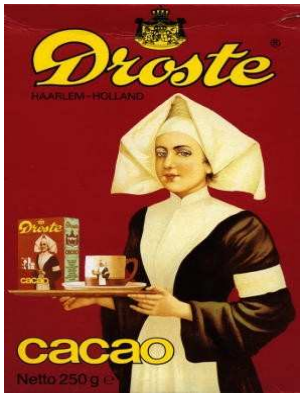
Recursion

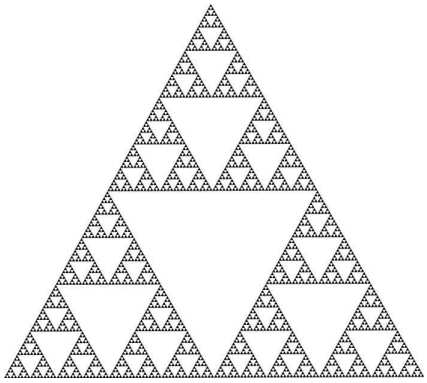
Binary Search

- If the list is empty, the answer is False.
- Otherwise, check the midpoint of the list.
- If the desired item is found there, then you are done. The answer is True.
- If the desired item is greater than the midpoint, forget about the first half of the list, and repeat the process on the second half of the list.
- If the desired item is smaller than the midpoint, forget about the second half of the list, and repeat the process on the first half of the list.

Merge Sort

- If the list is empty or has length 1, there is nothing to sort. We are done.
- Otherwise, split the list in two halves.
- Sort each of the the halves by doing the same thing for them.
- Merge the sorted halves back together.





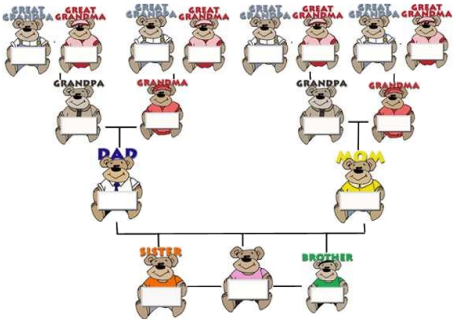
Dragon Fractal

- 0, 1, 2, 3, 4, ...
- http://www.youtube.com/watch?v=BnUTikyR1CU

Recursion in Language

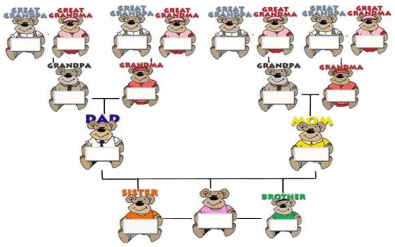
- the mouse squeaked
- the cat that chased the mouse that squeaked meowed
- the dog that chased the cat that chased the mouse that squeaked meowed barked
- ...

Define 'Ancestors'



Ancestors

- Your parents are your ancestors.
- The parents of your ancestors are your ancestors as well.



Natural numbers

- 0, 1, 2, 3, 4, ...
-

Natural numbers

- 0, 1, 2, 3, 4, ...
- 0 is a natural number.
- If x is a natural number, then x+1 is one, too.

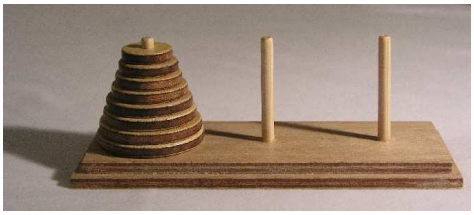
The Base Case

- the special case which stops the recursion
- You always need a base case. Otherwise your program will run forever.

The Recursive Case

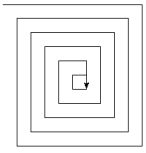
- the case in which a function calls itself with “smaller” input
- or: a structure that is built using a similar but smaller structure
- The recursive call must always work towards the base case. Otherwise your program may run forever.
- Typically, the recursive case divides the problem into smaller problems that are closer to the base case. (Divide and conquer.)

The Tower of Hanoi



Drawing Turtles

- Imagine we have a robot turtle which has a pen attached to it such that it draws a line wherever it goes.
- This robot understands the following commands:
  - forward(distance)
  - left(degree)
  - right(degree)
- Specify a recursive algorithm that steers this robot turtle to draw a square spiral of any given size.



Exercises

- Download binsearch.py and add print statements that show when the function is being called and when it returns, what parameters it is called with and what it returns.
- Do the same thing for mergesort.py.
- Python has a built-in module called turtle.py which lets you control a virtual pen carrying turtle. Download spiral.py. Complete the function draw_spiral such that it steers the turtle to draw a spiral of a given size.