ECE 476/676 - Test #2: Name _____

Due Sunday, March 30th at midnight. Individual Effort.

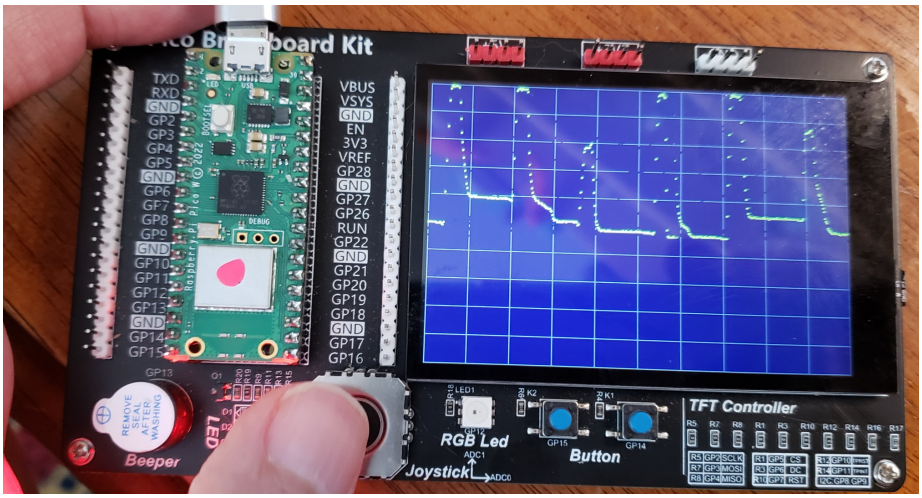
Heart Rate Sensor

Write a python program to

- Display your heart beat in real time on the LCD display,
- Detect heartbeats, and
- Beep (or blink a light) each heartbeat

Starting Code

The starting code (last page) is essentially the *oscilloscope.py* program from before. This program reads the voltage on ADC0 (the Y-axis of the joystick input) and displays the voltages read on ADC0 in real time.



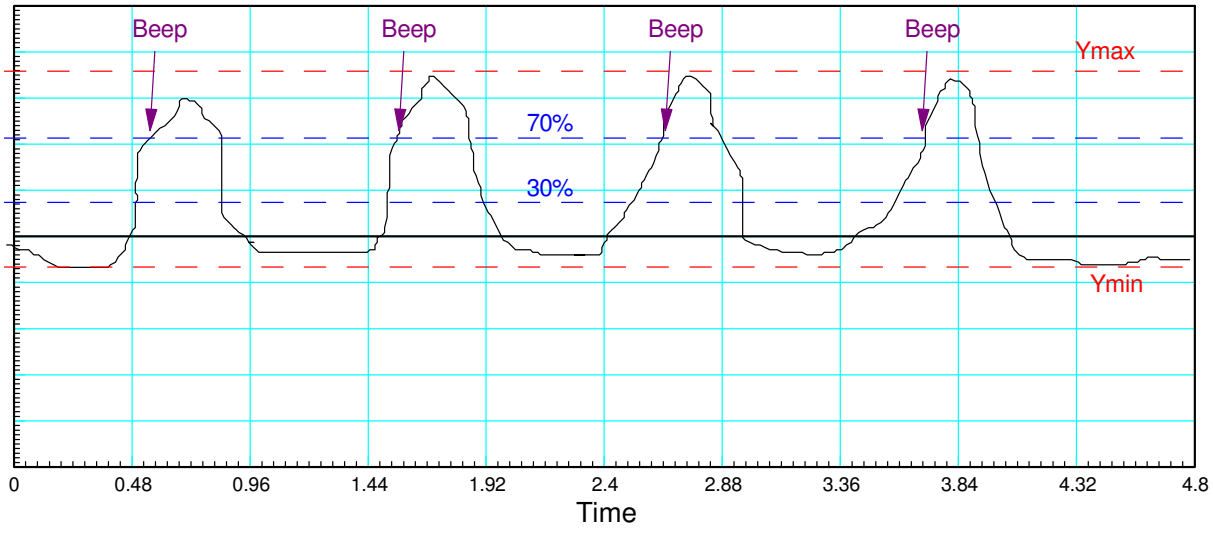
Starting Code displaying the votlage of ADC0
note: This allows you to test your code as you write it with the joystick input.
Eventually, it should read the hear pulse sensor on input ADC2

In this program, the variables are:

- Y[0]*480 — An array saving the voltages read on the A/D input relative to 1.65V (midband)
- 165 — midband (1.65V) plots as y=165
- X — Counter. X counts from 0 to 479 (4.79 seconds).
- i — Counter (equal to X). Indicates the x-coordinate on the LCD display

Grading

- (10 points) Display the voltage from a heart-rate sensor in your lab kit (read ADC2 on pin GP28)
- (10 points) Set the sampling rate to 10ms precisely using timer interrupts
- (10 points) Use edge interrupts to change the scaling of the axis by factors of 2x
  - When GP15 is pressed, the scaling on Y increases 2x (increases sensitivity)
  - When GP14 is pressed, the scaling on Y decreases 2x (decreases sensitivity)
  - Falling-edge interrupts detect the button presses)
- (10 points) Automatically detect the maximum and minimum reading of Y every pass
  - When X wraps around to 0, recompute the max and min readings of Y
- (10 points) Detect each heart beat
  - Add hysteresis to reduce noise at 30% and 70% of the range for Y
  - When Y goes above 70%, a heartbeat is detected
  - When Y goes below 30%, a new heartbeat starts
- (10 points) Using a timer interrupt beep and/or blink a light for 50ms when a heartbeat is detected
  - Interrupt so you can keep sampling every 10ms
- (10 points) Demo your heart sensor
  - In-person on with a video



One way to detect heartbeats is to add hysteresis at 30% and 70% of the range of Y
When Y goes above 70% after being below 30%, a pulse is detected

Code:

```
# Test2 Starting Code (oscilloscope code)

import LCD
from machine import ADC
from time import sleep_ms

a2d0 = machine.ADC(1)

Navy = LCD.RGB(0,0,10)
Yellow = LCD.RGB(150,150,0)
Grey = LCD.RGB(50,50,50)

LCD.Init()
LCD.Clear(Navy)
for i in range(0,11):
    LCD.Line(0, i*32, 479, i*32, Grey)
    LCD.Line(i*48, 0, i*48, 319, Grey)

npt = 480
Y = [0]*npt
k = 320 / 65535
X = i = 0

while(1):
    sleep_ms(10)

    y = a2d0.read_u16() - 0x8000
    LCD.Pixel2(X, 165-Y[i], Navy)

    Y[i] = k*y

    LCD.Pixel2(X, 165-Y[i], Yellow)
    X += 1
    i += 1
    if(X > 479):
        X = 0
        i = 0
```