# ECE 376 - Homework #4

C Programming & LCD Displays - Due Monday, September 30th

1) Determine how many clocks the following C code takes to execute

- Compile and download the code (modify working code and replace the main loop)
- Measure the frequency you see on RC0 (toggles every loop).
  - Use an osiclloscope - or -
  - Connect a speaker to RC0 with a 200 Ohm resistor and measure the frequency with a cell phone app like Piano Tuner
  - RC1 is 1/2 the frequency of RC0, RC2 is 1/4th, RC3 = 1/8th, etc
- The number of clocks it takes to execute each loop is

$$N = \left( \frac{10{,}000{,}000}{2 \cdot Hz} \right)$$

1a) Counting mod 32

```
unsigned char i
while(1) {
      i = (i + 1) % 32;
      if(i == 0) PORTC += 1;
      }
```

1b) Counting mod 35

```
unsigned char i
while(1) {
      i = (i + 1)% 35;
      if(i == 0) PORTC += 1;
      }
```

1c) Long Integer Division

```
unsigned long int A, B, C;
A = 123456789;
B = 2731;
while(1) {
    i = (i + 1)% 32;
    if(i == 0) PORTC += 1;
    C = A / B;
    }
```

1d) Floating Point Division

```
float A, B, C;
A = sqrt(3);
B = sqrt(2);
while(1) {
    PORTC += 1;
    C = A / B;
    }
```

### Lights-Out Game in C

2) Write a C program which allows you to play the lights-out game from HW #3

- On power up, PORTC = 0xFF and PORTD = 0x00
- When you press and release a button, the corresponding pin on PORTC and its neighbors are toggeled
  - RB0: Toggle pins RC0, RC1
  - RB1: Toggle pins RC0, RC1, RC2
  - etc.
- Each time you press and release a button, PORTD increments by one

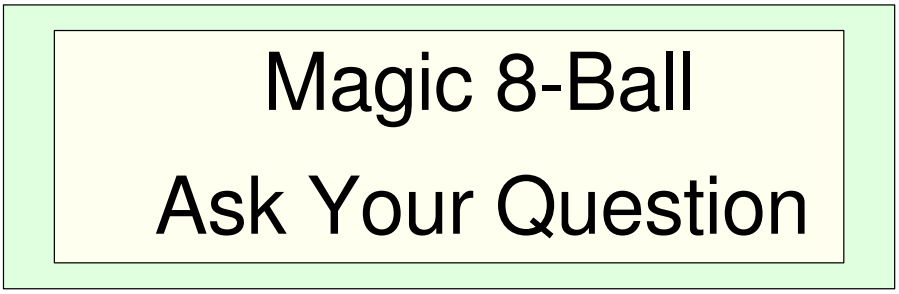
3) Verify your program runs on your PIC board

- Include the size of the compiled C code
- Check the timing by observation (an oscilloscope would be better...)

### LCD Display & Magic 8-Ball!

Problem 4-8) Turn your PIC board into a Magic 8-Ball:

- On power up, the Magic 8-Ball prompts you to ask a question
- You then ask your PIC board a question
- Shake the Magic 8-Ball three times (press RB0 three times)
- The answer to your question is then displayed on the LCD with one of 12 random fortunes:
  - It is certain, It is decidedly so, Without a doubt, Yes definately
  - Reply hazy try again, Ask again later, Better not tell you now, Cannot predict now
  - Dont count on it, My reply is no, Outlook not so good, Very doubtful
- Five seconds after your fortune is revealed, the



**Problem 4) Display Routine**

Write a subroutine in C which

- Is passed a number from 0..11
- Displays one of twelve messages based upon the number passed

Check your subroutine

**Problem 5) Random Number Generator.**

Program your PIC board to generate a random number in the range of 0..11 every time you press and release RB0.

- Display this number on the LCD and on PORTC

Generate 5+ random numbers and check your random number generator works.

**Problem 6) Count to Three**

Modify this code so that every third time you press and release RB0

- You generate a random number from 0..11
- A fortune is revealed based upon the random number

**Problem 7) Five Second Delay**

Modify the code so that after you press RB0 three times

- The program pauses for 5.0 seconds, then
- Starts over, prompting you to ask a question

**Problem 8) Demo** (20 pt)

Demonstrate your Magic 8-Ball