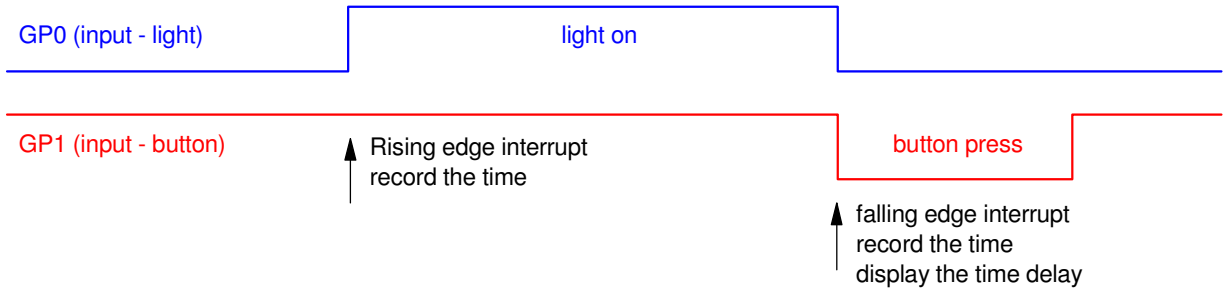
ECE 476/676 - Test #2: Name _____

1) Edge Interrupts: In order to measure your reflex time, a device turns on a light (detected on GP0) and then waits until you press a button (detected on GP1).

Write the interrupt initialization and interrupt service routine which:

- Triggers an edge interrupt on the rising edge of GP0
  - When this interrupt happens, it records the time with a resolution of 1ms
- Triggers an edge interrupt on the falling edge of GP1
  - When this interrupt happens, it records the time with a resolution of 1ms
  - It also sends the time difference to the display with a *print()* statement

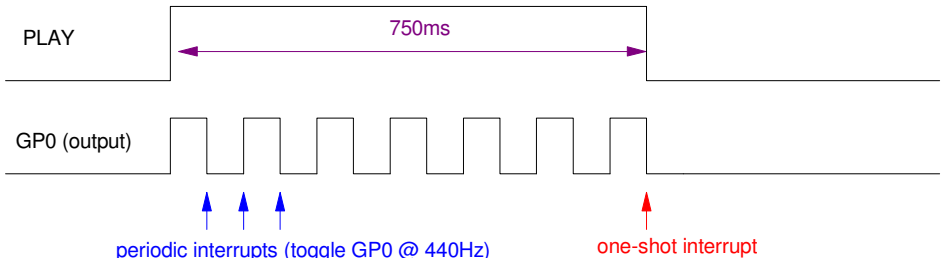


Edge Interrupt for GP0 rising edge interrupt - record the time	Edge interrupt for GP1 falling-sdge interrupt - record time & display time delay
Initialization	Initialization
Interrupt Service Routine	Interrupt Service Routine

2) Timer Interrupts: Write a python program which uses timer interrupts to

- play a 220Hz note on GP0 (toggle @ 440Hz with a periodic interrupt)
- for 750ms (one-shot interrupt turns off the sound)

Use a global variable, PLAY, to set the duration of the note



Timer Interrupt #1 periodic interrupt -toggle GP0 @ 440Hz when PLAY==1	Timer Interrupt #2 one-shot interrupt - clear PLAY (PLAY=0) after 750ms
Initialization	Initialization (plays 440Hz for 750ms one time)
Interrupt Service Routine	Interrupt Service Routine

3) Analog Sensors: Assume a temperature sensor tells you the temperature in degrees C

- variable degC, type = float

Write a Python subroutine which sets the pulse width on pin GP16 based upon the temperature:

Temperature degC	<20C	20C to 40C	>40C
Duty Cycle	0%	0% to 100% (proportional)	100%

```
def AnalogSensor_to_PWM(degC):
```

4) Annoy-A-Tron (Exponential Distribution)

Write a Python program which turns on the beeper (GP13=1) for 100ms every x seconds.

Let x be a random number from 0 to infinity with an exponential distribution which has a mean of 10 seconds

$$cdf(x) = 1 - \exp(-x/10)$$

$$x = -10 \cdot \ln(1 - p)$$ *where p is the probability in the range of (0,1)*

Generally Useful Python Routines

Binary Input (Button Pressed)

```
from machine import Pin

Button = Pin(15, Pin.IN, Pin.PULL_UP)
x = Button.value()
```

Binary Output (Blinking Light)

```
from machine import Pin

LED = Pin(16, Pin.OUT)
LED.toggle()
LED.value(1)
LED.value(0)
```

Analog Input (A2D Read)

```
from machine import ADC

a2d0 = ADC(0)
x = a2d0.real_u16()
```

Analog Output (PWM Output)

```
from machine import Pin, PWM

Aout = Pin(16, Pin.OUT)
Aout = PWM(Pin(16))
Aout.freq(1000)

# 0% duty cycle
Aout.duty_u16(0x0000)

# 100% duty cycle
Aout.duty_u16(0xFFFF)

# 50us pulse
Aout.duty_ns(50_000)
```

Measure a pulse width in milli-seconds

```
from machine import Pin, time_pulse_ms

X = Pin(19, Pin.IN, Pin.PULL_UP)
low = time_pulse_ms(19, 0, 500_000)
high = time_pulse_ms(19, 1, 500_000)
```

Pause 1.23 seconds

```
from time import sleep

sleep(1.23)
```

For Loops

```
for i in range(0,6):
    d1 = i
    for j in range(0,4):
        d2 = j
        y = d1 + d2
```

While Loops

```
t = 0
while(t < 5):
    t = t + 0.01
    print(t)
```

If - else if - else statements

```
if(x < 10):
    a = 1
elif(x < 20):
    a = 2
else:
    a = 3
```

Random Numbers

```
from random import random

p = random()
# x = 0.000 to 0.999
```

Measure time since reset

```
from time import ticks_ms

x0 = ticks_ms()
```

Interrupts

Edge Interrupt: Up Counter

```
from machine import Pin

interrupt_flag=0
N = 0

pin = Pin(15,Pin.IN,Pin.PULL_UP)
def IntServe(pin):
    global interrupt_flag
    global N
    interrupt_flag=1
    N = N + 1

pin.irq(trigger=Pin.IRQ_FALLING,
handler=IntServe)

while(1):
    if(interrupt_flag):
        print("N = ", N)
        interrupt_flag=0
```

Timer Interrupt: periodic @ 1 sec

```
from machine import Pin, Timer
from time import sleep

led = Pin(17, Pin.OUT)
tim = Timer()
N = 0

def tic(timer):
  global N
  N += 1

tim.init(freq=1, mode=Timer.PERIODIC,
callback=tic)

while(1):
  print(N)
  sleep(0.1)
```

Timer Interrupt: (one-shot – 5 sec delay)

```
from machine import Pin, Timer

tim = Timer()

pin1 = Pin(15,Pin.IN,Pin.PULL_UP)
Fan  = Pin(17,Pin.OUT)

def FanOff(pin1):
  Fan.value(0)

while(1):
  while(pin1.value() == 0):
    Fan.value(1)
  tim.init(freq=1/5, mode=Time.ONE_SHOT,
    callback=FanOff)
  while(pin1.value() == 1):
    pass
```