ECE 476/676 - Homework #6

Matrix Operations, Edge & Timer Interrupts - Due Monday, October 14th

Metronome

Build a metronome with your Pi-Pico.   Output a 10ms beep evern N ms

- On startup, N = 1000ms (60 beats per minute)
- Increase N by 1% each time you press GP15
- Decrese N by 1% each time you press GP14
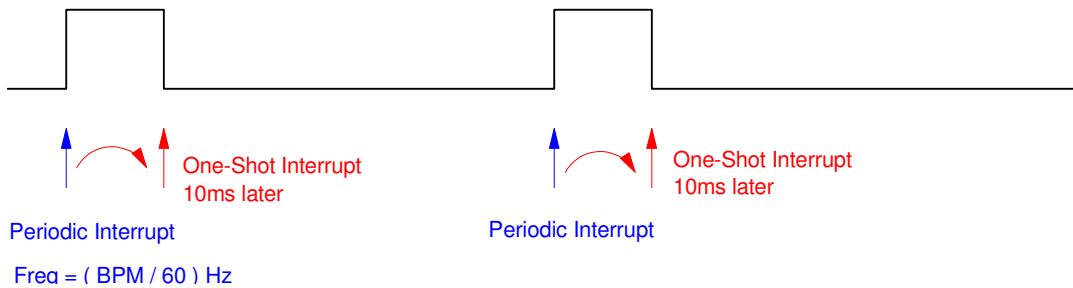- Display beets per minute on the graphics display

1) Write a Python program which outputs a 10ms pulse every 1000ms using Timer interrupts

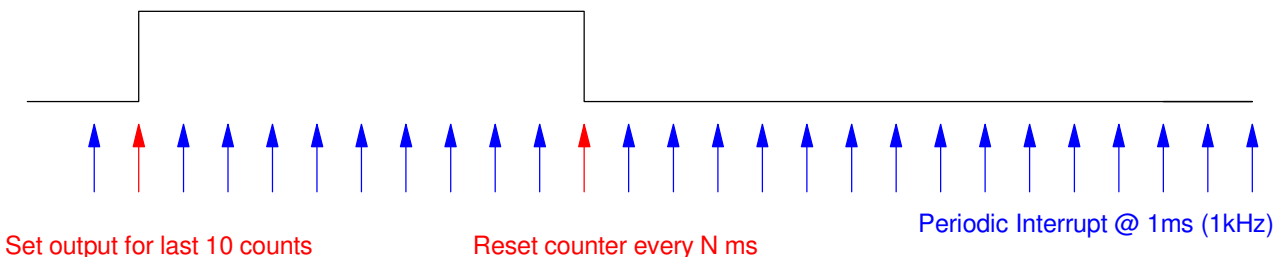Comments: There are several ways to do this problem

Option 1:

- You could set up a peroidic interrupt at 1.000Hz (60bpm) that turns on the speaker
- This then sets up a one-time interrupt 10ms later, which turns off the speaker

To adjust the tempo, you then keep resetting the periodic interrupt's clock rate.

Option 2:

- Set the periodic interrupt for a fixed 1000Hz (1ms)
- For ten counts, turn on the beeper (10ms)
- Count mod Period to set the duration (1000 = 1 second = 60bpm)

The latter is what I used (no graphics yet)

Python Code: Output a 10ms pulse every 1000ms using timer interrupts:

```
from machine import Pin, Timer

Beeper = Pin(13, Pin.OUT)

Tint = Timer()
flag = N = 0

def tick(x):
    global N, flag
    N = (N + 1) % 1000;
    if(N == 0):
        flag = 1
    if(N < 10):
        Beeper.value(1)
    else:
        Beeper.value(0)

Tint.init(freq=1000, mode=Timer.PERIODIC, callback=tick)

while(1):
    if(flag):
        flag = 0
        print('Beep')
```
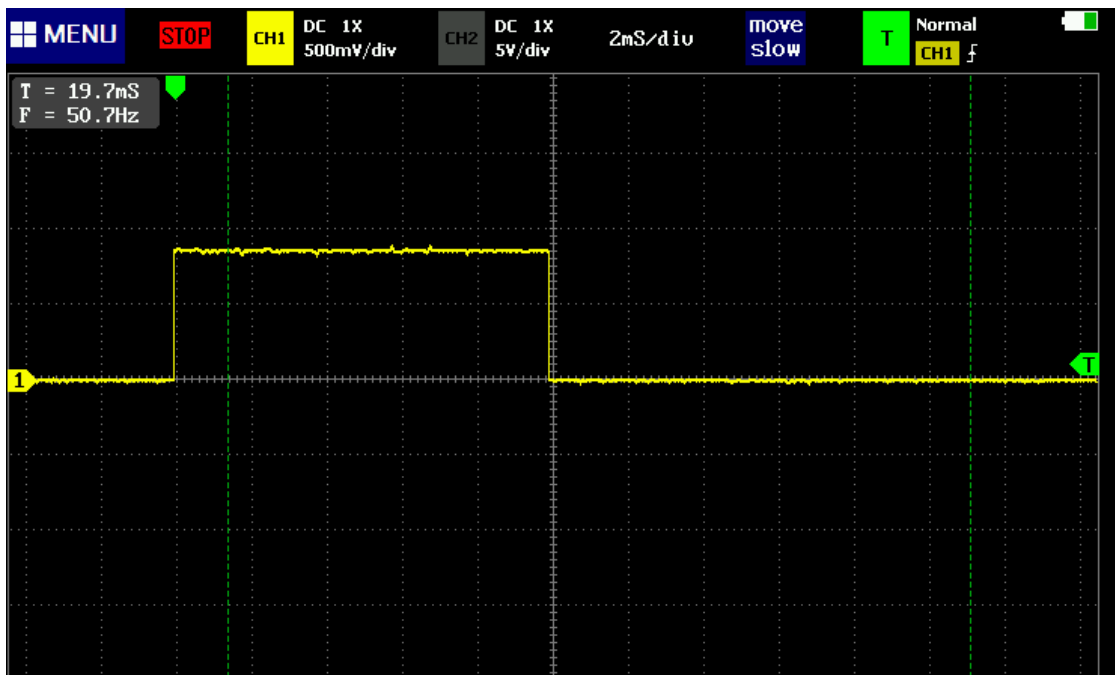
Test the program: Place the waveform on an oscilloscope

- Period = 1 second (check)
- Pulse width = 10ms (check)

2) Write a Python program which uses edge interrupts to
- Increase a number by 1% each time you press GP15
- Decrese a number by 1% each time you press GP14

Note:
- Time interrupts are in red
- Edge interrupts are in blue

```python
from machine import Pin, Timer

Beeper = Pin(13, Pin.OUT)

Tint = Timer()
flag = N = 0
Period = 1000

def tick(tim):
    global N, flag, Period
    N = (N + 1) % Period;
    if(N == 0):
        flag = 1
    if(N < 10):
        Beeper.value(1)
    else:
        Beeper.value(0)

Tint.init(freq=1000, mode=Timer.PERIODIC, callback=tick)

pin1 = Pin(15,Pin.IN,Pin.PULL_UP)
pin2 = Pin(14,Pin.IN,Pin.PULL_UP)

def Up(pin1):
    global Period
    Period = int(Period * 1.01)

def Down(pin2):
    global Period
    Period = int(Period * 0.99)

pin1.irq(trigger=Pin.IRQ_FALLING, handler=Up)
pin2.irq(trigger=Pin.IRQ_FALLING, handler=Down)

while(1):
    if(flag):
        flag = 0
        print('Perion = ',Period, 'ms')
```

shell

```
Period = 1000ms
Period = 1000ms
Period = 970ms
Period = 960ms
Period = 978ms
Period = 987ms
```

Testing the program:
- Each time you press GP15, the period goes up by 10%
- Each time you press GP14, the period goes down by 10%

3) Write a Python program which uses timer and edge interrupts to build a metronome
- Timer interrupts are in red
- Edge interrupt are in blue
- Include graphics

```python
from machine import Pin, Timer
import LCD_24x32 as LCD

Beeper = Pin(13, Pin.OUT)

Tint = Timer()
flag = N = 0
Period = 1000

def tick(tim):
    global N, flag, Period
    N = (N + 1) % Period;
    if(N == 0):
        flag = 1
    if(N < 10):
        Beeper.value(1)
    else:
        Beeper.value(0)

Tint.init(freq=1000, mode=Timer.PERIODIC, callback=tick)

pin1 = Pin(15,Pin.IN,Pin.PULL_UP)
pin2 = Pin(14,Pin.IN,Pin.PULL_UP)

def Up(pin1):
    global Period
    Period = int(Period * 1.01)

def Down(pin2):
    global Period
    Period = int(Period * 0.99)

pin1.irq(trigger=Pin.IRQ_FALLING, handler=Up)
pin2.irq(trigger=Pin.IRQ_FALLING, handler=Down)

LCD.Init()
White = LCD.RGB(250,250,250)
Grey = LCD.RGB(150,150,150)
Pink = LCD.RGB(250,150,150)
LtBlue = LCD.RGB(150,150,250)
Black = LCD.RGB(0,0,0)

LCD.Clear(Black)
LCD.Box(5,5,475,315,White)
LCD.Text4('Metronome', 132, 50, Pink, Black)

while(1):
    if(flag):
        flag = 0
        print('Period = ',Period)
        BPM = 60_000 / Period
        msg = 'BPM = ' + str(BPM)
        LCD.Text4(msg, 100, 150, LtBlue, Black)
        msg = 'Period = ' + str(Period) + 'ms'
        LCD.Text3(msg, 100, 200, Grey, Black)
```

4) Demo your metronome

- In-person on with a video
- Shows off better with a video