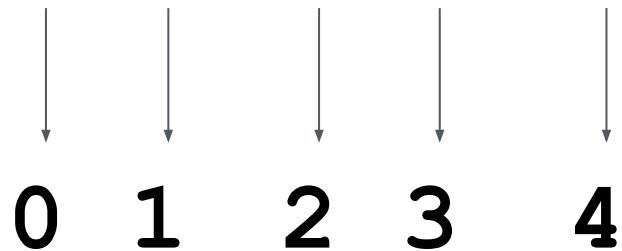


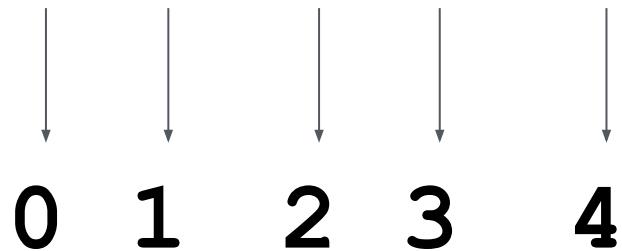
# **RECUSION AND FRACTALS**

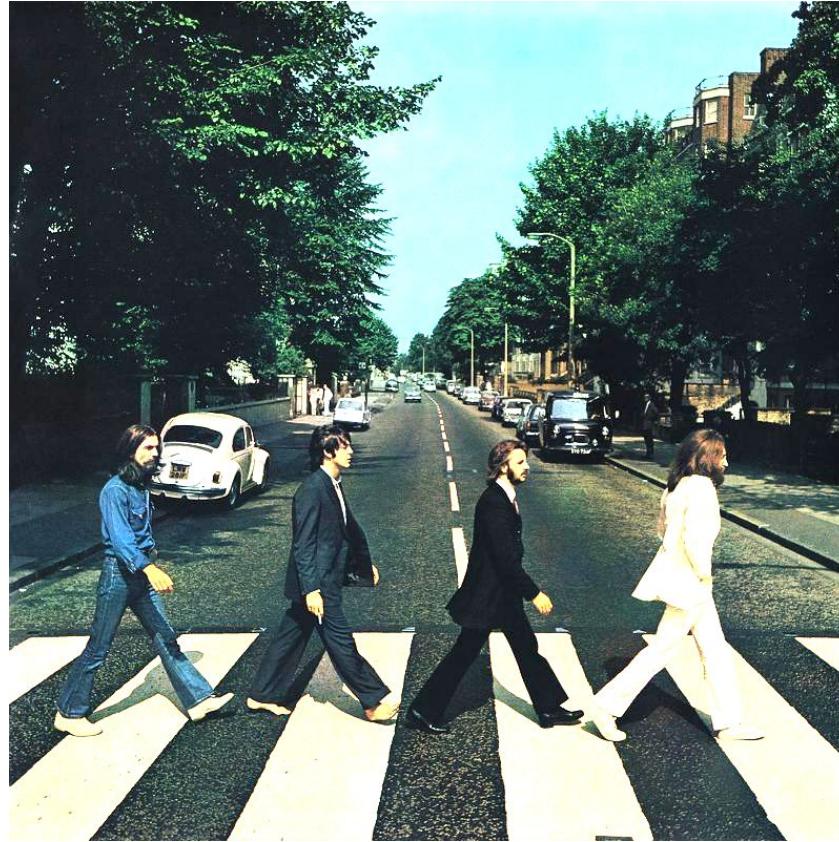
**ARRAY** is a list of variables

```
int someNumbers = [6, 98, 56, 42, 12]
```



```
int someNumbers = [6, 98, 56, 42, 12]
```





```
String [ ] beatles = {"George", "Paul", "Ringo", "John"}
```

**Pixel Array**

PIXELS ON SCREEN						
	x	0	1	2	3	4
y		0	1	2	3	4
		5	6	7	8	9
		10	11	12	13	14
		15	16	17	18	19
		20	21	22	23	24
		25	26	27	28	29

PIXEL ARRAY

Row index	0	1	2	3	4	5	6	7	8	9	10	11	12	13
	R	G	B	A	R	G	B	A	R	G	B	A	R	G
Pixel number	0	1	2	3	4	5	6	7	8	9	10	11	12	13

```
array([[[224, 167, 0],
       [233, 175, 5],
       [241, 181, 22],
       [222, 161, 10],
       [205, 143, 0],
       [216, 155, 5],
       [234, 174, 18],
       [229, 170, 4],
       [222, 165, 0],
       [231, 175, 0],
       [233, 169, 11],
       [226, 164, 3],
       [223, 161, 0],
       [228, 167, 1],
       [230, 172, 3]],
```

```
[[228, 174, 0],
 [232, 176, 5],
```

x →

0 1 2 3 4

y	0	1	2	3	4
1	5	6	7	8	9
2	10	11	12	13	14
3	15	16	17	18	19
4	20	21	22	23	24

← width = 5 →

Pixel 13 has an x value of 3 and y value of 2.

$$\begin{aligned}x + (y * \text{width}) \\= 3 + (2 * 5) \\= 3 + 10 \\= 13\end{aligned}$$

**Demo Time**

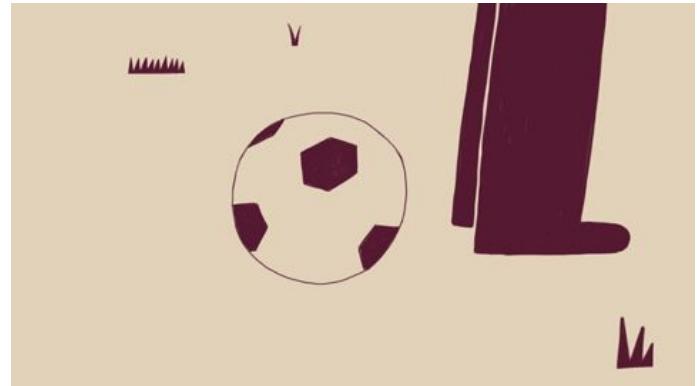
# **RECURSIVE FUNCTIONS**

Where a function call itself

```
void setup() {  
  
    kickTheBall();  
  
}  
  
void kickTheBall() {
```

Fell the ball with your foot;  
Kick it;

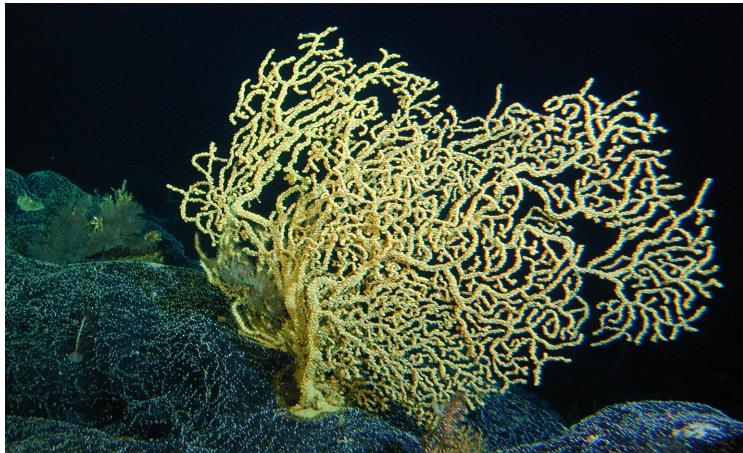
```
    kickTheBall();  
  
}
```



**Demo Time**

**NEVER ENDING PATTERNS! ?**

In nature...

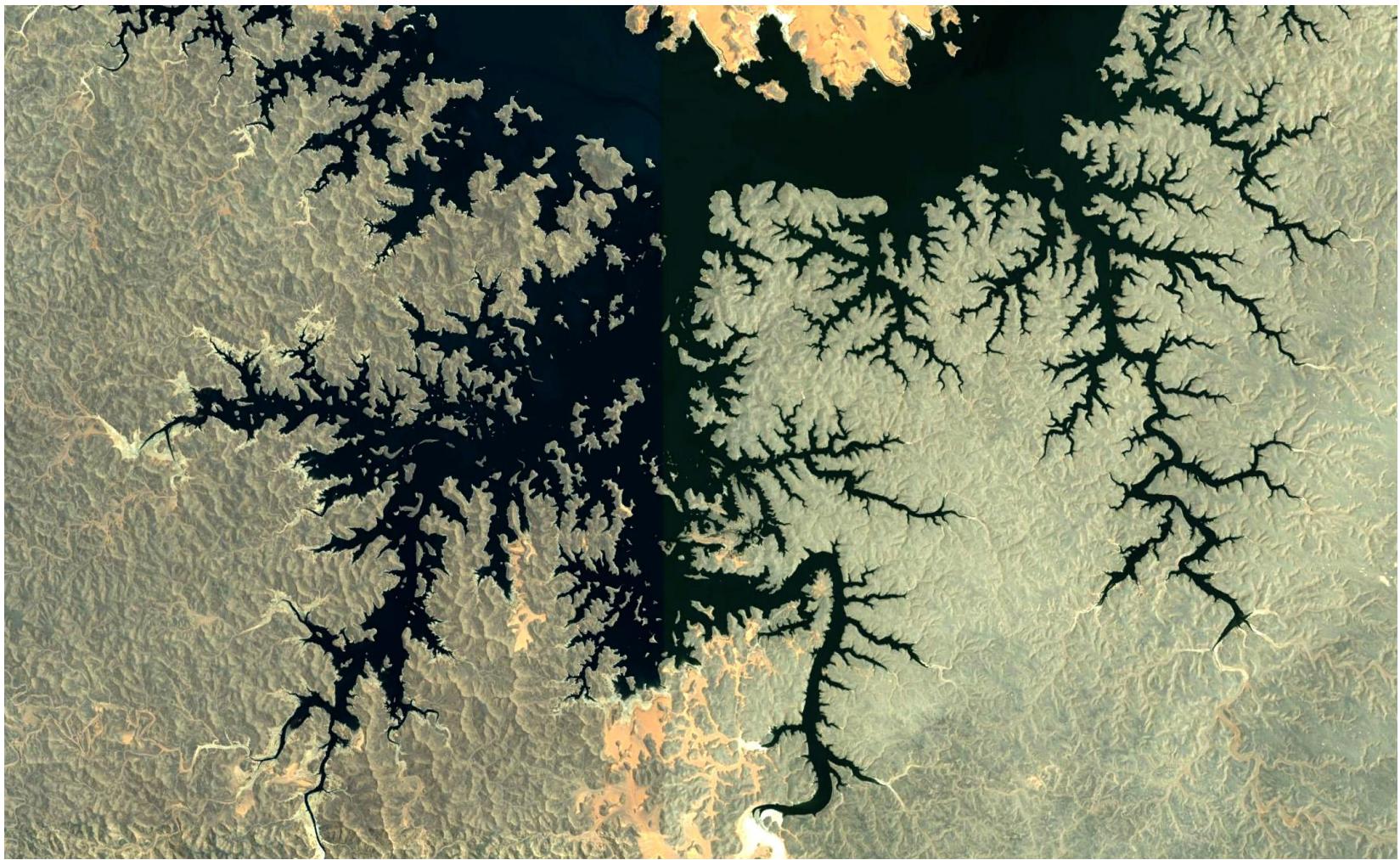


Corals

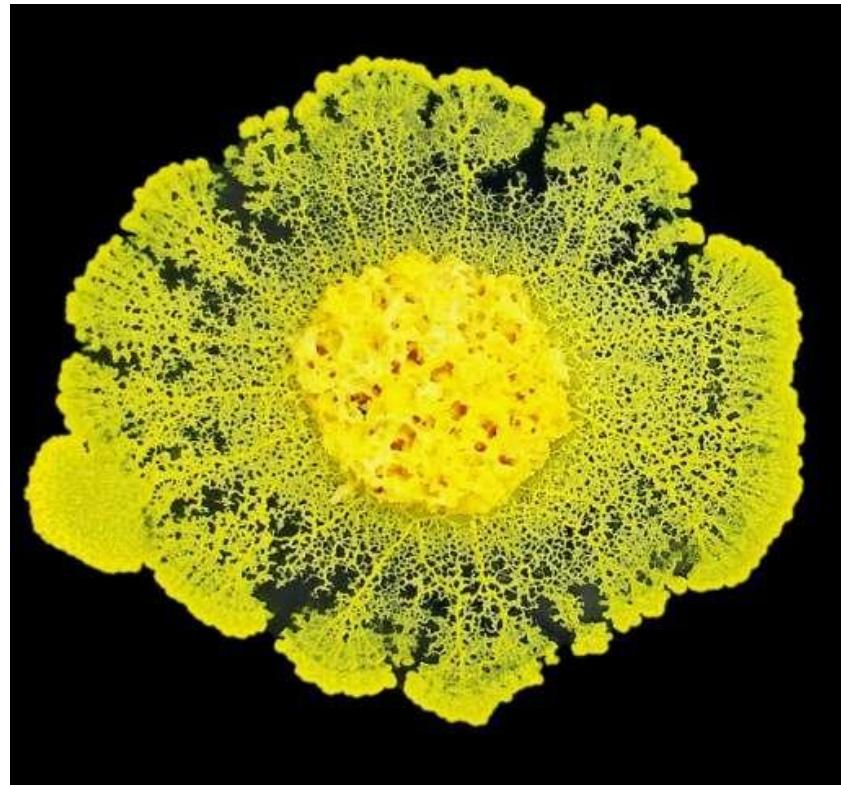
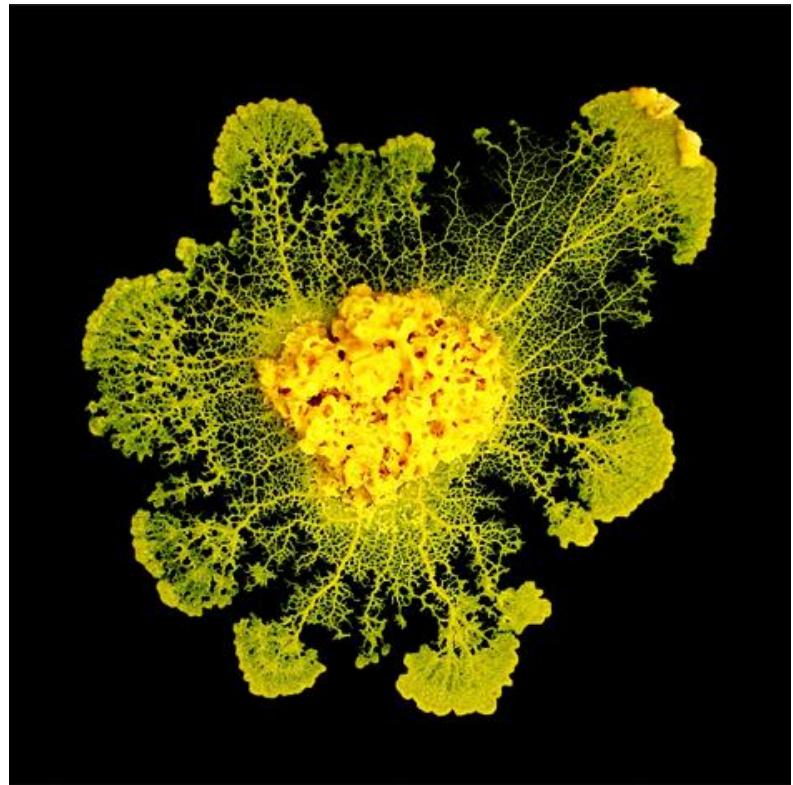


Fern

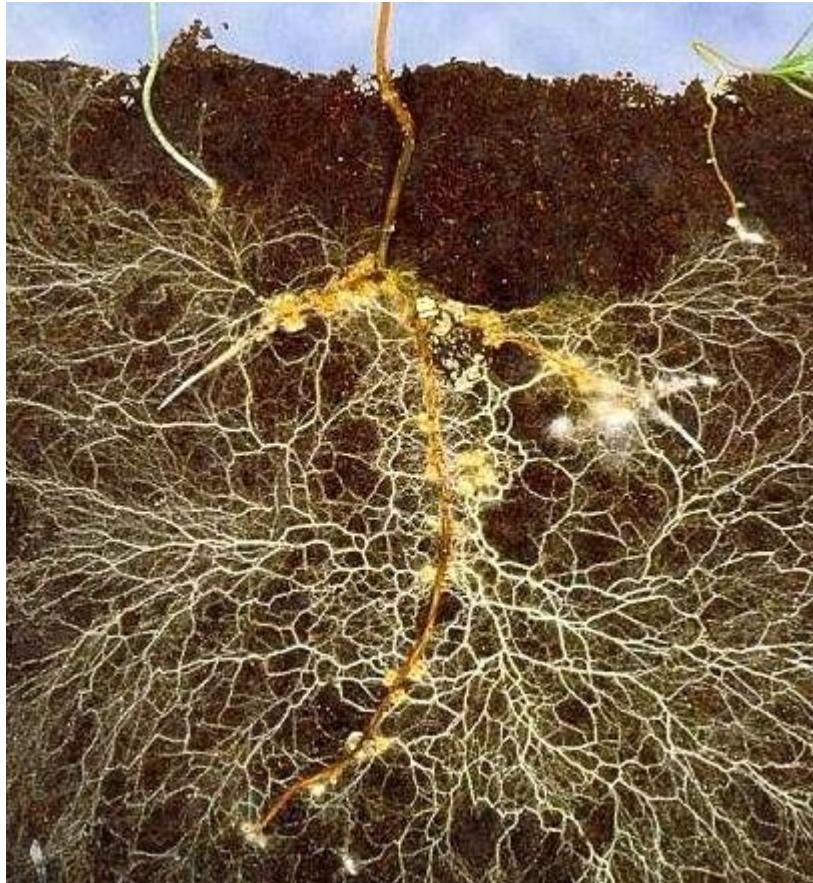




Nile Delta



Slime Mold



Fungus



Romanesco broccoli



Sea Urchin



# FRACTALS

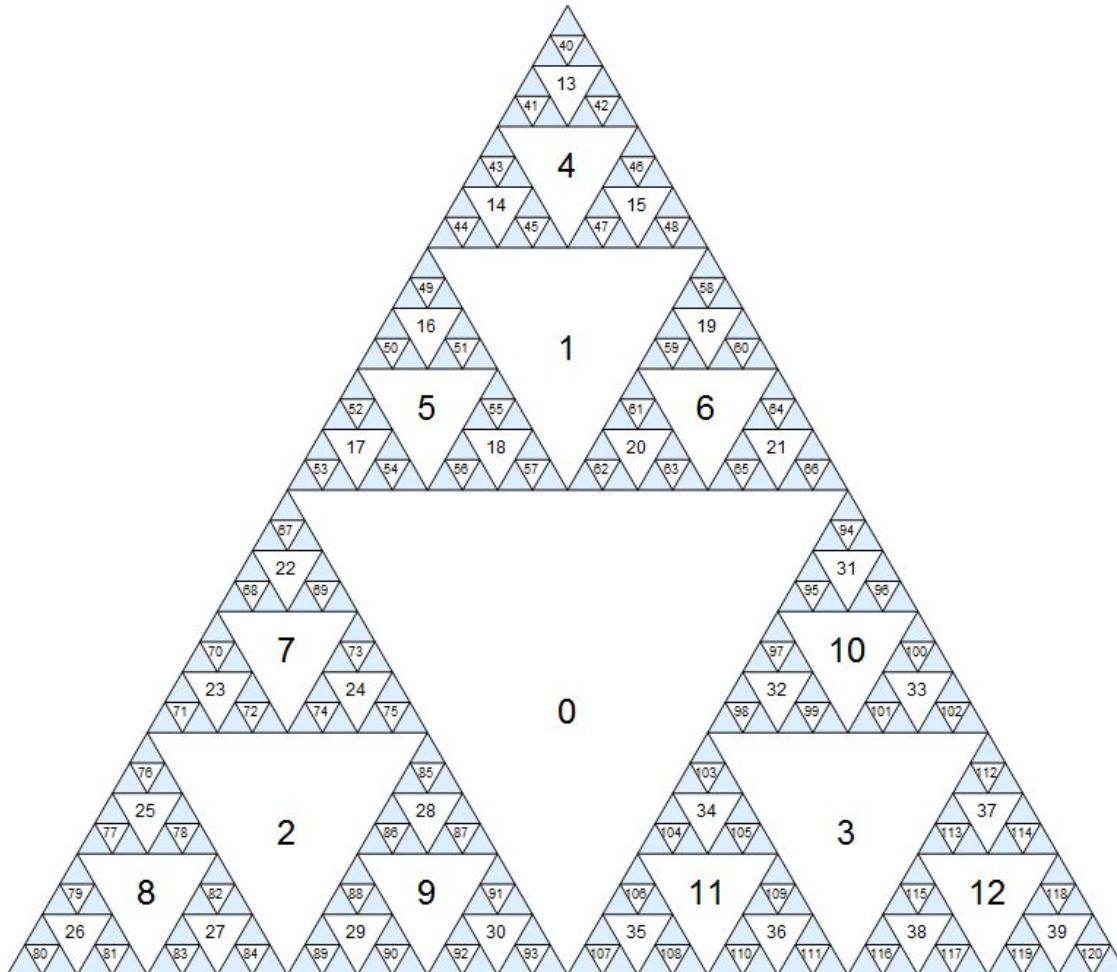
in math

**Fractals** are infinitely complex patterns that are self-similar across different scales.

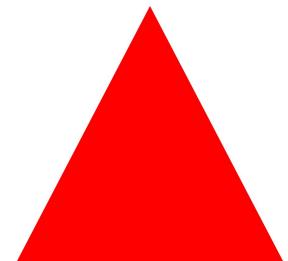
They are created by repeating a simple process over and over in an ongoing feedback loop.

# **FRACTALS**

Detailed,  
Recursive, and  
Infinitely self-similar  
mathematical set

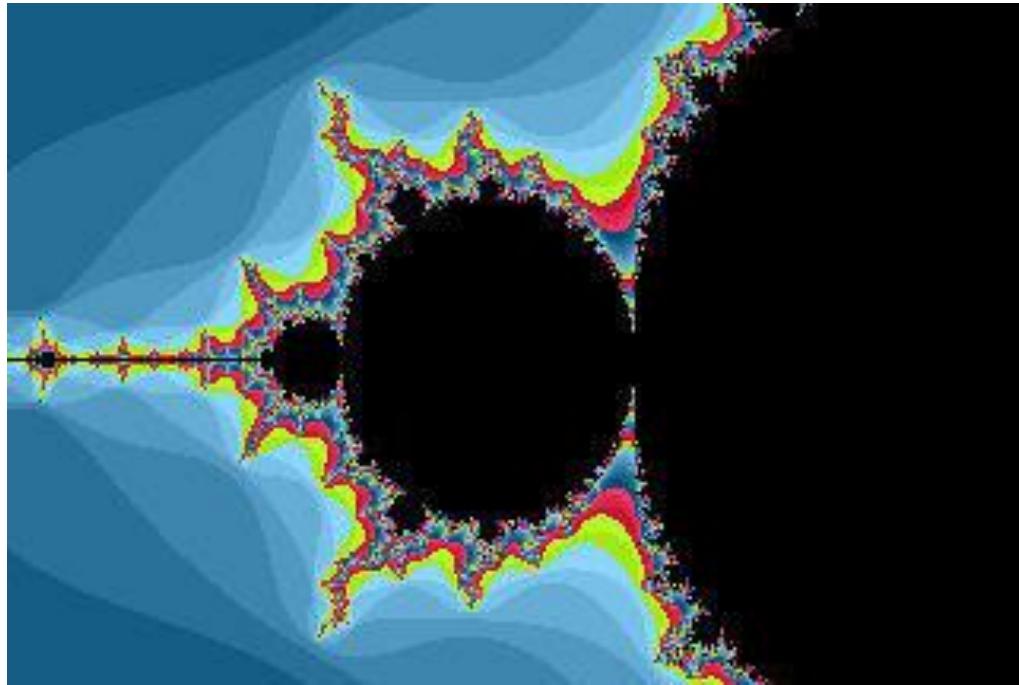


Sierpinski Triangle



The term "**fractal**" was first used by mathematician Benoit Mandelbrot in 1975.

A FRACTAL IS "a rough or fragmented geometric **shape** that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole"

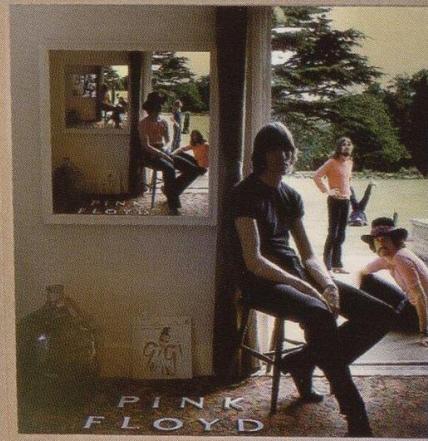


The Mandelbrot Set

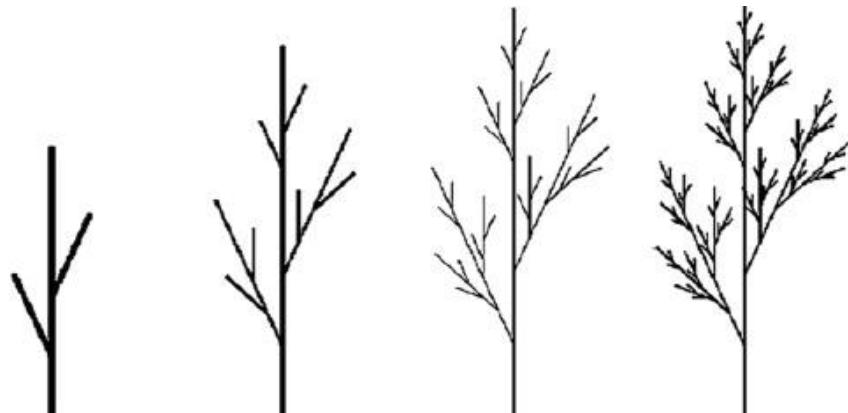


Mandlebulb  
3-dimensional fractal  
constructed by Daniel White  
and Paul Nylande

Crafted  
**FRACTALS**



PINK  
FLOYD



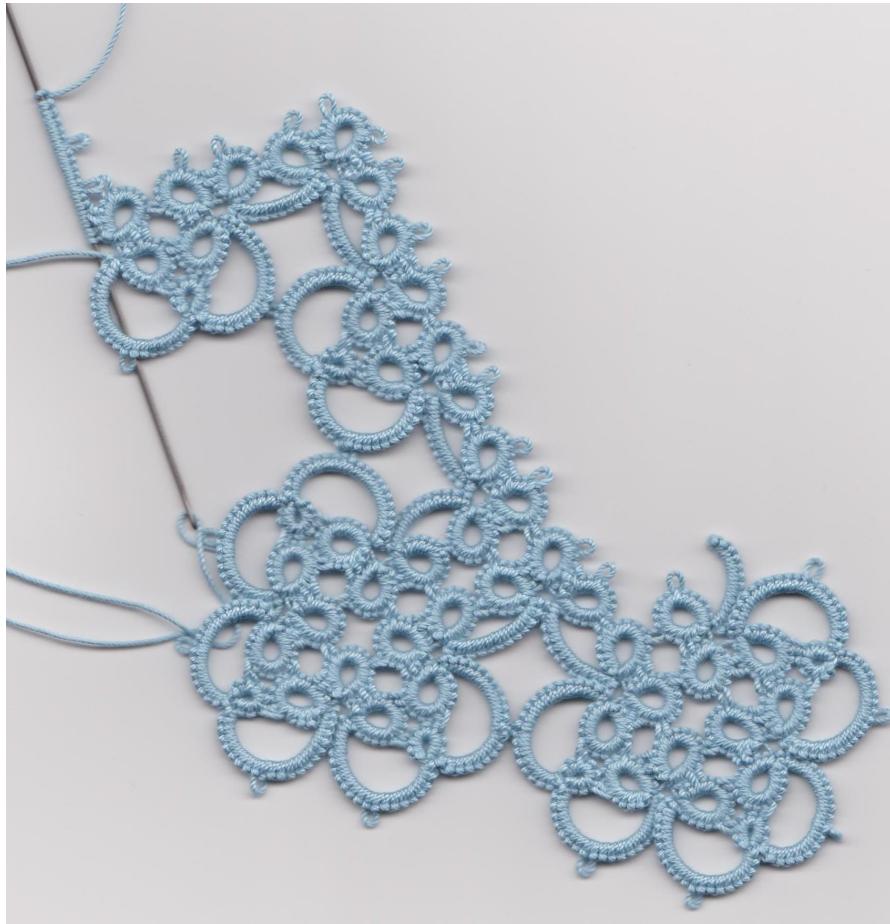
iteration 1

iteration 2

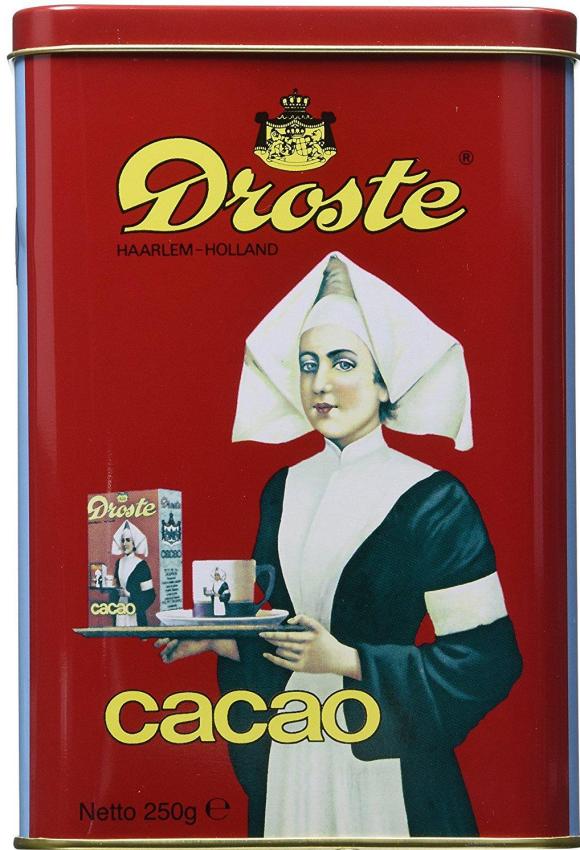
iteration 3

iteration 4











## Coding Fractals

