Microcontrollers & Applications

Lecture 4.3: Loops

For Loops (C & Python)

To repeat same statements if the number of repeatation is known.

- for (initialize; condition; finalize) statement;
  - Run the initialize first. If the condition is true, then statement runs. Run the finalize last. Go to the initialize again.
- for (i=0; i<10; i++) Serial.println(i);
  - Displays numbers from 0 to 9 (excluding 10).

```
for i in range(0,10):
    uart.write("%d\n", i)
```

While Loops (C & Python)

To repeat same statements if the given condition is true.

- Unless the given condition is false, then the statement runs.
  - while (condition) statement;

- break; directly exits from the loop or conditional.
- ; or empty curly braces do nothing ☺
- continue; directly goes to the end of loop or conditional.
  - In for loop, it goes to the finalize statement.
  - In while loop, it goes to the condition check statement.

- // Displays numbers from 0 to 9 (excluding 10).
- i=0;
- while (i<10) {
  - Serial.println(i);
  - i++;
  - }

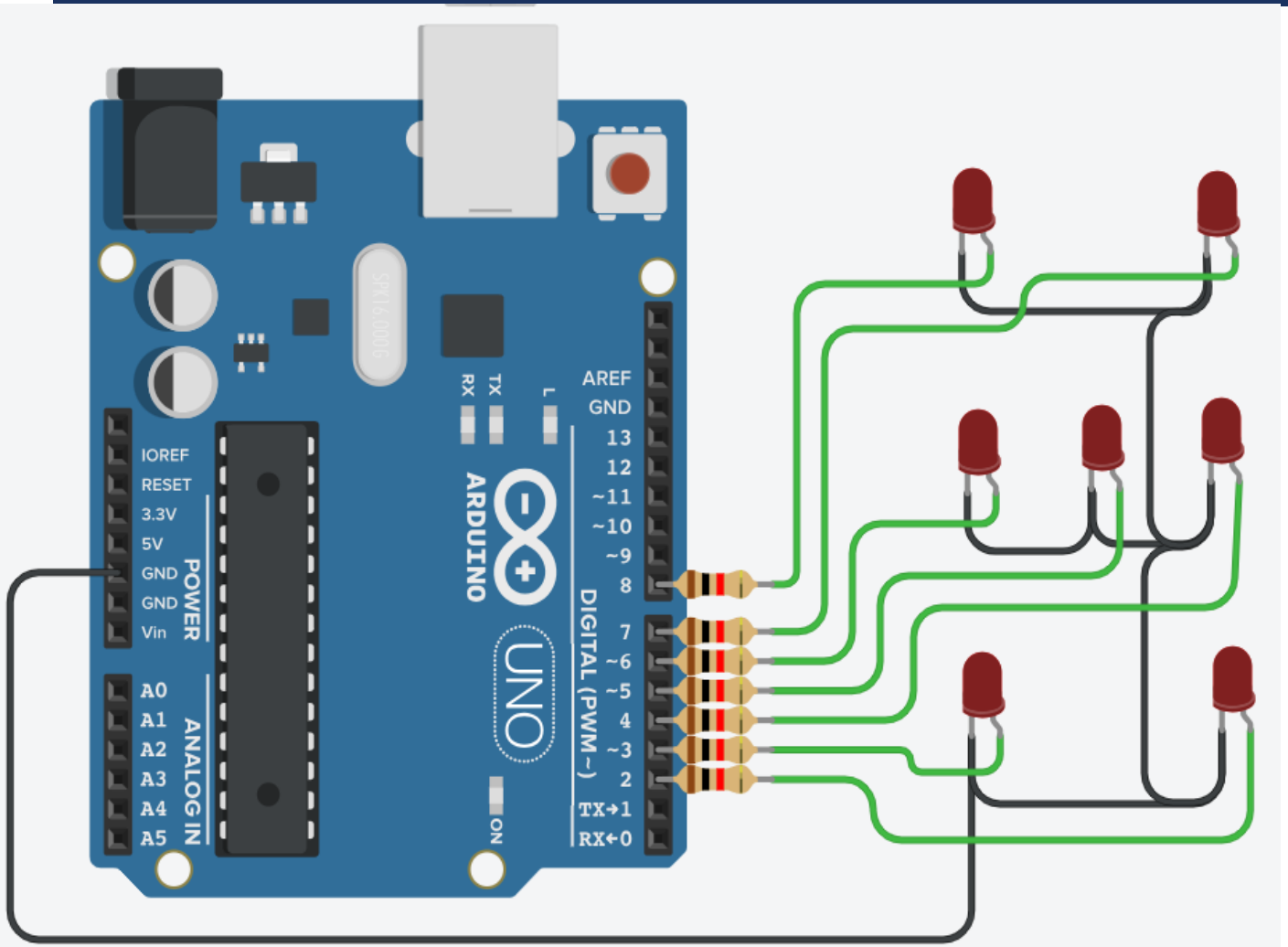
while condition:

    statement

- break directly exits from the loop or conditional.
- pass do nothing ☺
- continue directly goes to the end of loop or conditional.
  - In for loop, it goes to the finalize statement.
  - In while loop, it goes to the condition check statement.

- # Displays numbers from 0 to 9 (excluding 10).
- i=0
- while i<10:
  - uart.write("%d\n",i)
  - i++

FOR Loop Examples #1 (Arduino)




```
1  #define NUM_LEDS 7
2  unsigned int LED[NUM_LEDS] = {2,3,4,5,6,7,8};
3
4  void setup()
5  {
6    Serial.begin(9600);
7    Serial.println("LED test started");
8
9    for (int i=0; i<NUM_LEDS; i++)
10     pinMode(LED[i], OUTPUT);
11
12   for (int j=0; j<3; j++) {
13
14     for (int i=0; i<NUM_LEDS; i++)
15       digitalWrite(LED[i], HIGH);
16
17     delay(1000);
18
19     for (int i=0; i<NUM_LEDS; i++)
20       digitalWrite(LED[i], LOW);
21
22     delay(500);
23   }
24
25   Serial.println("LED test finished");
26 }
27
28 void loop()
29 {
30 }
```

FOR Loop Examples #2 (cont'd from Example #1)

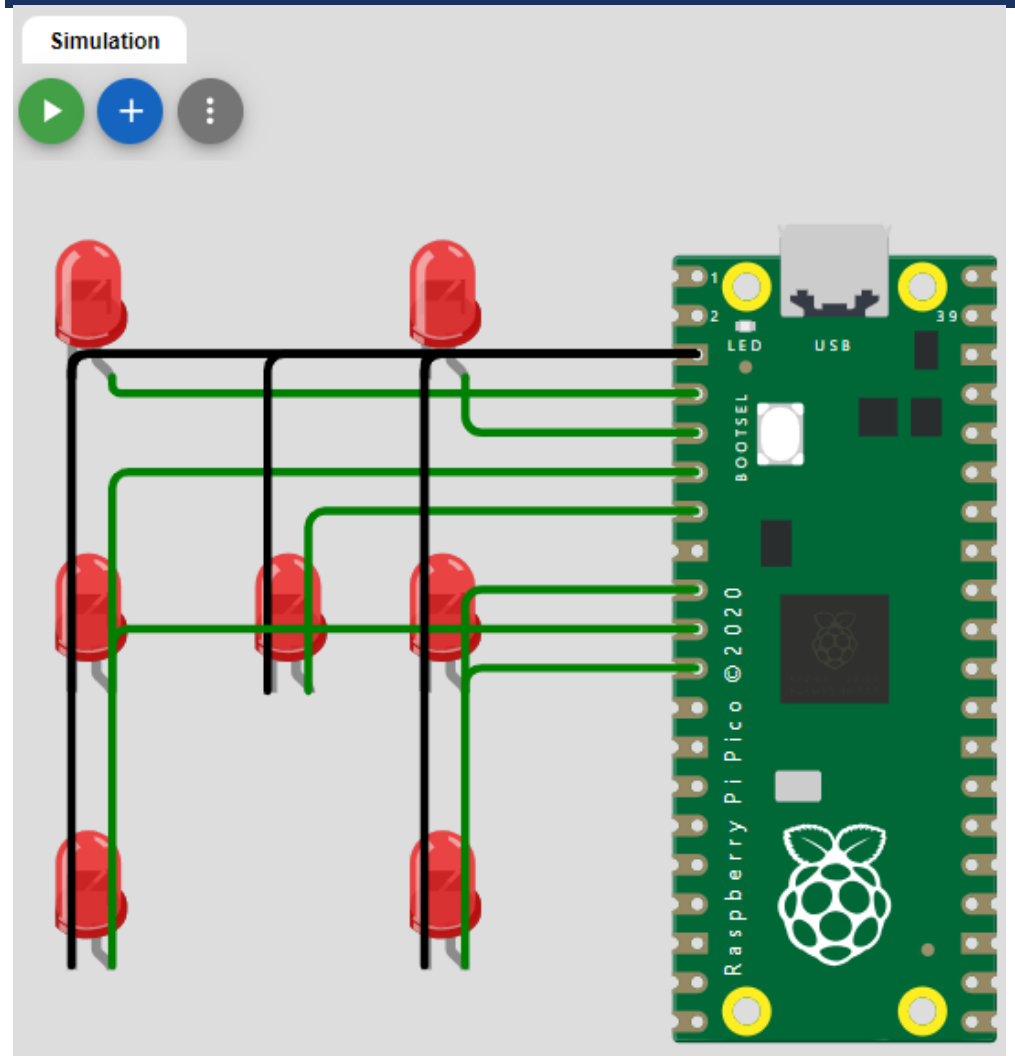
```
1  #define NUM_LEDS 7
2  unsigned int LED[NUM_LEDS] = {2,3,4,5,6,7,8};
3
4  unsigned int NUMBERS[6][NUM_LEDS] = {
5    { LOW,  LOW,  LOW, HIGH,  LOW,  LOW,  LOW},
6    { LOW, HIGH,  LOW,  LOW,  LOW, HIGH,  LOW},
7    { LOW, HIGH,  LOW, HIGH,  LOW, HIGH,  LOW},
8    {HIGH, HIGH,  LOW,  LOW,  LOW, HIGH, HIGH},
9    {HIGH, HIGH,  LOW, HIGH,  LOW, HIGH, HIGH},
10   {HIGH, HIGH, HIGH,  LOW, HIGH, HIGH, HIGH}
11 };
12
13 void loop()
14 {
15   for (unsigned int num = 0; num<6; num++) {
16     for (int i=0; i<NUM_LEDS; i++)
17       digitalWrite(LED[i], NUMBERS[num][i]);
18     Serial.print("Dice is ");
19     Serial.println(num+1);
20     delay(1000);
21   }
22 }
```

```
24 void setup()
25 {
26   Serial.begin(9600);
27   Serial.println("LED test started");
28
29   for (int i=0; i<NUM_LEDS; i++)
30     pinMode(LED[i], OUTPUT);
31
32   for (int j=0; j<3; j++) {
33
34     for (int i=0; i<NUM_LEDS; i++)
35       digitalWrite(LED[i], HIGH);
36
37     delay(1000);
38
39     for (int i=0; i<NUM_LEDS; i++)
40       digitalWrite(LED[i], LOW);
41
42     delay(500);
43   }
44
45   Serial.println("LED test finished");
46 }
```

Dice numbers are shown from 1 to 6 with 1-sec delay.

https://wokwi.com/projects/392824445208958977

FOR Loop Example (CircuitPython Diagram)




```
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"black", [] ],
    [ "pico:GP3", "led2:A",
"green", [] ],
    [ "pico:GND.1", "led3:C",
"black", [] ],
    [ "pico:GP4", "led3:A",
"green", [] ],
    [ "pico:GND.1", "led4:C",
"black", [] ],
    [ "pico:GP5", "led4:A",
"green", [] ],
    [ "pico:GND.1", "led5:C",
"black", [] ],
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"green", [] ],
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"black", [] ],
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"green", [] ],
    [ "pico:GND.1", "led7:C",
"black", [] ],
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"serialMonitor:TX", "", [] ]
  ],
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"always" },
  "dependencies": {}
}
```

DIAGRAM.JSON file

FOR Loop Example (CircuitPython Code)

```
import time
import board
import digitalio
import busio

NUM_LEDS = 7
LED      = [board.GP2, board.GP3, board.GP4, board.GP5, board.GP6, board.GP7, board.GP8]
NUMBERS = [
  [0, 0, 0, 1, 0, 0, 0],
  [0, 1, 0, 0, 0, 1, 0],
  [0, 1, 0, 1, 0, 1, 0],
  [1, 1, 0, 0, 0, 1, 1],
  [1, 1, 0, 1, 0, 1, 1],
  [1, 1, 1, 0, 1, 1, 1]]

#setup
#uart = busio.UART(tx=board.GP0, rx=board.GP1, baudrate=9600, timeout=0)
time.sleep(0.5)
print("LED test started")
time.sleep(0.1)

led = list()
for i in range(NUM_LEDS):
  pinLed = LED[i]
  led.append(digitalio.DigitalInOut(pinLed))
  led[i].direction = digitalio.Direction.OUTPUT

for j in range(3):
  for i in range(NUM_LEDS):
    led[i].value = True

  time.sleep(1)
  for i in range(NUM_LEDS):
    led[i].value = False

  time.sleep(0.5)
print("LED test finished")

#loop
while True:
  for num in range(6):
    for i in range(NUM_LEDS):
      led[i].value = NUMBERS[num][i]

    print("Dice is " + str(num+1))

    time.sleep(1)
```

Left to Students: Loop Examples

- Write the following programs both in Arduino C and Rpi Pico CircuitPython and simulate them:

1. Find the minimum, maximum, median, and average of the 100 numbers stored in an array and report them to the serial port.
2. Read numbers from the serial port. It continues unless the value of 0 is read from the serial port. The program finds the average of positive numbers and negative numbers separately and report them to the serial port. When 0 comes from the serial port, it neglects the previous values and starts from the beginning again (not means initializing or resetting the board).
3. Find the total of numbers between 15 and 123, then report the result to the serial port.
4. When a number reads from the serial port, it reports whether this number is a prime number or not to the serial port back.
5. There are two buttons. When the first button is pressed, it starts counting. When the second button is pressed, it stops counting and report it to the serial port.
6. Generates six integer numbers randomly between 1 and 49 (LOTTERY numbers). Numbers should be different from others. Report these six numbers to the serial port in a single line. Infinitely many times repeat this procedure, all numbers must be unique in every line, but this is not required among lines.

Thanks for listening ☺

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