Recursion Discussion 6

1. FACTORIAL

woohoo!

First an example: Factorial

- "The factorial of a non-negative number n, denoted by n! is the product of all positive integers less than or equal to n."
 - \circ "for example, 5! = 5 x 4 x 3 x 2 x 1 = 120"

We can also write this as:

 $5! = 5 \times 4! = 5 \times 4 \times 3! = 5 \times 4 \times 3 \times 2! = 5 \times 4 \times 3 \times 2 \times 1! = 5 \times 4 \times 3 \times 2 \times 1 = 120$

Factorial in Snap!

- Use factorial (5) as an example.
- In the previous slide, 5! could be represented as $5 \times 4! = 5 \times 4 \times 3!$ and etc.
- The same logic applies for this Snap! version.
- \triangleright factorial(5) = 5 x factorial(4) = 5 x 4 x factorial(3), and etc.

+factorial+ num +

num x factorial num - 1

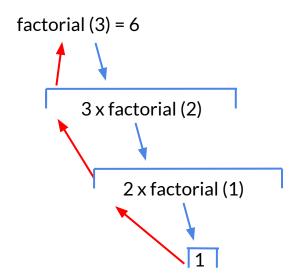
report 1

else

The recursion finally ends at factorial(1), when our block just reports 1, not calling itself again.

Factorial in Snap!

Think of this recursive process like a ladder. You go down the ladder until you hit the base case, then you go back up to evaluate and compute the values.



2. Defining Recursion

woohoo!

What does recursion mean to you?

Based on what you've learned in lab, lecture, and your personal thoughts and/or analogies, how would you define recursion?

Base Case(s):

Recursive Case(s):

Base Case(s):

Simplest form of the problem.

Recursive Case(s):

Base Case(s):

Simplest form of the problem.

Recursive Case(s):

Divide problem into smaller instances.

Base Case(s):

Simplest form of the problem.

Recursive Case(s):

- Divide problem into smaller instances.
- Invoke function (recursively).

Base Case(s):

Simplest form of the problem.

Recursive Case(s):

- Divide problem into smaller instances.
- Invoke function (recursively).
- Work towards base case.

3. Fibonacci

woohoo!

So what is the Fibonacci sequence?

So what is the Fibonacci sequence?

- It is the numbers: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144...
- "In mathematical terms, the sequence F_n of Fibonacci numbers is defined by the recurrence relation --

$$F_n = F_{n-1} + F_{n-2}$$
 with seed values $F_0 = 0$, $F_1 = 1$ "

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$$F_n = F_{n-1} + F_{n-2}$$
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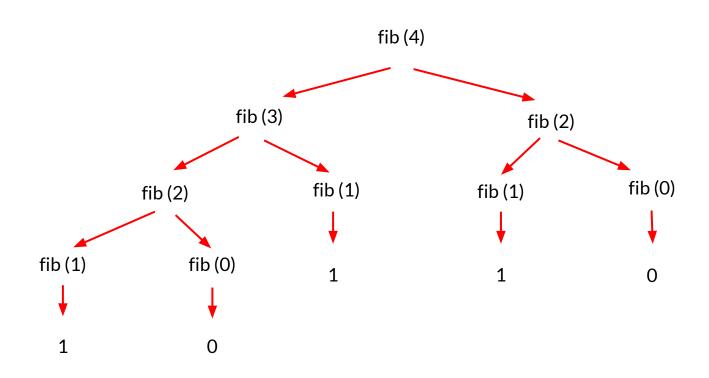
We can turn this recurrence relation into a recursive function in Snap!.

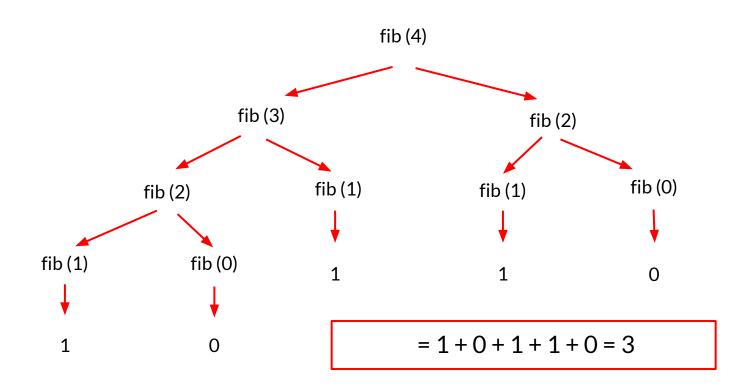
```
+fibonacci+ num
   num | < 1
report 0
   num = 1
report 1
else
        fibonacci num - 1 +
                                fibonacci num - 2
report
```

The Fibonacci block actually has 2 base cases.

There are also 2 recursive calls of the fibonacci block in the recursive case.

```
+fibonacci+ num
   num < 1
report 0
   num = 1
report 1
else
                                  fibonacci num
         fibonacci num
report
```





4. Practice Problems

woohoo!

Say My Name, Say My Name



Write a block that says all numbers between an input number and 0.

Say the number from 20 to zero

Say My Name, Say My Name



```
+Say+the+number+from+num +to+zero+
   num <
say 0 for 1 secs
else
    num for 1 secs
Say the number from
                    num
                                to zero
```

I got 99 letters but a "B" ain't one.



Given a word as input, find the number of characters in the word.

number of characters in Jay Z



I got 99 letters but a "B" ain't one.



Given a word as input, find the number of characters in the word.

number of characters in Jay-Z

all but first letter of abe

HINT

I got 99 letters but a "B" ain't one.



```
+number+of+characters+in+ word +
   word
report 0
else
        1 + number of characters in all but first letter of word
report
```

O.N.I.F.C.F.I.N.O



A palindrome is a word that is spelled the same way forwards and backwards (example: r-a-c-e-c-a-r). Given a word as an input, report whether or not the word is a palindrome.

Is racecar a palindrome? true

HINT

all but first letter of abe



all but last letter of abe



O.N.I.F.C.F.I.N.O

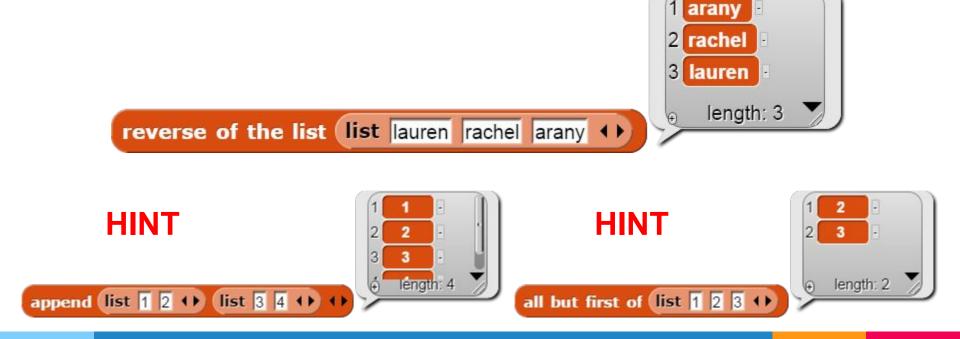


```
+Is+ word +a+palindrome?+
     length of word = 1 var or var length of var = 0
report true
else
   letter 1 of word = letter length of word of word
 report
  Is all but first letter of all but last letter of word
                                                     a palindrome?
else
 report false
```

Change Up My List



Given a list as input, report the reverse of the list.



Change Up My List



```
+reverse+of+the+list+ list +
    length of list = 1
report list
else
report
  append
                                            list item 1 

of list 

◆ ◆
  reverse of the list all but first of list
```

Change Up (Part Of) My List



Given a list, a minimum number and maximum number as input, reverse the order of the list, but only for items within the range of the max and min.





List After Block Called

Change Up (Part Of) My List



```
+reverse + order + of + (list) + from + (min) + to + (max) +
script variables (temp1) (temp2) ()
   min > max
stop this block ▼
else
 set temp1 ▼ to min
 set temp2 ▼ to max
 replace item (max) of (list) with (temp1)
 replace item min of list with temp2
 reverse order of list from min + 1 to max - 1
```

Report Length or Die Trying



Write the **length of length of length**

Report Length or Die Trying



```
+length+of+(list)+
   empty? list
report 0
else
        1 + length of all but first of list
report
```

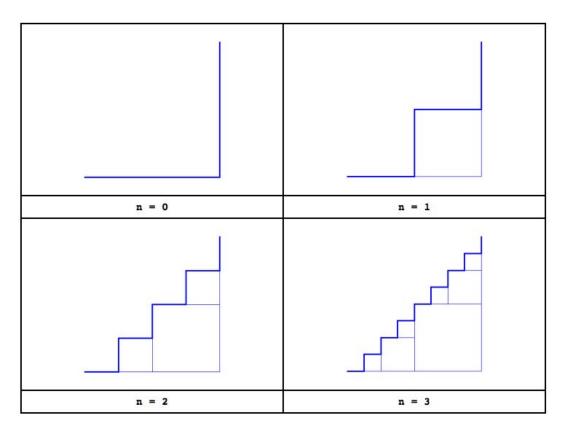
See you next week!

EXTRA (don't use FA15)

5. Fractal Practice

woohoo!

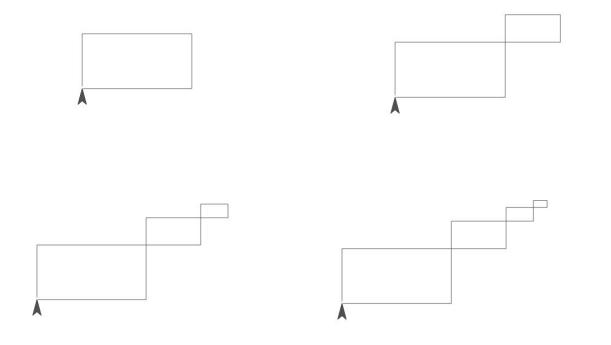
Ladder Fractal



Ladder Fractal Solution

```
+ladder+fractal+with+n+levels+of+size+size+
move s steps
turn 5 90 degrees
move s steps
turn 5 -90 degrees
ladder fractal with (n) – (1) levels of size (5)
ladder fractal with (n) - (1) levels of size (s)
```

Rectangle Fractal



Rectangle Fractal Solution

```
+ Rectangle + fractal + level + levels + and + size + size +
If levels = 0
repeat 2
  move size / 2 steps
  turn 👌 90 degrees
  move size steps
 turn ( 90 degrees
move size / 2 steps
 turn 👌 90 degrees
 move size steps
turn 5 90 degrees
 Rectangle fractal level (levels) - 1) and size (size) / 2)
 turn (180) degrees
 move size / 2 steps
 turn ( 90 degrees
 move size steps
 turn 👌 90 degrees
```