

# ECE 476/676 - Homework #7

Edge and Timer Interrupts - Due Monday, March 17th

## Roulette!



Program a roulette wheel with eight numbers (1-8) on your Pi-Pico using Python.

- On reset, you start with \$100 in your bank account.
- You can bet on numbers 1 through 8 on the roulette wheel. Pushing the analog input up and down allows you to change which number you're betting on.
- When you press GP15, the game starts.
  - A random number in the range of 0-8 is generated
  - Numbers 1-8 correspond to the winning number
  - 0 means the winning number is the number you bet on minus one (you *just* missed)
- Once the game starts, the ball rolls around the roulette wheel
  - The ball position is shown on the LCD display
  - The ball shifts N times ( $N = 23 + X$  where X is a random number generated when you press GP15)
  - Each shift is 200ms
- The ball then stops on the winning number
  - If you bet on this number, your bank increases by \$8 (you win)
  - If not, your bank decreases by \$1 (you lose)

## Grading:

- 10 points: Use edge interrupts to detect when you press GP15
- 10 points: Use timer interrupts to move the ball every 200ms (you can vary this if you like)
- 10 points: Allow you to adjust which number you're betting on using the joystick
- 10 points: Display on the LCD the ball position as it moves, the number you're betting on, and your bank balance.
- 10 points: Demonstrate your working program

Build the program step by step:

Step 1: Display your bet, the ball position, and your bank balance (get the display working first so you can see what's happening)

```
from time import sleep
from random import randrange
from math import sin, cos, pi
import LCD
from machine import ADC, Pin, Timer

Bet = Ball = 1
Flag = N = 0
Bank = 100

def Display():
    LCD.Circle(300, 160, 90, Red)
    LCD.Circle(300, 160, 85, Orange)
    LCD.Circle(300, 160, 80, Yellow)
    for i in range(1,9):
        x = 300 + 100*cos(i*pi/4)
        y = 160 + 100*sin(i*pi/4)
        LCD.Text(str(i), x, y, White, Black)

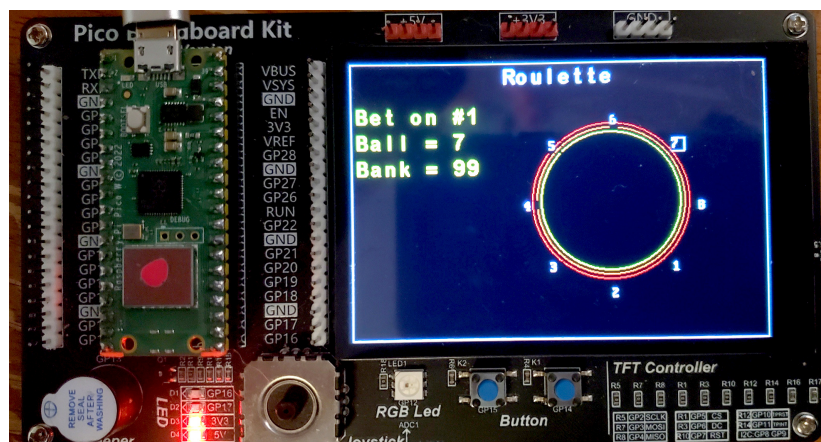
LCD.Init()
Yellow = LCD.RGB(250,250,0)
White = LCD.RGB(250,250,250)
Black = LCD.RGB(0,0,0)
Pink = LCD.RGB(250,100,100)
Red = LCD.RGB(250,0,0)
Orange = LCD.RGB(250,150,0)

LCD.Clear(Black)
LCD.Box(0,0,479,319, White)
LCD.Title('Roulette', White, Black)
Display()

while(1):

    msg = 'Bet on #' + str(Bet)
    LCD.Text2(msg, 5, 50, Yellow, Black)
    msg = 'Ball = ' + str(Ball)
    LCD.Text2(msg, 5, 80, Yellow, Black)
    msg = 'Bank = ' + str(Bank) + ' '
    LCD.Text2(msg, 5, 110, Yellow, Black)

    sleep(0.1)
```



Step 2: Get the analog input to work.

- Pushing the joystick up, increases the number you're betting on
- Pushing the joystick down decreases the number you're betting on

Check that the display changes when you press the joystick

```
x0 = a2d1.read_u16()

while(1):
    dx = (a2d1.read_u16() - x0)
    if(dx > 10_000):
        Bet = min(Bet+1, 8)
    if(dx < -10_000):
        Bet = max(Bet-1, 1)

    msg = 'Bet on #' + str(Bet)
    LCD.Text2(msg, 5, 50, Yellow, Black)
    msg = 'Ball = ' + str(Ball)
    LCD.Text2(msg, 5, 80, Yellow, Black)
    msg = 'Bank = ' + str(Bank) + ' '
    LCD.Text2(msg, 5, 110, Yellow, Black)

    sleep(0.1)
```

Check:

- Number you bet on can be increased or decreased as you push the joystick up and down

Step 3: Start the game and generate a random number on a falling-edge interrupt on GP15

```
Bet = Ball = 1
Flag = N = 0
Bank = 100

pin = Pin(15, Pin.IN, Pin.PULL_UP)
LED = Pin(16, Pin.OUT)
Beeper = Pin(13, Pin.OUT)

def IntServe(pin):
    global Ball
    global Flag
    global Bet
    global N
    Flag = 1
    X = randrange(9)
    if(X == 0):
        X = X - 1
    if(X == 8):
        X = 8
    N = 40 + X - Ball
    print('Edge Interrupt: N = ', N)

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

Check:

- Pressing GP15 changes N every time it's pressed

#### Step 4: Turn on the timer interrupts

- Start the interrupt with the edge interrupt
- Continue for N times

```
tim = Timer()

def Wheel(pin1):
    global N
    global Ball
    x = 300 + 100*cos(Ball*pi/4)
    y = 160 + 100*sin(Ball*pi/4)
    LCD.Box(x, y, x+15, y+15, Black)
    Ball = (Ball % 8) + 1
    N = N - 1
    if(N > 0):
        tim.init(period = int(100 + 1000/N),mode=Timer.ONE_SHOT,callback=Wheel)
    LED.toggle()
    x = 300 + 100*cos(Ball*pi/4)
    y = 160 + 100*sin(Ball*pi/4)
    LCD.Box(x, y, x+15, y+15, White)
    Beep()
```

#### When turned on

- Flag = 1
- N > 0

the timer interrupts repeat N times then stop

#### Step 4: Calculate winnings

If the game just ended (Flag == 1 and N == 0), check to see if you won

```
while(1):
    dx = (a2d1.read_u16() - x0)
    if(dx > 10_000):
        Bet = min(Bet+1, 8)
    if(dx < -10_000):
        Bet = max(Bet-1, 1)

    if(Flag == 1):
        if(N == 0):
            Flag = 0
            if(Ball == Bet):
                Bank += 8
            else:
                Bank -= 1

    msg = 'Bet on #' + str(Bet)
    LCD.Text2(msg, 5, 50, Yellow, Black)
    msg = 'Ball = ' + str(Ball)
    LCD.Text2(msg, 5, 80, Yellow, Black)
    msg = 'Bank = ' + str(Bank) + ' '
    LCD.Text2(msg, 5, 110, Yellow, Black)

    sleep(0.1)
```

## Final Code:

```
from time import sleep
from random import randrange
from math import sin, cos, pi
import LCD
from machine import ADC, Pin, Timer

a2d0 = ADC(0)
a2d1 = ADC(1)

Bet = Ball = 1
Flag = N = 0
Bank = 100

x0 = a2d1.read_u16()

pin = Pin(15, Pin.IN, Pin.PULL_UP)
LED = Pin(16, Pin.OUT)
Beeper = Pin(13, Pin.OUT)

# --- Edge Interrupts

def IntServe(pin):
    global Ball
    global Flag
    global Bet
    global N
    Flag = 1
    X = randrange(9)
    if(X == 0):
        X = X - 1
    if(X == 0):
        X = 8
    N = 40 + X - Ball
    tim.init(period = 200, mode=Timer.ONE_SHOT, callback=Wheel)

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

# --- Timer Interrupts

tim = Timer()
N = 0

def Wheel(pin1):
    global N
    global Ball
    x = 300 + 100*cos(Ball*pi/4)
    y = 160 + 100*sin(Ball*pi/4)
    LCD.Box(x, y, x+15, y+15, Black)
    Ball = (Ball % 8) + 1
    N = N - 1
    if(N > 0):
        tim.init(period = int(100 + 1000/N), mode=Timer.ONE_SHOT, callback=Wheel)
    LED.toggle()
    x = 300 + 100*cos(Ball*pi/4)
    y = 160 + 100*sin(Ball*pi/4)
    LCD.Box(x, y, x+15, y+15, White)
    Beep()
```

```

# --- Beep for 50ms

def Beep():
    Beeper.value(1)
    sleep(0.05)
    Beeper.value(0)

# --- Display Routine

def Display():
    LCD.Circle(300, 160, 90, Red)
    LCD.Circle(300, 160, 85, Orange)
    LCD.Circle(300, 160, 80, Yellow)
    for i in range(1,9):
        x = 300 + 100*cos(i*pi/4)
        y = 160 + 100*sin(i*pi/4)
        LCD.Text(str(i), x, y, White, Black)

LCD.Init()
Yellow = LCD.RGB(250,250,0)
White = LCD.RGB(250,250,250)
Black = LCD.RGB(0,0,0)
Pink = LCD.RGB(250,100,100)
Red = LCD.RGB(250,0,0)
Orange = LCD.RGB(250,150,0)

LCD.Clear(Black)
LCD.Box(0,0,479,319, White)
LCD.Title('Roulette', White, Black)
Display()

# --- Main Loop

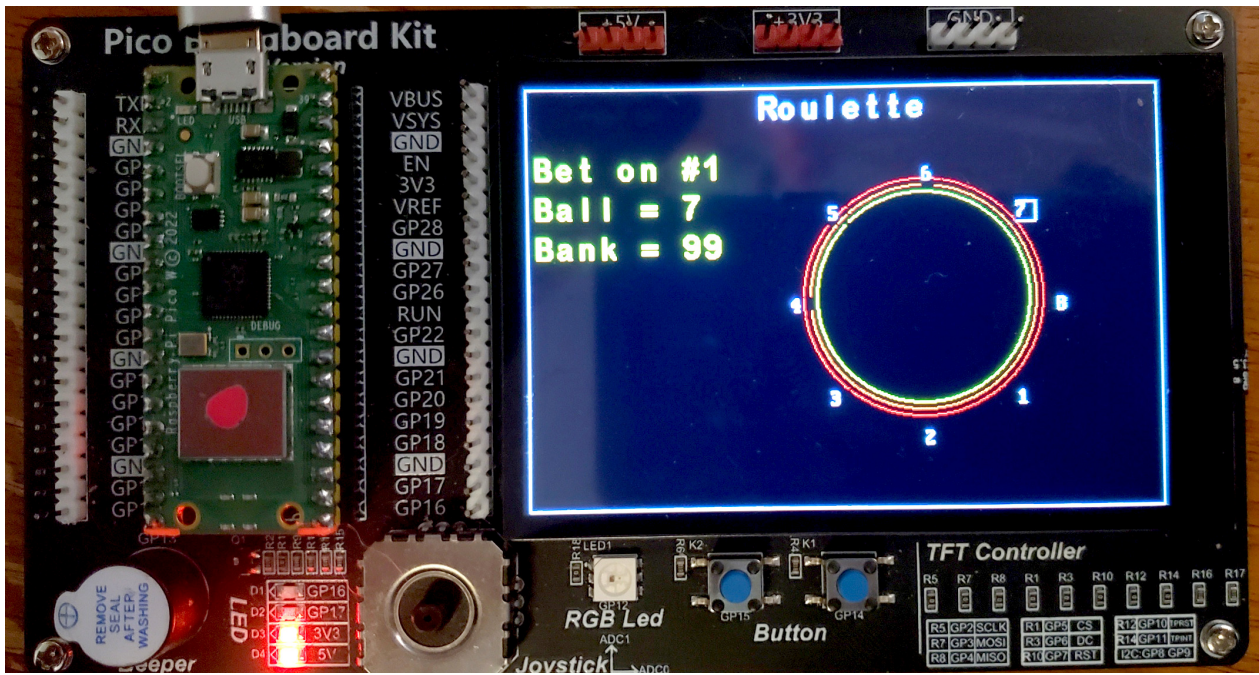
while(1):
    dx = (a2d1.read_u16() - x0)
    if(dx > 10_000):
        Bet = min(Bet+1, 8)
    if(dx < -10_000):
        Bet = max(Bet-1, 1)

    if(Flag == 1):
        if(N == 0):
            Flag = 0
            if(Ball == Bet):
                Bank += 8
            else:
                Bank -= 1

    msg = 'Bet on #' + str(Bet)
    LCD.Text2(msg, 5, 50, Yellow, Black)
    msg = 'Ball = ' + str(Ball)
    LCD.Text2(msg, 5, 80, Yellow, Black)
    msg = 'Bank = ' + str(Bank) + ' '
    LCD.Text2(msg, 5, 110, Yellow, Black)

    sleep(0.1)

```



Checks:

	Bet	Winning #	Bank
•	4	1	95
•	5	8	94
•	5	6	93
•	2	8	92
•	1	4	91
•	6	7	90
•	6	7	89
•	6	8	88
•	7	4	87
•	8	8	95
•	8	4	94

Looks OK

- Numbers look random
- Wheel is spinning
- Stops on a number
- I lose \$1 when wrong
- I gain \$8 when I win