16.317: Microprocessor Systems Design I

Fall 2015

Lecture 28: Key Questions
November 13, 2015

1. Describe the assembler directives that can be used in the MPLAB IDE.

2. Explain the operation of the following assembly program, which lights a single LED:

```
Start:
    banksel        TRISC     ;select bank1
    bcf            TRISC,0   ;make C0 an output
    banksel        LATC      ;select bank2
    clrf           LATC      ;initialize the
                             ; LATCH by
                             ; turning off
                             ; everything
    bsf            LATC,0    ;turn on LED C0 (DS1)
    goto           $         ;sit here forever!

    end
```

3. Explain the equivalent program in C, shown below:

```
void main(void) {
    TRISCbits.TRISC0 = 0;      // Pin 0 = output
    LATC = 0; //clear all pins to 0
    LATCbits.LATC0 = 1; // turn ON LED
    while(1) continue;
}
```

4. Describe how to compile and run code in MPLAB. Explain the differences between running
   code in the simulator and on the development board. Also, discuss how to use the in-circuit
   debugger to access code on the chip as it runs.

5. Describe the following assembly program, which blinks a single LED:

```
cblock 0x70     ;shared memory accessible from all banks
Delay1          ;Two registers for delay loop in shared mem
Delay2
    endc

    ORG 0
Start:
    banksel         OSCCON          ;bank1
    movlw           b'00111000'     ;set cpu speed of 500KHz
    movwf           OSCCON          ;OSCCON configures
                                    ;  internal clock
    bcf             TRISC,0         ;Pin C0 = output for DS1
    banksel         LATC            ;bank2
    clrf            LATC            ;Turn off all of the LEDs
MainLoop:
    bsf             LATC, 0         ;turn on DS1

OndelayLoop:
    decfsz          Delay1,f        ;Waste time.
    bra             OndelayLoop     ;Inner loop takes 3 inst
                            ; per loop * 256 loops =
                                    ; 768 instructions
    decfsz          Delay2,f        ;The outer loop takes an
                                    ; additional 3
                                    ; instructions per loop
                                    ; * 256 loops
    bra             OndelayLoop     ;(768+3) * 256 = 197376
                                    ; instructions /
                                    ; 125K instructions per
                                    ; second = 1.579 sec
    bcf             LATC,0          ;Turn off LED C0
OffDelayLoop:
    decfsz          Delay1,f  ;same delay as above
    bra             OffDelayLoop
    decfsz          Delay2,f
    bra             OffDelayLoop
    bra             MainLoop        ;Do it again...
    end
```

6. Describe the equivalent program in C, shown below:

```c
void main(void) {
    unsigned int delay;  // 16 bit variable

    OSCCON = 0b00111000; //500KHz clock speed
    TRISCbits.TRISC0 = 0;      //using pin as output
    delay = 11250;
    while (1) {
     //each instruction is 8us  (1/(500KHz/4))
     while(delay-- != 0)continue;

     LATCbits.LATC0 ^= 1;       //toggle LED
     delay = 11250;      //reset delay counter
    }
}
```