Discussion 6: Intro to Recursion

Factorials are Factorials Times Factorials

Factorials are defined as the product of a positive integer and all consecutive smaller positive integers. For example, factorial(5) = 5 x 4 x 3 x 2 x 1. Fill in the code below to recursively compute a factorial. Don't worry about the case of n < 1.

```
factorial(n):
    if_________________________________________________________:
        report ________________________________________________
    else:
        report ________________________________________________
```

PalindromeemordnilaP

(a) A palindrome is a word that is spelled the same way forwards and backwards. In other words, the first letter must equal the last letter, the second letter must equal the second to last letter ... etc. For the purposes of this problem, all zero-letter and one-letter words are palindromes.

Using the above information, fill in the recursive palindrome function. You have access to the two functions below.

```
    all-but-first-letter-of( word )
        reports word with the first letter removed
    all-but-last-letter-of( word )
        reports word with the last letter removed
```

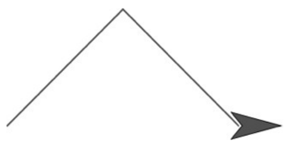
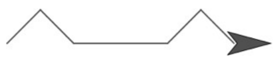
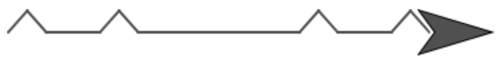
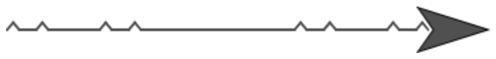
```
is (word) a palindrome?:
    if_____________________________________________________________:
        report ____________________________________________________
    else:
        if_________________________________________________________:
            report ________________________________________________
        else:
            report ________________________________________________
```

(b) Fill in the progression of calls to: is (racecar) a palindrome?

```
is (racecar) a palindrome? ↘
      is (___________) a palindrome? ↘
                is (__________) a palindrome? ↘
                          is (_________) a palindrome? ↘
                                                       _________
```

Where are These Cats Coming From?!

In the following exercise, we will address how to construct and how to think about fractals recursively. You may assume that the sprite starts off at the leftmost part of each level, facing right. *Note that each level is 1/3 of the size of the previous level.*

Level 1: 	Level 2: 
Level 3: 	Level 4: 

1) Which level corresponds to the base case?

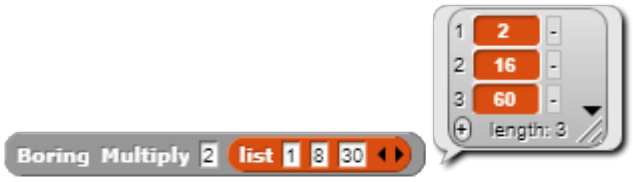
2) For our base case, in what direction does our sprite start and end in?

3) In each level, circle each instance of the previous level. Each of these instances refers to one recursive call.

4) What does the sprite do between each of the recursive calls?

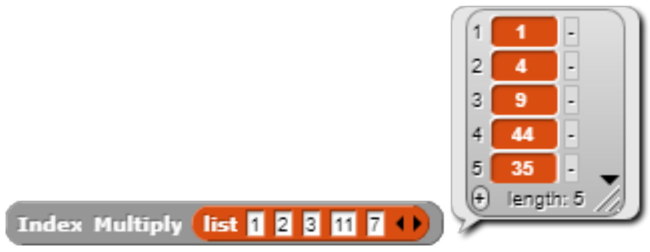
Challenge Problems

1) Write the function "Boring Multiply," which takes as input a number and a list, and recursively multiplies every item of the list by the number. It should output a new list containing the multiplied values (in order) without modifying the input list.



```
Boring Multiply:
    if_________________________________________________________:
        report __________________________________________________
    else:
        report __________________________________________________
               __________________________________________________
               __________________________________________________
               __________________________________________________
```

2) Now the real fun begins. Write the function "Index Multiply," which takes as input a list, and recursively multiplies every item of the list by its index (i.e., position) in the list. It should output a new list containing the multiplied values (in order) without modifying the input list. This problem is harder than it may seem at first glance…don't be afraid to think creatively!



```
Index Multiply:
    if_________________________________________________________:
        report __________________________________________________
    else:
        report __________________________________________________
               __________________________________________________
               __________________________________________________
               __________________________________________________
```

Below are some blocks that you may find useful in writing your solutions to the challenge problems.

Block	Description
all but first of	Reports a new list containing all items of the input list, except the first item.
all but last of	Reports a new list containing all items of the input list, except the last item.
in front of	Appends the input item to the front of the input list, and reports this combination as a *new* list.
length of	Reports the length of the input list.
item of	Retrieves the given item of the input list. The "item" variable may be set to any number, "last," or "random."
append	Appends the two (or more) input lists into a single aggregate list, reporting the output as a *new* list.
empty?	Reports whether the input list is empty.