz crystal clock. One instruction cycle = 4 * Tosc.
; TenMsH      equ  13         ; Initial value of TenMs Subroutine's counter
; TenMsL      equ  250
; COUNTH and COUNTL are two variables
TenMs
        nop                         ; one cycle
        movlw       TenMsH          ; Initialize COUNT
        movwf       COUNTH
        movlw       TenMsL
        movwf       COUNTL
Ten_1
        decfsz      COUNTL,F        ; Inner loop
        goto        Ten_1
        decfsz      COUNTH,F        ; Outer loop
        goto        Ten_1
        return
```

4. Describe the operation of the given subroutine, which toggles a series of 3 LEDs in sequence, assuming those LEDs are attached to bits 0-2 of Port D.

```
BlinkTable
        movf    PORTD, W          ; Copy present state of LEDs into W
        andlw   B'00000111'       ; and keep only LED bits
        addwf   PCL,F             ; Change PC with PCLATH and offset in W
        retlw   B'00000001'       ; (000 -> 001) reinitialize to green
        retlw   B'00000011'       ; (001 -> 010) green to yellow
        retlw   B'00000110'       ; (010 -> 100) yellow to red
        retlw   B'00000010'       ; (011 -> 001) reinitialize to green
        retlw   B'00000101'       ; (100 -> 001) red to green
        retlw   B'00000100'       ; (101 -> 001) reinitialize to green
        retlw   B'00000111'       ; (110 -> 001) reinitialize to green
        retlw   B'00000110'       ; (111 -> 001) reinitialize to green
```

In calling program

```
        call    BlinkTable  ; get bits to change into W
        xorwf   PORTD, F    ; toggle them  into PORTD
```