

# Lecture 10: Recursion

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CS 51P

October 9, 2018

# Example: Palindromes

EVE

CIVIC

MADAM

AVID DIVA

STEP ON NO PETS

STRESSED DESSERTS

ABLE WAS IERE I SAW ELBA

LIVED ON DECAF FACED NO DEVIL

# Example: Palindromes

- One way to think about palindromes:

ABLE WAS I ERE I SAW ELBA  
...

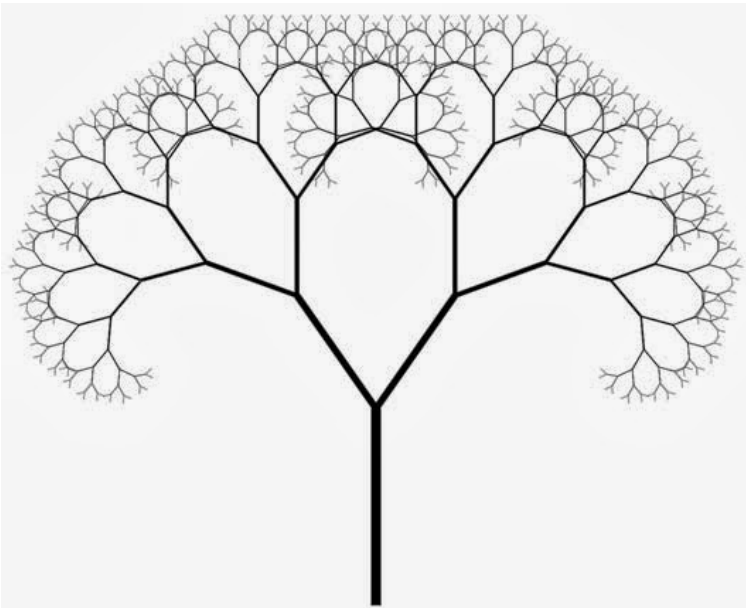
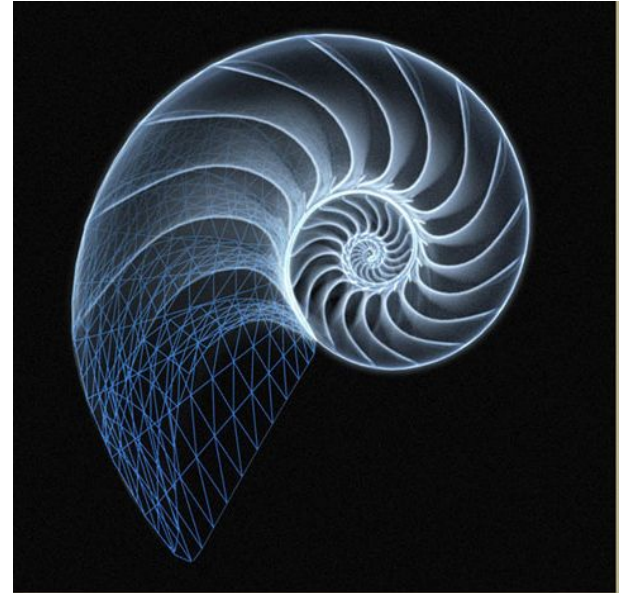


- Another way to think about palindromes:

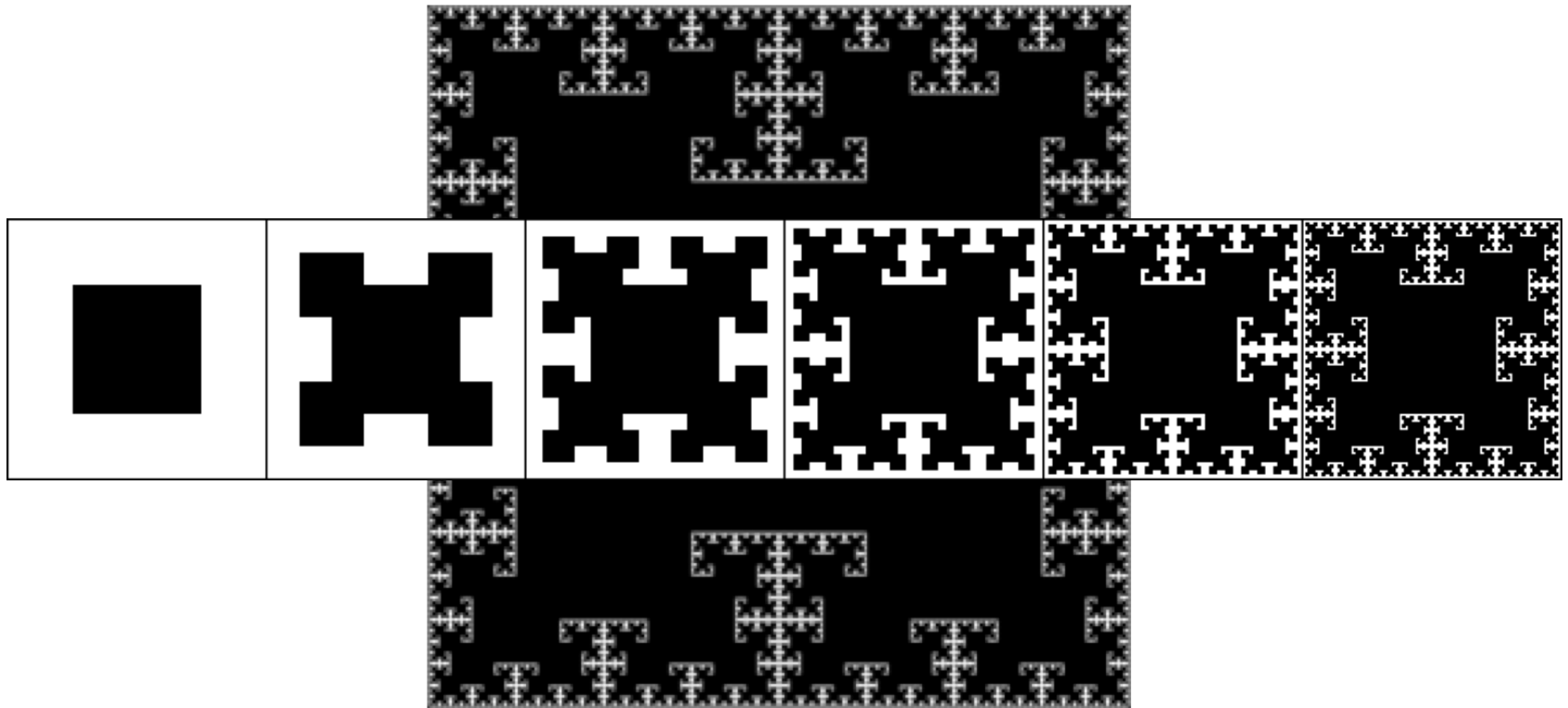
ABLE WAS I ERE I SAW ELBA



# Recursion

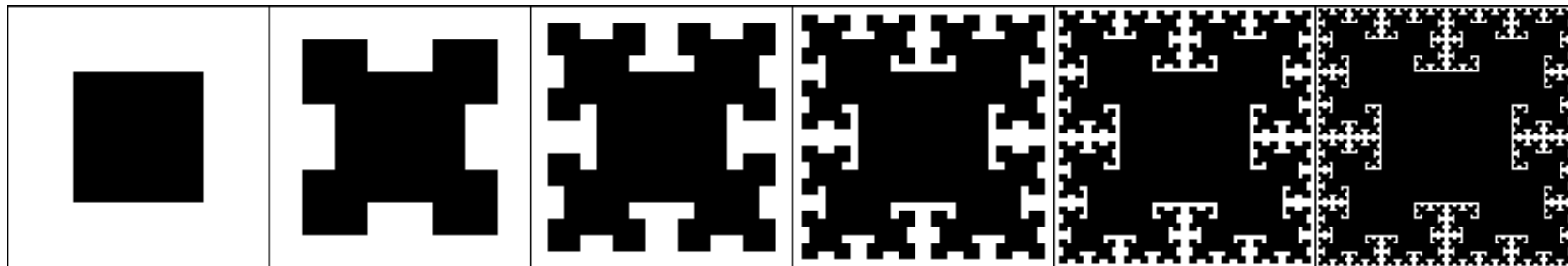


# Recursion



# Recursive definition

- a  $x$  is  $y$  plus  $\#$  smaller  $x$ . unless it is very small, in which case it is  $z$ .
- A  $t\_square$  is a square
  - plus 4 smaller  $t\_squares$ 
    - of half the size
    - centered at each of the corners of the large square
  - unless it's very small in which case it's nothing



# Example: matryoshka

a  $_x_$  is  $_y_$  plus  $_#_$  smaller  $_x_$ . unless it is very small, in which case it is  $_z_$ .

- What is a matryoshka?

a matryoshka is a doll plus 1 smaller matryoshka. unless it is very small, in which case it is nothing.

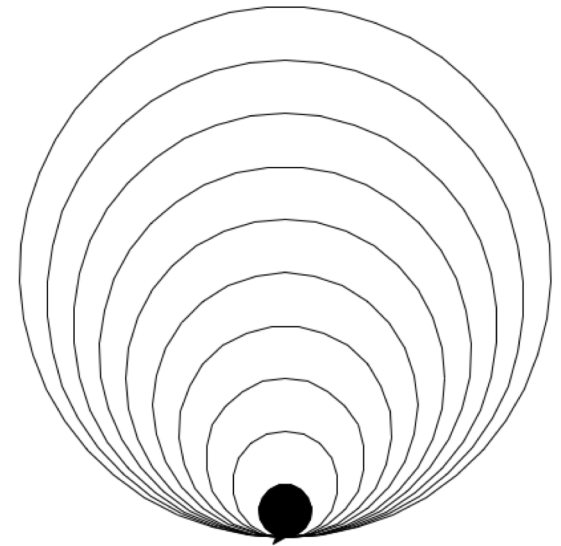


# Example: circle\_drawing

a `_x_` is `_y_` plus `_#_` smaller `_x_`. unless it is very small, in which case it is `_z_`.

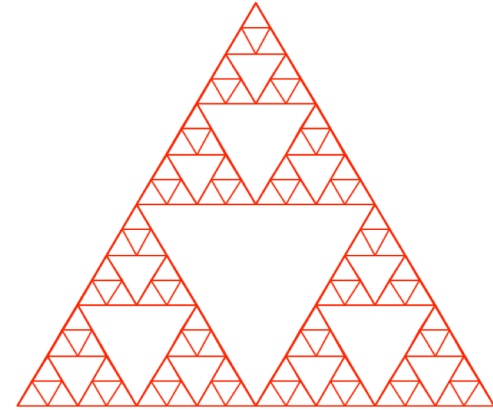
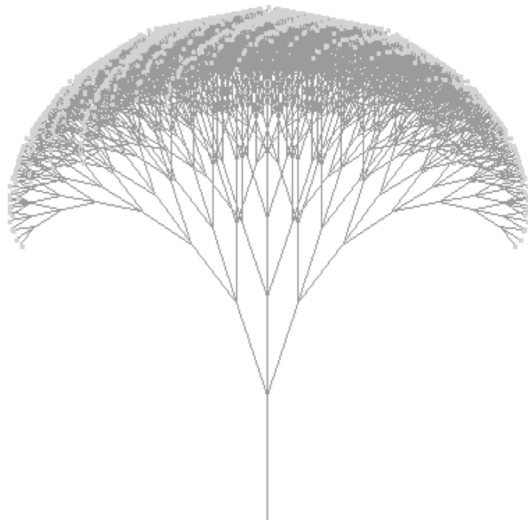
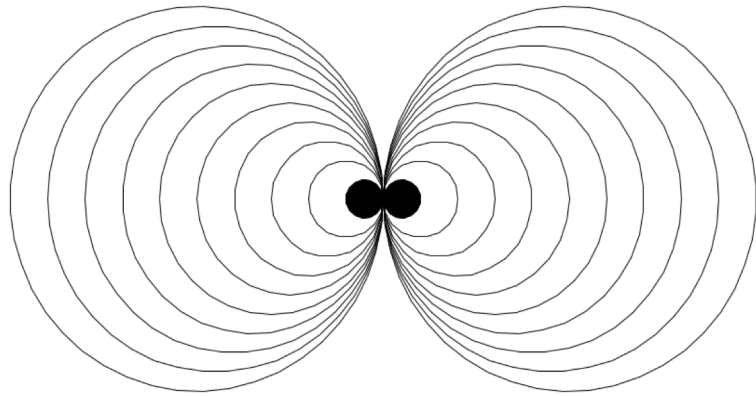
- What is a `circle_drawing`?

a `circle_drawing` is a circle plus 1 smaller `circle_drawing`. unless it is very small, in which case it is a filled circle





# Exercise: seeing recursion



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# Recursion

- Recursive functions are functions that call themselves

recursion

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Did you mean: **recursion**

Circular definition: a definition that is circular

# Avoiding Infinite Recursion:

## 1) Define a base case:

- Some conditions when the function doesn't recursively call the function (usually the "smallest" case)

## 2) Define a recursive case:

- Some conditions when the function recursively calls itself
- Make sure it calls itself with different (usually "smaller") arguments!

**Sanity Check:** does the recursive case create smaller/simpler versions of itself? will the code eventually reach the base case?

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# Exercise

```
def mystery(n):  
    if n == 1:  
        return 1  
    else:  
        return n + mystery(n-1)
```

- what is returned by `mystery(3)`? `mystery(5)`?  
`mystery(k)`?

# Exercise

- Fibonacci numbers:

1, 1, 2, 3, 5, 8, 13, 21, ...

- Define a function `fib` which takes a parameter `n` (an int) and returns the  $n^{\text{th}}$  Fibonacci number