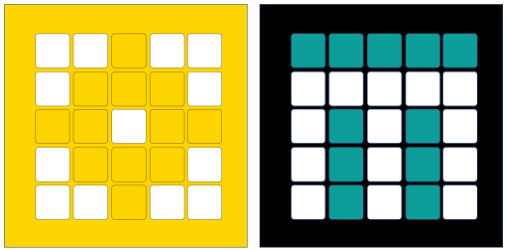
PRIME LESSONS

By the Makers of EV3Lessons



RECURSION

BY SANJAY AND ARVIND SESHAN

LESSON OBJECTIVES

- Learn how to create recursive functions

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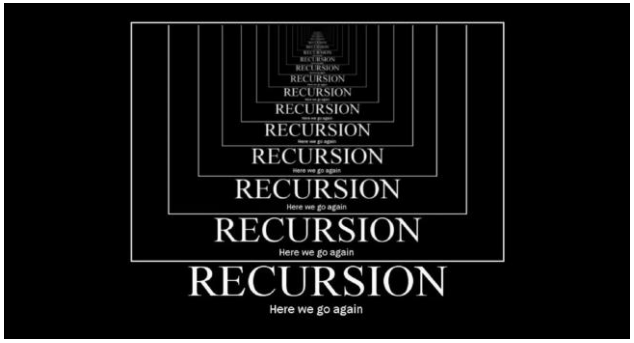
INTRO TO RECURSION

- Definition recursion (n):
  - see recursion
- The definition refers to itself (like a loop)
- Some famous examples are:
  - Fibonacci series: $f_n = f_{n-1} + f_{n-2}$ *1, 1, 2, 3, 5, 8, 13, ...*
  - Factorial: $n! = n * (n-1)!$ *5! = 5*(4*(3*(2*(1)))) = 120*
- In Python: a function that calls itself



PROGRAMMING A RECURSIVE FUNCTION

- There are two parts to recursion:
  - The base case → a known case
    - Sometimes there are multiple base cases
  - The recursive case → everything else

```
def recursiveFunction():
    if (this is the base case):
        return something non-recursive
    else:
        return something recursive
```

RECURSION: FACTORIAL

- Base Case: factorial(1) = 1 (i.e. 1! = 1)
- Recursive case: return n*(factorial(n-1))

```
def factorial(n):
    if (n == 1):
        return 1
    else:
        return n*factorial(n-1)
```

RECURSION: FIBONACCI

- Base Case 1: fibonacci(1) = 1
- Base Case 2: fibonacci(2) = 1
- Recursive case: return fibonacci(n-1)+fibonacci(n-2)

```
def fibonacci(n):
    if (n == 1):
        return 1
    elif (n == 2):
        return 1
    else:
       return fibonacci(n-1) + fibonacci(n-2)
```

CHALLENGE: PELL SEQUENCE

- Create a recursive function to get the nth value in the Pell sequence
- The Pell sequence is 0, 1, 2, 5, 12, 29, 70, 169, 408, 985, ……
- Mathematically, it is defined as

$$P_n = 2 * P_{n-1} + P_{n-2}$$

- Print the 5th PELL number to the light matrix

CHALLENGE SOLUTION

```
def PELL(n):
    if (n==1):
        return 0
    elif (n==2):
        return 1
    else:
        return 2*PELL(n-1)+PELL(n-2)

hub.light_matrix.write(PELL(5))
```

CREDITS

- This lesson was created by Sanjay and Arvind Seshan for Prime Lessons
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