# ECE 376 - Homework \#6 <br> A/D Converters, Data Collection, Chi-squared Test, Student t-Test. <br> Due Monday, October 10th 

## Analog Inputs

1) Determine how long it takes to do an A/D conversion with a PIC processor
```
void main(void)
{
    TRISC = 0;
    ADCON1 = 0x0F;
// Turn on the A/D input
    TRISA = 0xFF;
    TRISE = 0x0F;
    ADCON2 = 0x95;
    ADCON1 = 0x07;
    ADCONO = 0x01;
    while(1) {
        A2D = A2D_Read(0);
        PORTC = PORTC + 1;
        }
    }
```

2) Assume the $A / D$ reads 371 for the following circuit.

- What is the voltage, Vx ?
- What is the resitance, Rt?
- What is the temperature?

Assume

$$
R_{t}=1000 \cdot \exp \left(\frac{3905}{T+273}-\frac{3905}{298}\right) \Omega
$$



## Analog Inputs

3-5) Design an embedded system which uses the analog input on RA0 (as you adjust the potentiometer on your board, the A/D goes from $0(0 \mathrm{~V})$ to $1023(5 \mathrm{~V})$. Some suggestions are

- Electronic Trombone: Play $400 \mathrm{~Hz}(\mathrm{~A} / \mathrm{D}=0)$ to $800 \mathrm{~Hz}(\mathrm{~A} / \mathrm{D}=1023)$ when you press RB0
- Electronic Die: Roll an N sided die each time you press and release RB0. N varies from 2-sided $(\mathrm{A} / \mathrm{D}=0)$ to $20 \operatorname{sided}(\mathrm{~A} / \mathrm{D}=1023)$
- Stepper-Motor Thermometer: Read the temperature with the A/D input. Indicate the temperatuer with the stepper motor ( 0 steps $=0$ degrees, 100 steps $=100$ degrees )
- Other

3) Requirements. Specify

- The inputs (includng at least one analog input)
- The outputs, and
- How they relate (i.e. what it does)

4) C-code and flow chart
5) Testing and validation

- Collect data to verify that you meet the requirements.


## Chi-Squared Test

6) Determine experimentaly using a chi-squared test whether or not the following C code produces a fair 6-sided die:
```
while(1) {
    while(!RB0);
    while(RBO) DIE = (DIE + 1) % 6;
    DIE += 1;
    LCD_Move(1,0); LCD_Out(DIE, 1, 0);
    SCI_Out(DIE, 1, 0);
    SCI_CRLF();
    }
```

7) Determine experimentaly using a chi-squared test whether or not the following $C$ code produces a fair 6-sided die:
```
while(1) {
    while(!RB0);
    while(RBO) {
        DIE = (DIE + 1) % 6;
        X = (X + 1) % 101;
        }
    DIE = DIE + 1;
    if(X < 10) DIE = 6;
    LCD_Move(1,0); LCD_Out(DIE, 1, 0);
    SCI_Out(DIE, 1, 0);
    SCI_CRLF();
    }
```

8) (over)

## Am I Psychic?

8) Determine whether or not you're psychic:

- Guess which number you're going to roll with the fair 6-sided die.
- Roll the dice a bunch of times and count how many times you're right ( $\mathrm{N}>10$ )

Use a chi-squared test to determine whether or not you're guessing ( correct $1 / 6$ th of the time )

## Full Code for Problem \#6

```
// Global Variables
const unsigned char MSGO[21] = "Electronic Dice ";
// Subroutines
#include <pic18.h>
#include "lcd_portd.c"
// Main Routine
void main(void)
{
    unsigned int i, DIE, X;
    TRISA = 0;
    TRISB = 0xFF;
    TRISC = 0;
    TRISD = 0;
    TRISE = 0;
    ADCON1 = 0x0F;
    LCD_Init();
    LCD_Move(0,0); for (i=0; i<20; i++) LCD_Write(MSGO[i]);
    Wait_ms(500);
// Initialize Serial Port to 9600 baud
    TRISC = TRISC | 0xC0;
    TXIE = 0;
    RCIE = 0;
    BRGH = 0;
    BRG16 = 1;
    SYNC = 0;
    SPBRG = 255;
    TXSTA = 0x22;
    RCSTA = 0x90;
    while(1) {
        while(!RB0);
        while(RBO) DIE = (DIE + 1) % 6;
        DIE += 1;
        LCD_Move(1,0); LCD_Out(DIE, 1, 0);
        SCI_Out(DIE, 1, 0);
        SCI_CRLF();
        }
    }
```

