Recursion

Discussion 7

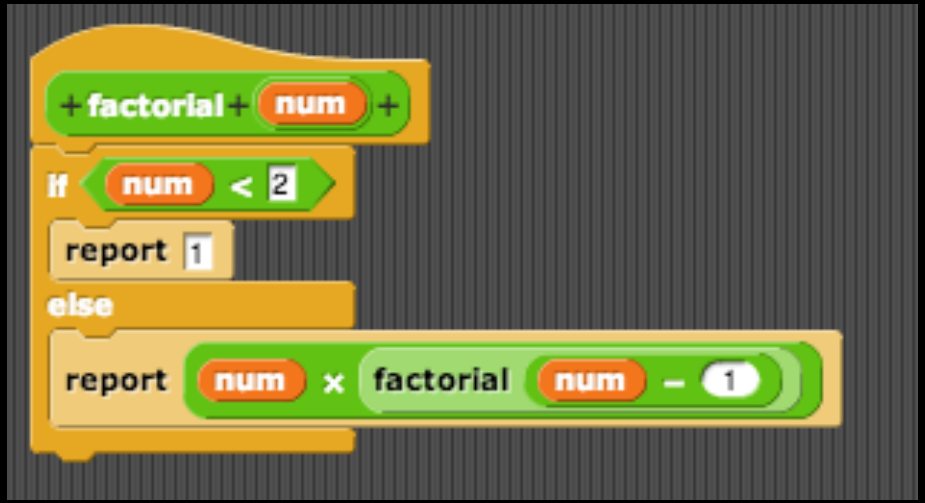
First an example: Factorial

- “the factorial of a non-negative number n, denoted by n!, is the product of all positive integers less than or equal to n”
  - “for example, 5! = 5 x 4 x 3 x 2 x 1 = 120”
- we can also write this as

  5! = 5 x 4! = 5 x 4 x 3! = 5 x 4 x 3 x 2! = 5 x 4 x 3 x 2 x 1! = 5 x 4 x 3 x 2 x 1 = 120

Factorial in Snap

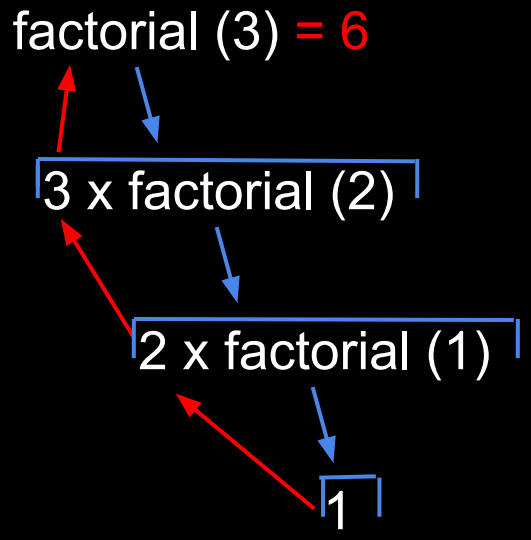
- using factorial (5)
  as an example



- in the previous slide, 5! could be represented as 5 x 4! = 5 x 4 x 3! and etc.
- the same logic applies for this Snap version
- factorial (5) = 5 x factorial (4) = 5 x 4 x factorial (3), and etc.
- 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)



What does recursion mean to you?

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

Recursion

Base Case(s):

Recursive Case(s):

Recursion

Base Case(s):
-Simplest form of the problem

Recursive Case(s):

Recursion

Base Case(s):
-Simplest form of the problem

Recursive Case(s):
-Divide problem into smaller instances

Recursion

Base Case(s):
-Simplest form of the problem

Recursive Case(s):
-Divide problem into smaller instances
-Invoke function (recursively)

Recursion

Base Case(s):
-Simplest form of the problem

Recursive Case(s):
-Divide problem into smaller instances
-Invoke function (recursively)
-Work towards base case

The Fibonacci Sequence

So what is the fibonacci sequence?

The Fibonacci Sequence

So what is the fibonacci sequence?

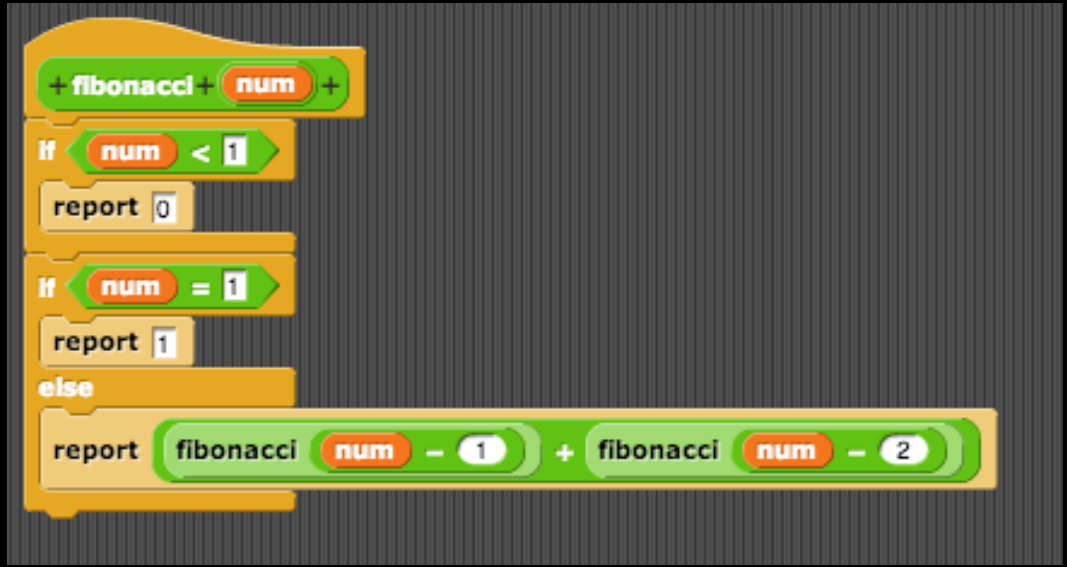
- they are the numbers 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, …
- “in mathematical terms, the sequence F_n of Fibonacci numbers is defined by the recurrence relation

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

The Fibonacci Sequence

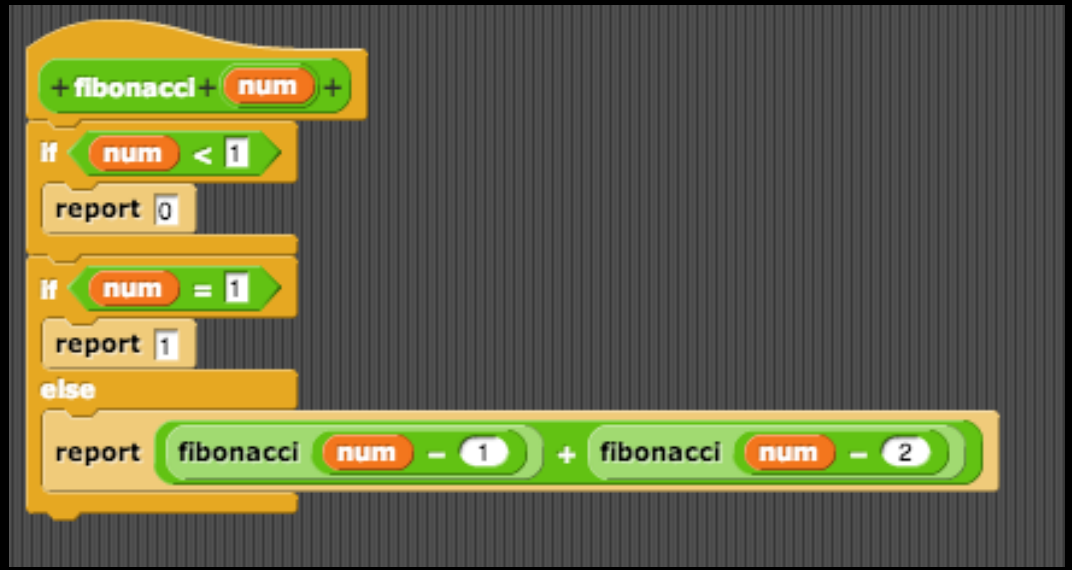
$F_n = F_{n-1} + F_{n-2}$ with seed values $F_0 = 0$, $F_1 = 1$ ”

- we can turn this recurrence relation into a recursive function in Snap



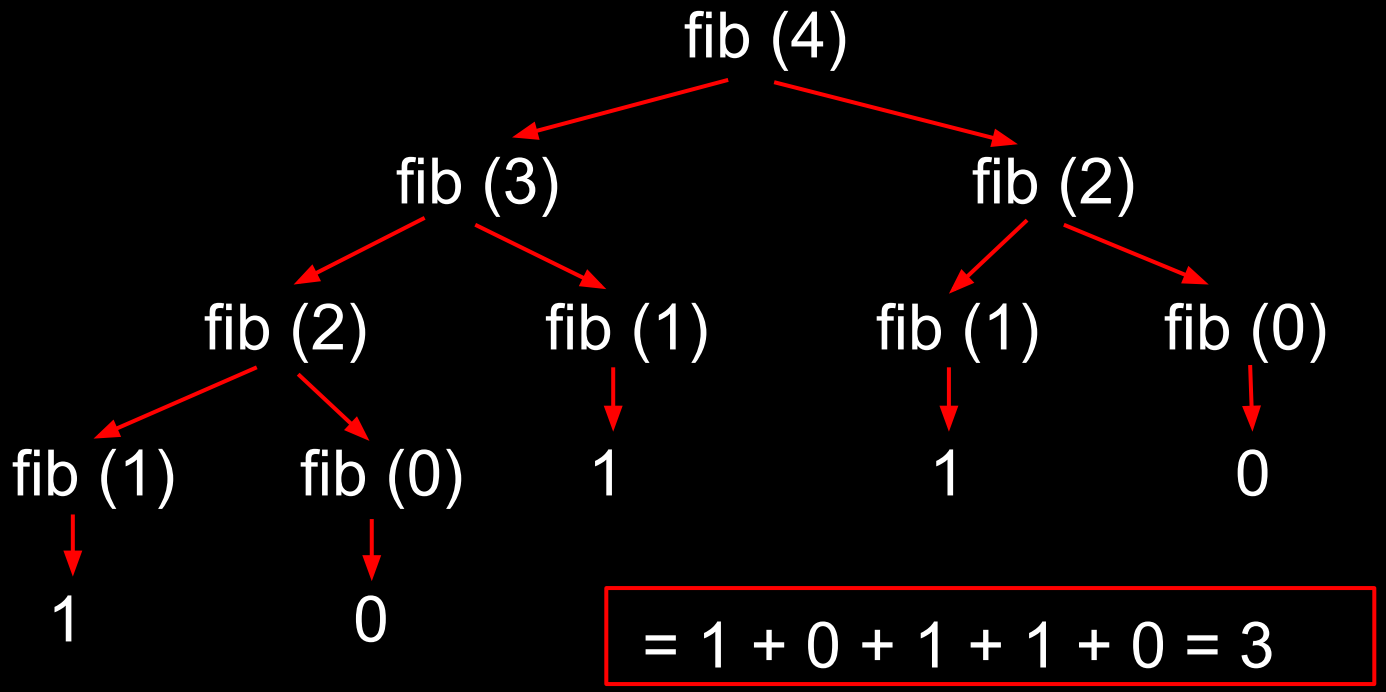
The Fibonacci Sequence

- the fibonacci block actually has two base cases
- there are also two recursive calls of the fibonacci block in the recursive case



The Fibonacci Sequence

* fib short for fibonacci



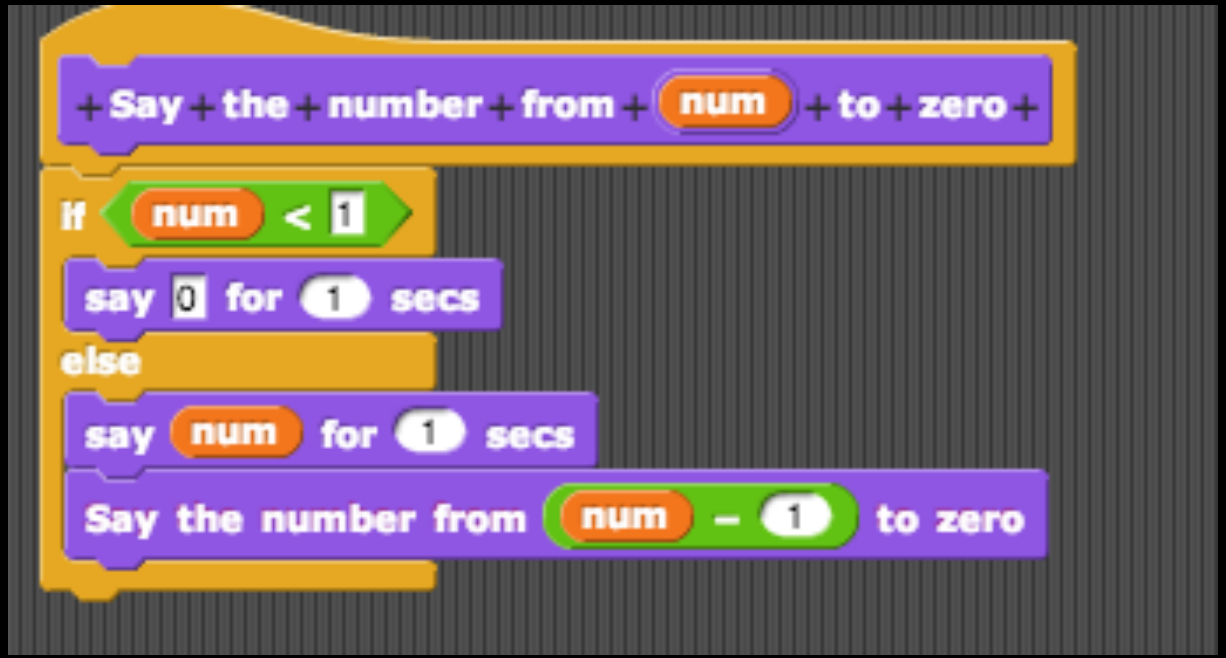
Practice Problems

Note: Most of these problems will require you to first import the “List Utilities” and “Words, sentences” libraries. Also remember to use recursion in your solutions.

Say My Name, Say My Name

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

Say My Name, Say My Name

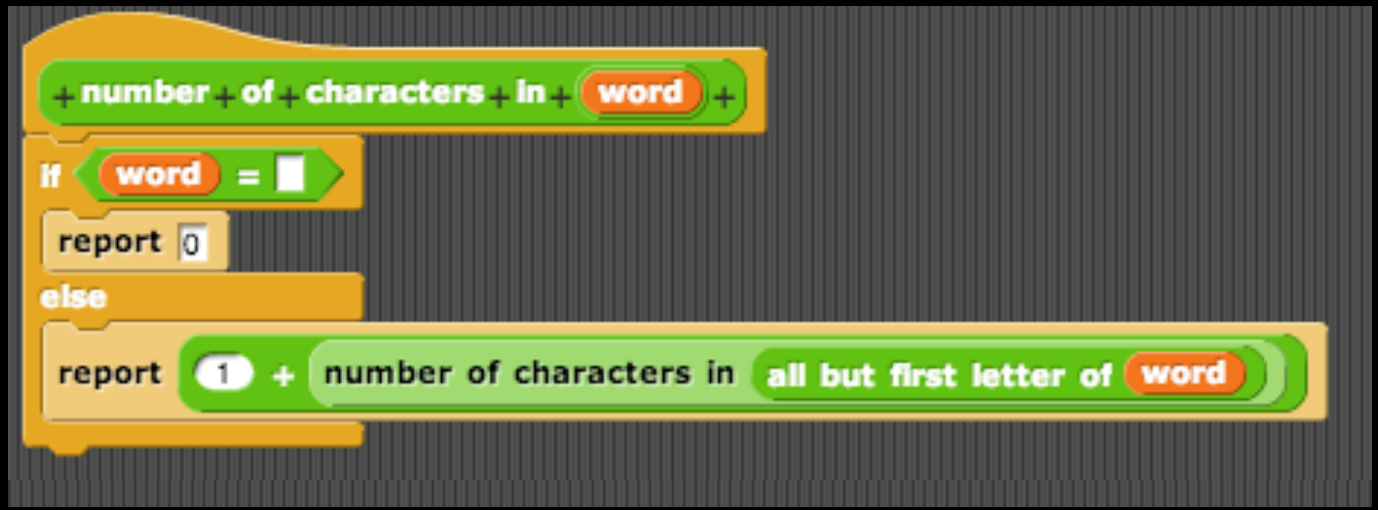


I Got 99 letters but a “B” ain’t one

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

HINT:

I Got 99 letters but a “B” ain’t one

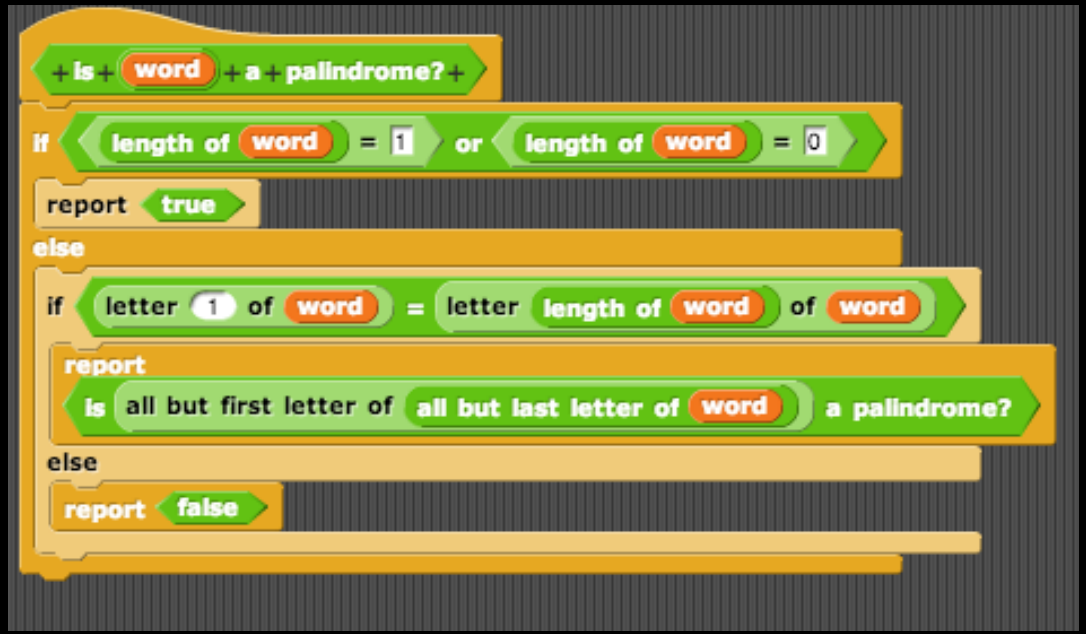


O.N.I.F.C.F.I.N.O.

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

HINTS:

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

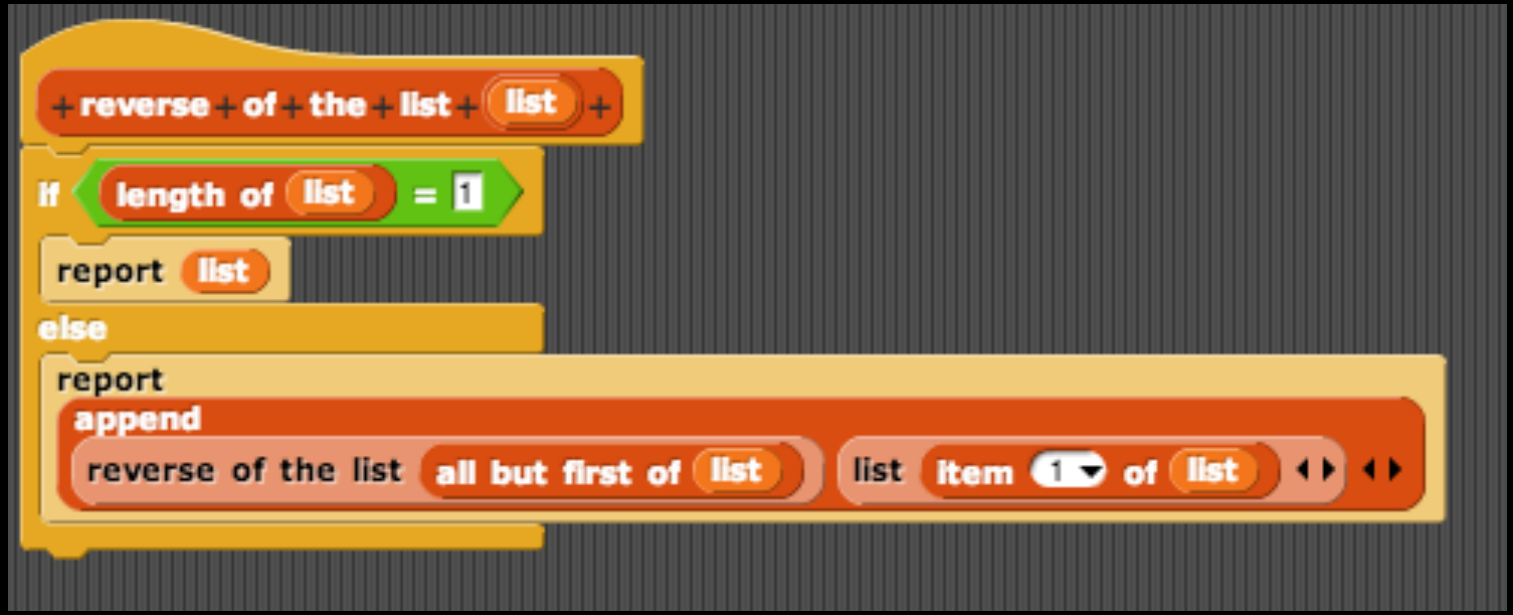

+ is + word + a + palindrome? +
if length of word = 1 or length of word = 0
report true
else
if letter 1 of word = letter length of word of word
report
is all but first letter of all but last letter of word a palindrome?
else
report false

Smack My List Up

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

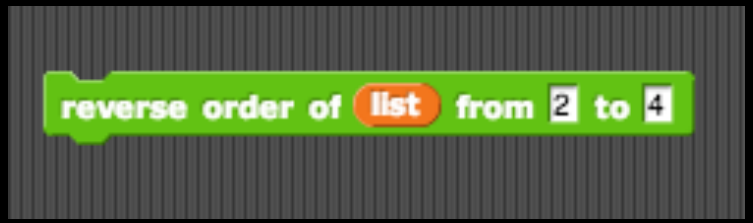
HINTS:

Smack My List Up



Smack (Part of) My List Up

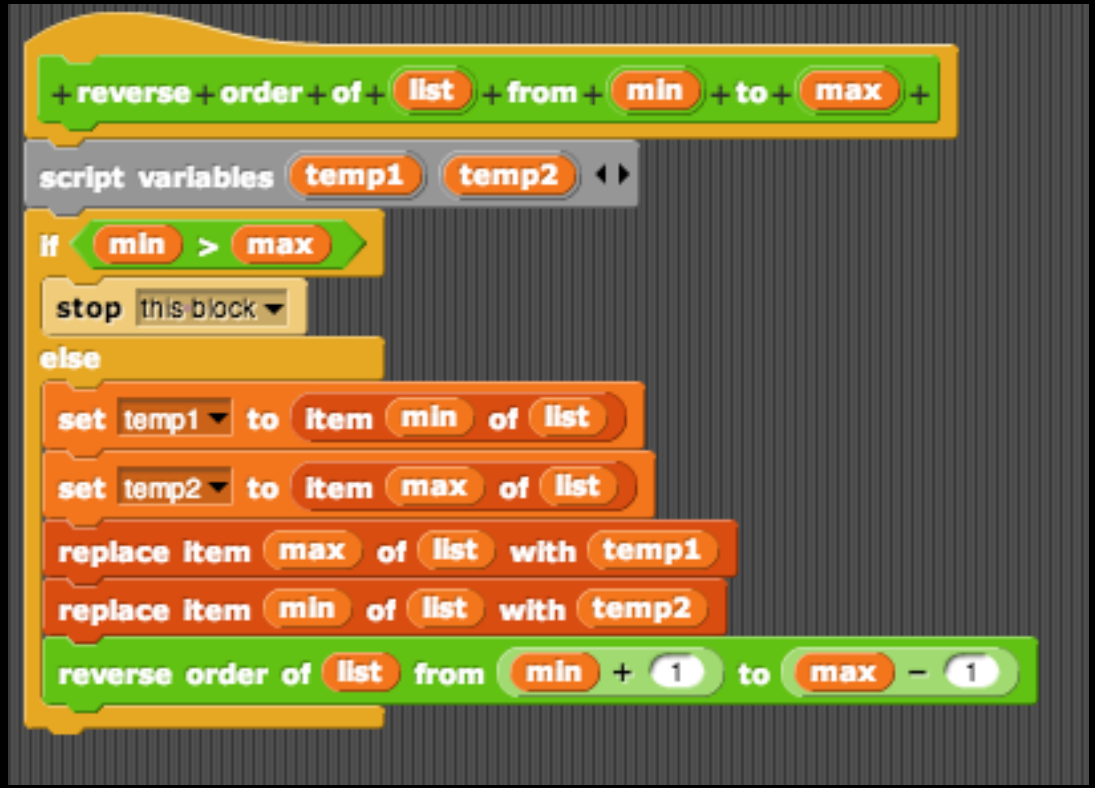
Given a list, a minimum number and maximum number as input, reverse the order of the list, but only for items within the range of minimum to maximum.



Original List

List After Block Call

Smack (Part of) My List Up



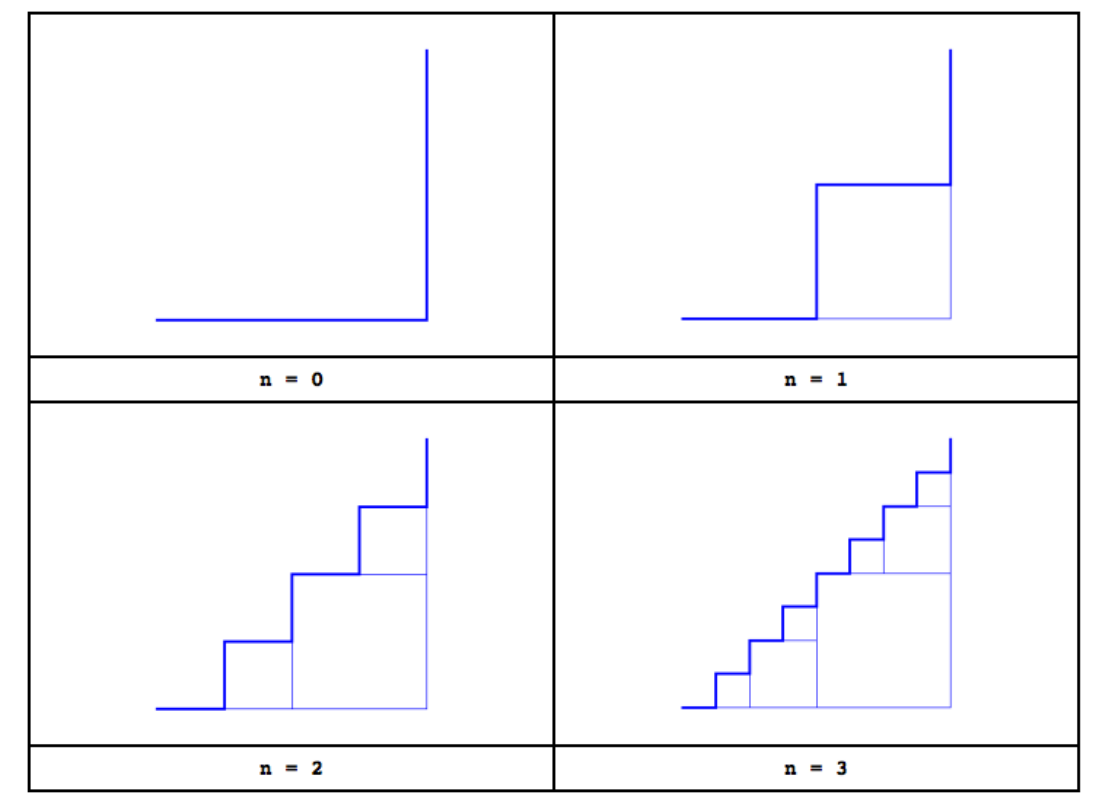
Report Length or Die Trying

Write the 

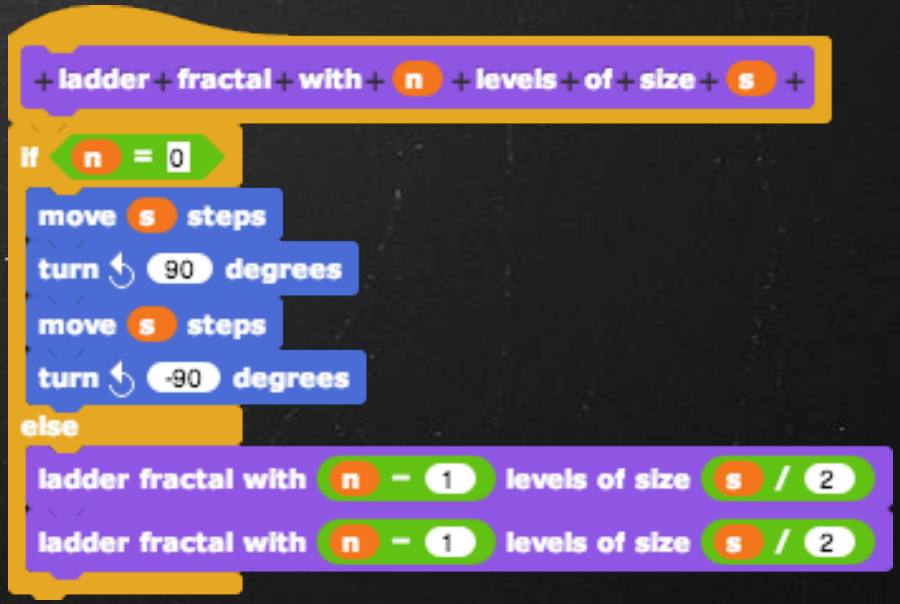
block without using the built-in Snap! block.

Report Length or Die Trying

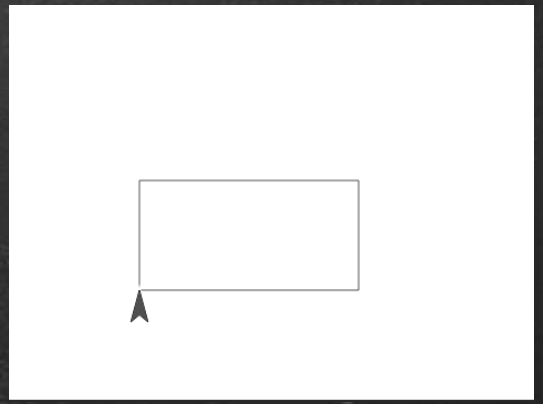
Ladder Fractal

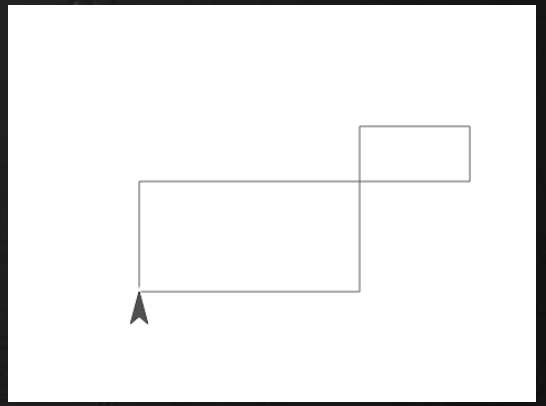


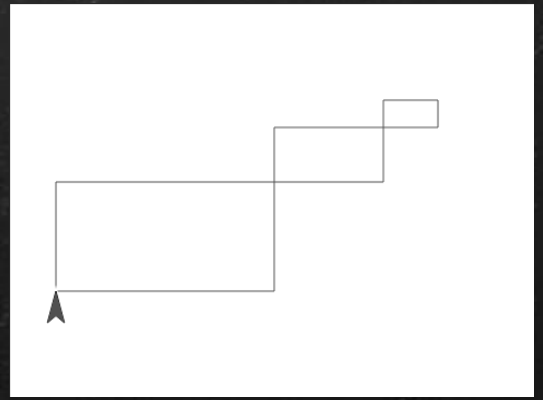
Ladder Fractal Solution

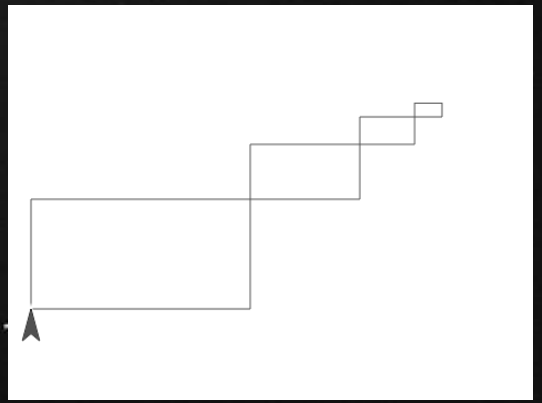


Rectangle Fractal









Rectangle Fractal Solution