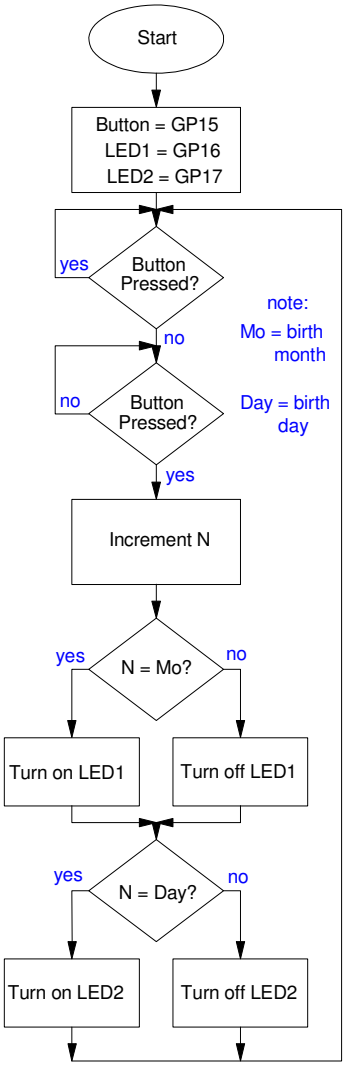
ECE 476/676 - Final Exam: Name _____

1) Python Programming - The following flow chart counts the number of times button on GP15 is pressed:

- N = the number of button presses
- When N matches your birth month (1..12), the LED on GP16 turn on
- When N matches your birth day (1..31), the LED on GP17 turn on

Write the corresponding Python code

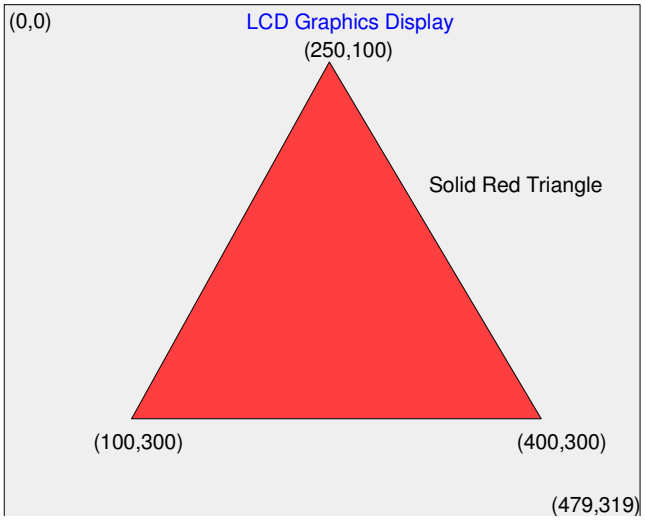


2) Python Programming - Subroutines.

Write a Python subroutine which draws a solid red triangle on the graphics display with vertices at

- (x0, y0) = (250, 100)
- (x1, y1) = (100, 300)
- (x2, y2) = (400, 300)

```
def Draw_Red_Triangle():
```



3) Sensors: The following Python program reads the temperature from a DS18B20 sensor.

Modify this code so that

- It reads the temperature every 1.00 second
- It keeps track of
  - The number of readings (n),
  - The sum of temperatures (m1), and
  - The sum of temperature squared (m2)

$$m_1 = \Sigma\,(T)$$

$$m_2 = \Sigma\,(T^2)$$

- It then computes the mean, variance, and 90 percent confidence interval

$$\text{x = mean} = \frac{1}{n} \cdot m_1$$

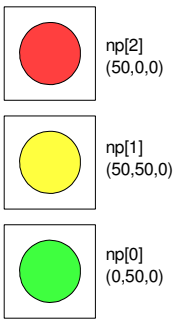
$$\text{v = variance} = \left(\frac{1}{n-1}\right)\left(m_2 - \frac{1}{n} \cdot m_1^2\right)$$

$$\text{xmax, xmin = 90\% confidence interval = mean} \pm 1.64\sqrt{\frac{\text{variance}}{n}}$$

```
import machine, onewire, ds18x20, time

ds_pin = machine.Pin(4)
ds_sensor = ds18x20.DS18X20(onewire.OneWire(ds_pin))

roms = ds_sensor.scan()

while(1):
  ds_sensor.convert_temp()
  time.sleep_ms(750)
  T = ds_sensor.read_temp(rom[0])
```

4) Interrupts & Stoplight: Write a Python program which uses interrupts to drive a stoplight.

- Edge Interrupt: Each time you press the button GP15 (falling edge interrupt), it counts mod 3.
  - Mode = 0 >> 1 >> 2 >> 3 >> repeat
- Timer Interrupt: Interrupt every 1.00 second



The variable Mode sets the operation:

- Mode = 0: set the color as green for 5 seconds, yellow for 1 second, red for 6 seconds, repeat
- Mode = 1: set the color to red
- Mode = 2: flashing red (red for 1 second, off for one second, repeat)
- Mode = 3: flashing yellow (yellow for 1 second, off for one second, repeat)

The main routine to set the stoplight to red is as follows (from test #3). The main loop does nothing (all work is done inside the interrupts)

```
from machine import Pin, bitstream

timing = [300, 900, 700, 500]
np = Pin(12, Pin.OUT)

red = bytearray([0,0,0,0,0,0,0,50,0])
yellow = bytearray([0,0,0,50,50,0,0,0,0])
green = bytearray([50,0,0,0,0,0,0,0,0])

bitstream(np, 0, timing, red)

while(1):
    pass
```