ECE 376 - Test #2: Name _____
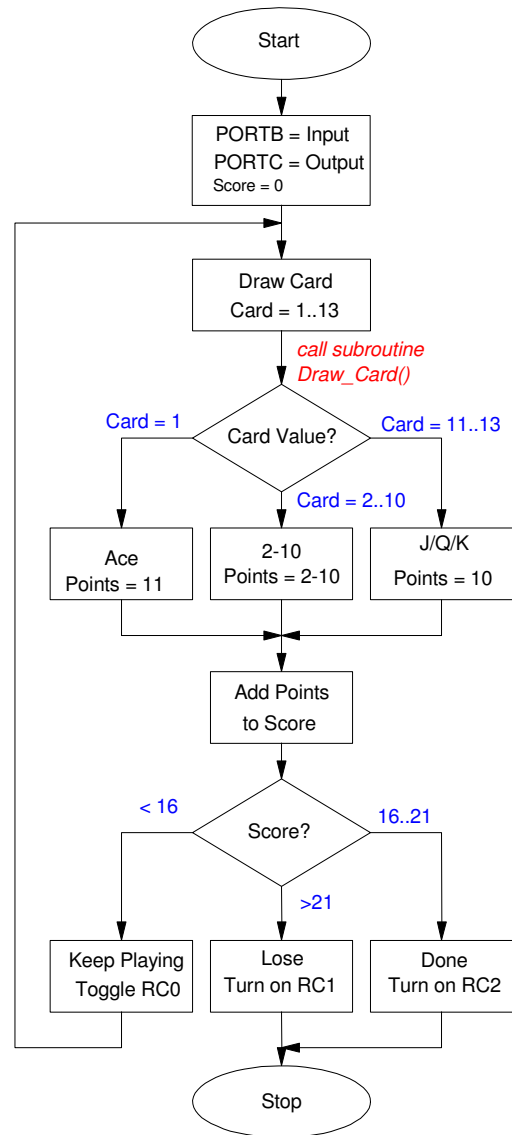
C-Programming on a PIC Processor

1) C Coding & Flow Charts (25 points)

Write the corresponding C code for the flow chart shown to play a limited version of Black Jack

- Start with zero points
- Draw a card (aces are always 11 points)
- Compute your score
- Keep playing until you have 16 or more points
- If you go over 21 points, you lose

assume a subroutine exists that returns a number 1..13 when called (different problem on this test)

```
void main(void) {

   ADCON1 = 0x0F;
```


Start

PORTB = Input
PORTC = Output
Score = 0

Draw Card
Card = 1..13

call subroutine Draw_Card()

Card Value?

Card = 1   Card = 2..10   Card = 11..13

Ace   2-10   J/Q/K
Points = 11   Points = 2-10   Points = 10

Add Points
to Score

Score?

< 16   >21   16..21

Keep Playing   Lose   Done
Toggle RC0   Turn on RC1   Turn on RC2

Stop

2) Subroutines: (25 points)

Write a subroutine

- Which is passed an integer, N
- The subroutine waits until you press and release button RB0
- When released, a random number (X) is returned in the range of 1 .. N

```
unsigned int Draw_Card(unsigned int N)
{
    unsigned int X;
    :
    :
    return(X);
    }
```

3) Analog Inputs (25 points)

Assume the A/D input to a PIC processor has the following hardware connection where R is a 3k thermistor where T is the temperature in degrees C

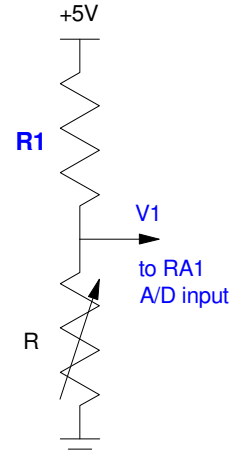$$R = 2200 \cdot \exp\left(\frac{3800}{T+273} - \frac{3800}{298}\right)\Omega$$

+5V

R1

V1

to RA1
A/D input

R

Let the R1 be your birthday

    R1 = 900 + 100*month + day
    May 15th would give R1 = 1415 Ohms

If the A/D reads 872, determine

- The temperature in degrees C,
- The resistance, R,
- The voltage, V1, and
- The smallest change in termperature you can detect

R1 900 + 100*mo + day	T (degees C)	R Thermistor - Ohms	V1 Volts	A/D Reading
				872

4) chi-squared test (10 points)

The high and low temperature in Fargo has been recorded each day since 1900 (124 years). So far this year, Fargo has hit a record high nine times in the past 71 days.

Use a chi-squared test to determine the probability that 2024 is no different than any other year (the probability of any given day being a record high is 1/124).

note: n = 71 (first 71 days of 2024

Case	p binomial distribution	np expected results	N actual results	Chi-Squared
Record High	1/124		9	
Normal Year	123/124		62	
			Total	

Chi-Squared Table

Probability of rejecting the null hypothesis

dof	99%	95%	90%	80%	60%	40%	20%	10%	5%	1%
1	6.64	3.84	2.71	1.65	0.71	0.28	0.06	0.02	0	0
2	9.21	5.99	4.61	3.22	1.83	1.02	0.45	0.21	0.05	0.01
3	11.35	7.82	6.25	4.64	2.95	1.87	1.01	0.58	0.22	0.07
4	13.28	9.49	7.78	5.99	4.05	2.75	1.65	1.06	0.48	0.21
5	15.09	11.07	9.24	7.29	5.13	3.66	2.34	1.61	0.83	0.41
6	16.81	12.59	10.64	8.55	6.21	4.57	3.07	2.20	1.63	0.87
7	18.47	14.06	12.02	9.80	7.28	5.49	3.82	2.83	2.17	1.24

5) t-Tests (15 points)

Hector Airport has been recording temperatures in Fargo since 1942 (82 years of data). The statistics for the high temepature for the month of February are:

- mean = 42.9183F
- st dev = 7.0888F
- n = 82 (numer of data points)

In 2024, the high for February was 61.0F

Use a student t-test to determine the probability of being warmer than 61.0F in the month of February

Student t-Table (area of tail)

df \ p	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	0.15	0.2
1	-636.619	-318.309	-63.6567	-31.8205	-12.7062	-6.3138	-3.0777	-1.9626	-1.3764
2	-31.5991	-22.3271	-9.9248	-6.9646	-4.3027	-2.92	-1.8856	-1.3862	-1.0607
10	-4.5869	-4.1437	-3.1693	-2.7638	-2.2281	-1.8125	-1.3722	-1.0931	-0.8791
20	-3.8495	-3.5518	-2.8453	-2.528	-2.086	-1.7247	-1.3253	-1.064	-0.86
30	-3.646	-3.3852	-2.75	-2.4573	-2.0423	-1.6973	-1.3104	-1.0547	-0.8538
40	-3.551	-3.3069	-2.7045	-2.4233	-2.0211	-1.6839	-1.3031	-1.05	-0.8507
50	-3.496	-3.2614	-2.6778	-2.4033	-2.0086	-1.6759	-1.2987	-1.0473	-0.8489
60	-3.4602	-3.2317	-2.6603	-2.3901	-2.0003	-1.6706	-1.2958	-1.0455	-0.8477
70	-3.435	-3.2108	-2.6479	-2.3808	-1.9944	-1.6669	-1.2938	-1.0442	-0.8468
80	-3.4163	-3.1953	-2.6387	-2.3739	-1.9901	-1.6641	-1.2922	-1.0432	-0.8461
90	-3.4019	-3.1833	-2.6316	-2.3685	-1.9867	-1.662	-1.291	-1.0424	-0.8456
100	-3.3905	-3.1737	-2.6259	-2.3642	-1.984	-1.6602	-1.2901	-1.0418	-0.8452