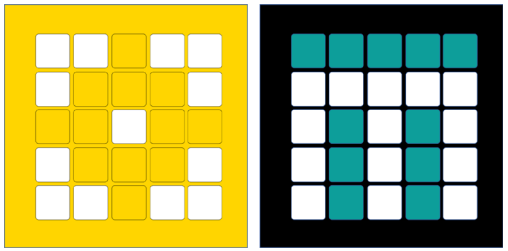
PRIME LESSONS

By the Makers of EV3Lessons



LOOPS

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LESSON OBJECTIVES

- Learn how to repeat an action using loops

REPEATING CODE

- Let us say that you want the robot to repeat an action over and over again.
  - Would you copy the code over and over?
  - What if you wanted to repeat the action forever?
- You can use the loops to repeat an action for a number of times or until some exit condition is met
- Python has two types of loops: for loops and while loops

WHILE LOOPS

- Let's say we want to run a task while some condition is True
  - E.g. while I am in the library, stay quiet
- In Python, we use while (statement): to run code while the statement is True
- In the example on the right, x==8 is always True, so "Yay!" will print forever
  - If you insert x=10 inside the loop, "Yay!" will only print once, for example
- While loops are useful for repeating a task until a certain sensor reading:

```
x = 8
while (x == 8):
    print("Yay!")
```

Output:

```
Yay!
Yay!
Yay!
... [repeats forever]
```

```
# Move forward until the distance sensor returns <=10cm value
while (getDistance() > 10):
    moveForward()
# Assume that getDistance() gets the distance sensor's value in
# centimeters and moveForward() moves the robot forward
```

Note:
Remember to indent the code you want to run in the loop

INDEFINITE WHILE LOOPS

- You can also use while loops to loops forever

```
while True:
    Code
```

- By setting the condition to be True always, the loop will repeat forever

CHALLENGE

- Create a variable x and assign it a value
- Create a while loop that displays all squares (e.g., 4, 9, 16, …) that are less than x on the hub

CHALLENGE SOLUTION

```
from spike import PrimeHub, LightMatrix
hub = PrimeHub()

# this creates the variable x and set it to 51
x = 51

# this creates a variable y that we will use as a
# loop counter. We start with y = 1
y = 1

# this loops until the square of y is >= x
while ((y**2)< x):
    hub.light_matrix.write(y**2)
    # we need to increment y to consider the
    # net squared value
    y += 1
```

FOR LOOPS

- Similar to while loops, but run for a fixed count
  - E.g. jump 10 times
- A basic for loop is set up like the example on the right
- In "for i in range(start, end, increment):"
  - range() creates a set of numbers between a start and less than end (or just end when only one parameter is present) spaced apart by increment. The start and increment values are optional.
  - The variable i takes the next value from the set each time (you can name this variable anything you want; standard convention is i, j, k)
  - In the example, i will only be between 0 and 9, since it checks for counter < n (not <=)

```
for i in range(0,10):
    print("Jump!")
    print(i)
```

Output:

```
Jump!
0
Jump!
1
....
Jump!
9
```

ANALYSIS: FOR LOOPS WITH RANGE()

- Basic structure:

```
for i in range(4):
    print(i)
```

```
Output:
0
1
2
3
```

- You can also set a start position:

```
for i in range(2, 4):
    print(i)
```

```
Output:
2
4
```

- Notice that 4 was not included. The range() function excludes the maximum that you set.
- Finally, you can increment by different values other than 1

```
for i in range(2, 7, 2):
    print(i)
```

Increment

```
Output:
2
4
6
```

FOR LOOPS WITH A LIST OF NUMBERS

- For loops can be used to iterate over a comma separated list of numbers (enclosed by brackets [])

```
for i in [0, 2, 6]:
    print(i)
```

Output:

0

2

6

Note: This example uses lists, which we have not covered yet.

LOOP EXAMPLES

```
# A for loop repeats an action a specific number of
times
# based on the provided range
def sumFromMToN(m, n):
    total = 0
    # note that range(x, y) includes x but excludes y
    for x in range(m, n+1):
        total += x
    return total
```

```
def printStarRectangle(n):
    # print an nxn rectangle of asterisks
    for row in range(n):
        for col in range(n):
            print("*", end="")
        print()
```

```
# use while loops when there is an
indeterminate number of iterations
def leftmostDigit(n):
    n = abs(n)
    while (n >= 10):
        n = n//10
    return n
```

CHALLENGE: PRIME NUMBERS

- Your goal is to check if any given positive integer n is prime
- Hints:
  - Prime numbers are only divisible by 1 and itself
  - You need to check divisibility by numbers between 2 and the n-1
  - Modulo (%) will help here (the number can be factored by integer a if n%a==0)

CHALLENGE SOLUTION

```
n = 3 # your number here
prime = True # start by assuming it is prime
if (n <= 1): # 1 and lower are not prime
    prime = False
for factor in range(2,n): # check all possible factors [2, n)
    if (n % factor == 0): # n%factor == 0 when it is a divisor
        prime = False # set that n is not prime
if prime:
    print("is prime") # the number is prime
else:
    print("not prime") # the number is not prime
```

CREDITS

- This lesson was created by Arvind and Sanjay Seshan for Prime Lessons
- More lessons are available at www.primelessons.org