THE TREE AND THE FOREST

Lior Ben-Gai
December 2019

images by: http://www.yamamotomasao.jp/

WHAT'S NEXT?

You are here

Recursion

Data structures

Raster graphics

3D graphics and vectors

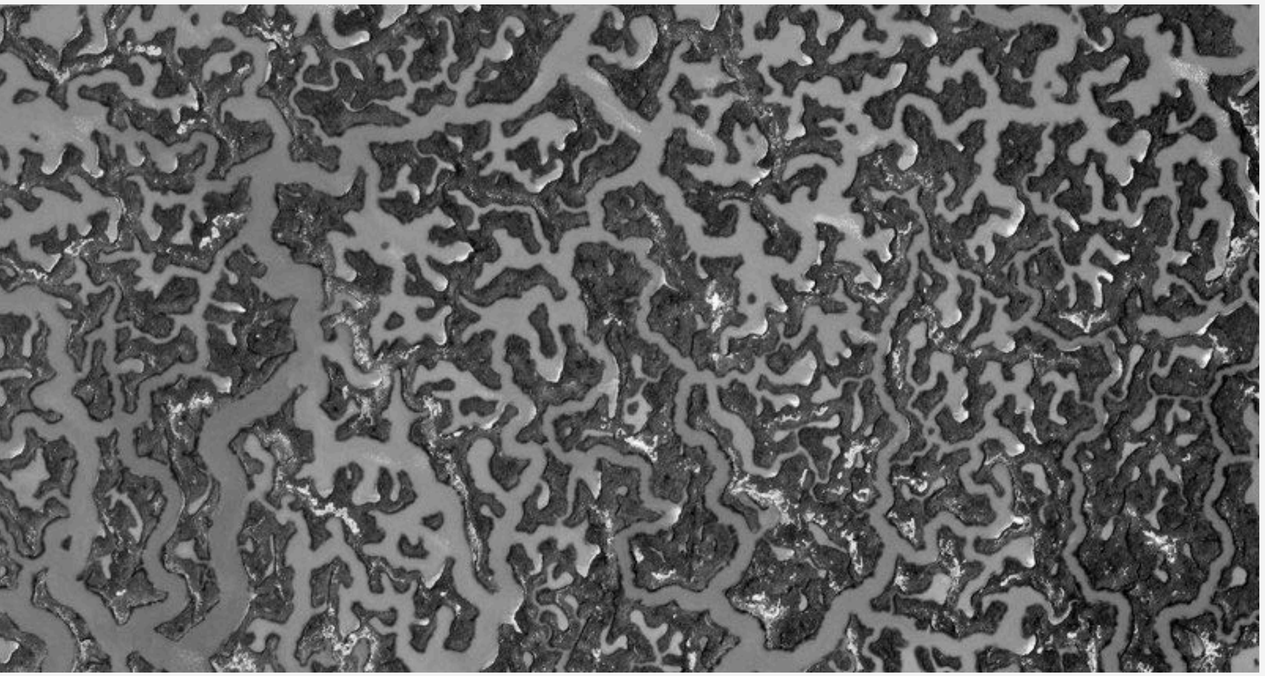
Intro to HTML

conclusion and submission

UMBRA

Malcolm Sutherland

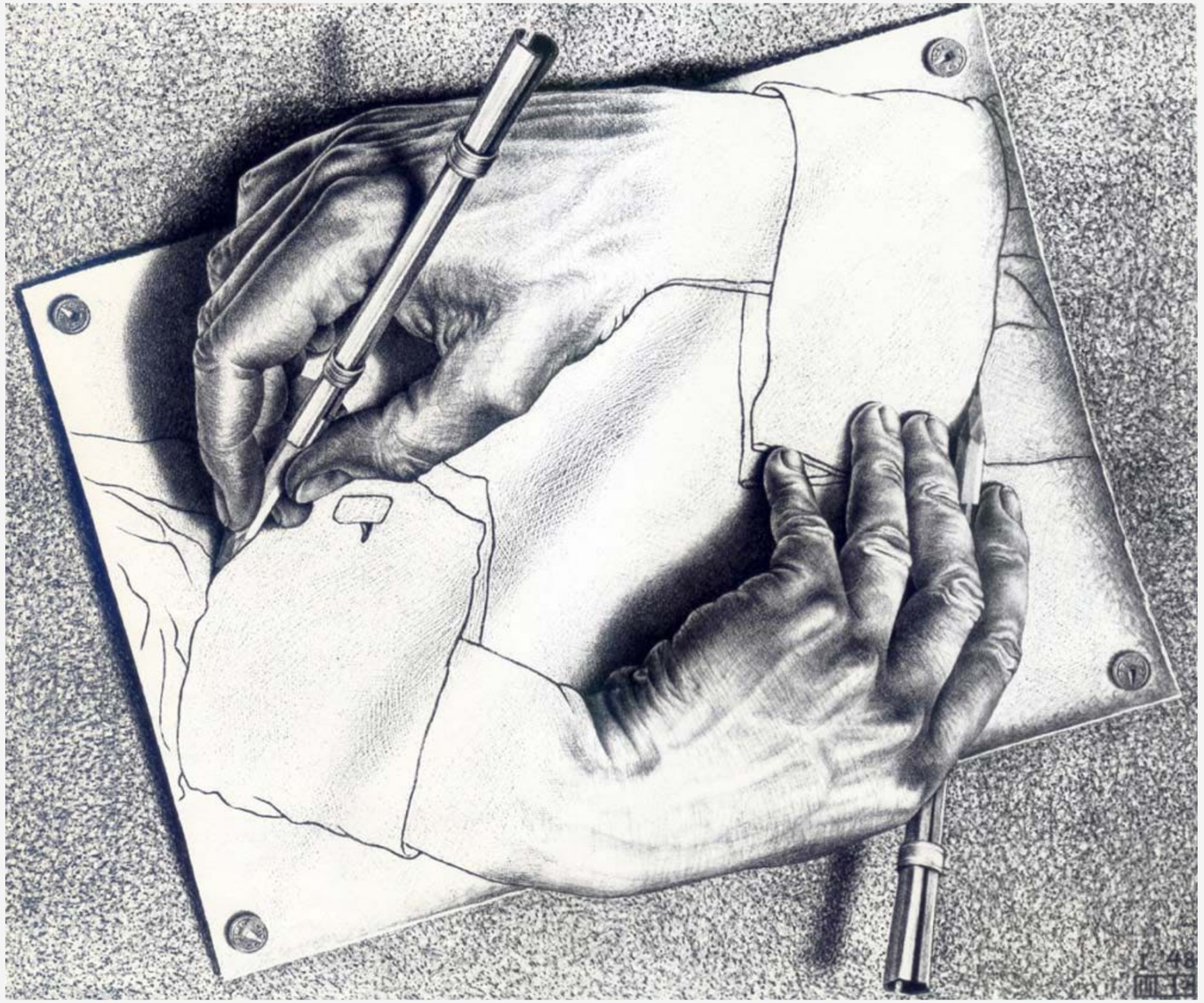
https://vimeo.com/14844291



BIG

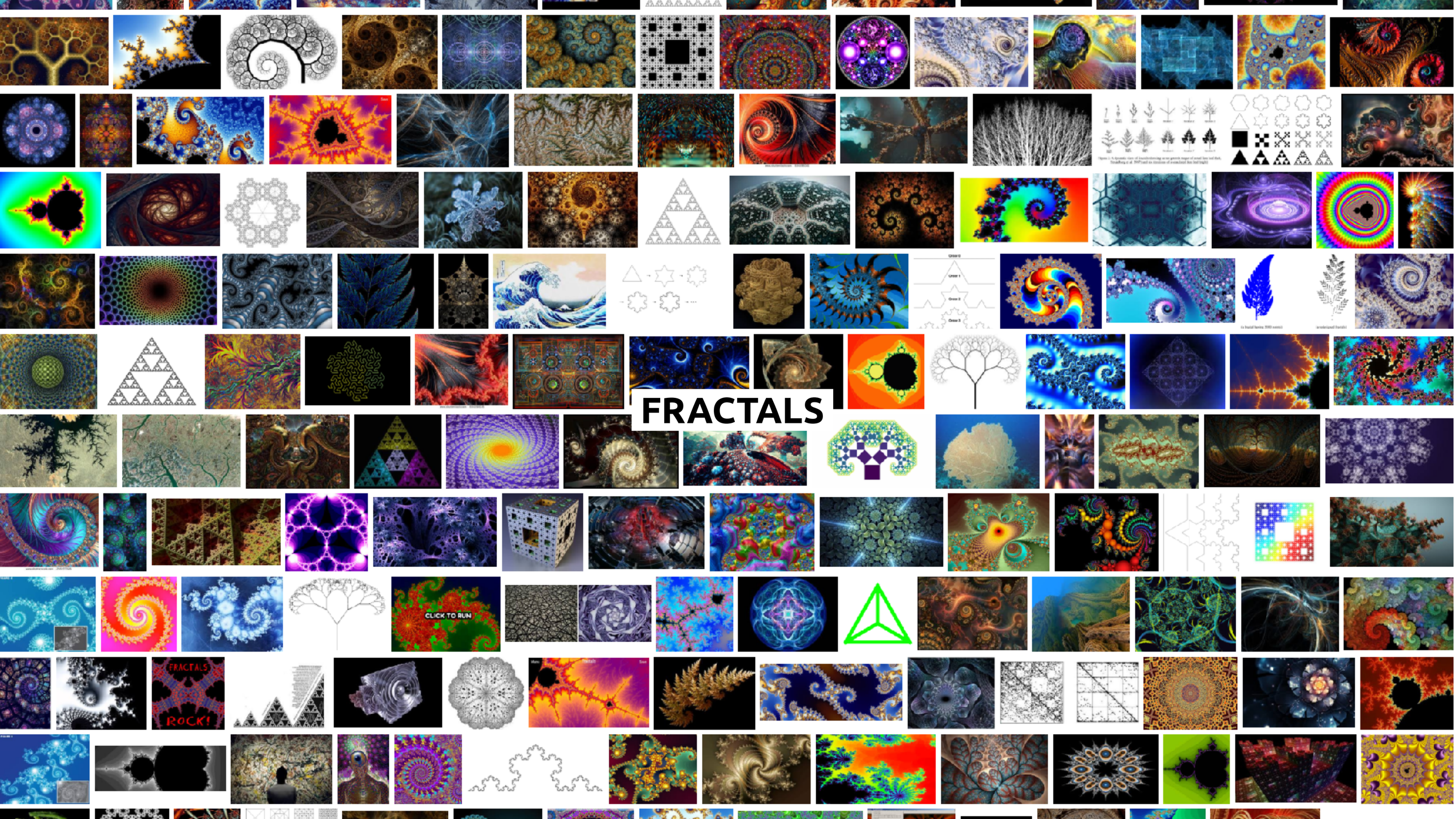
small

SELF-REFERENCE



M.C. Escher
Drawing Hands 1948


PATTERNS IN NATURE
MATH IN NATURE
Patterns in Nature
Horst: Patterns from Nature
PATTERNS OF NATURE


FRACTALS
CLICK TO RUN
FRACTALS
ROCK!

Fractal-like patterns occur widely in nature, in phenomena as diverse as clouds, river networks, geologic fault lines, mountains, coastlines,[38] animal coloration, snow flakes,[39] crystals,[40] blood vessel branching,[41] and ocean waves.[42]

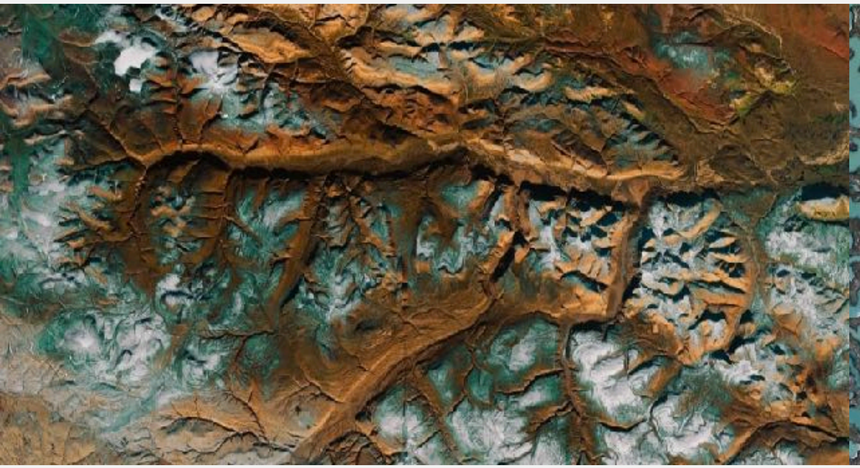
Leaf of cow parsley, *Anthriscus sylvestris*, is 2- or 3-pinnate, not infinite

Fractal spirals: Romanesco broccoli showing self-similar form

Angelica flowerhead, a sphere made of spheres (self-similar)

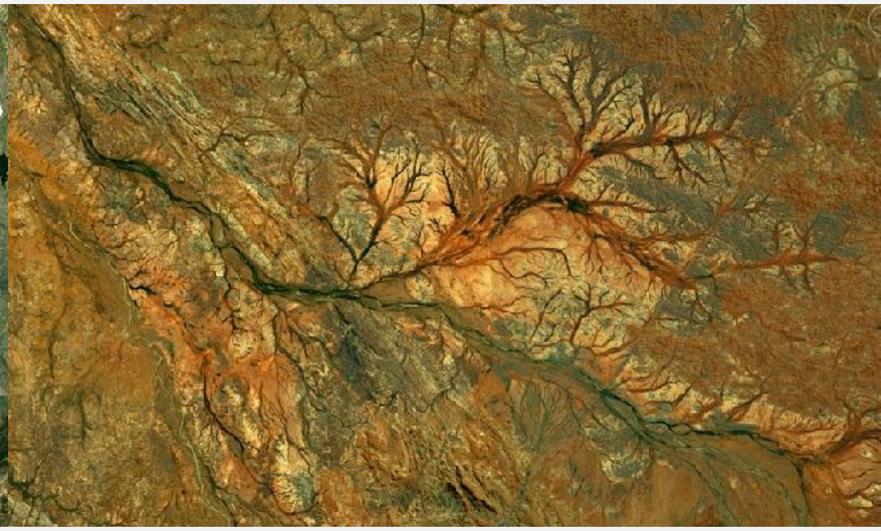
Trees: Lichtenberg figure: high voltage dielectric breakdown in an acrylic polymer block

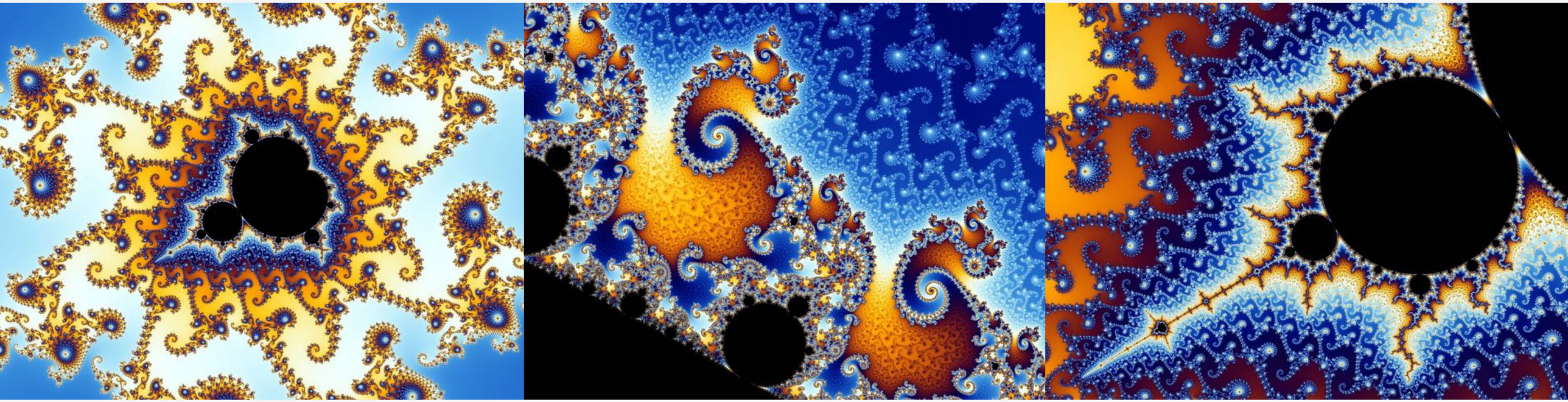
Trees: dendritic copper crystals (in microscope)



http://paulbourke.net/fractals/googleearth/

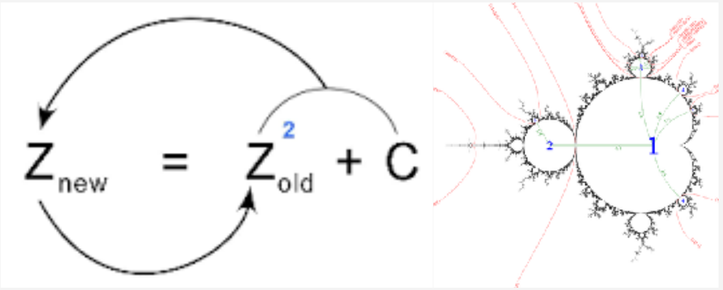


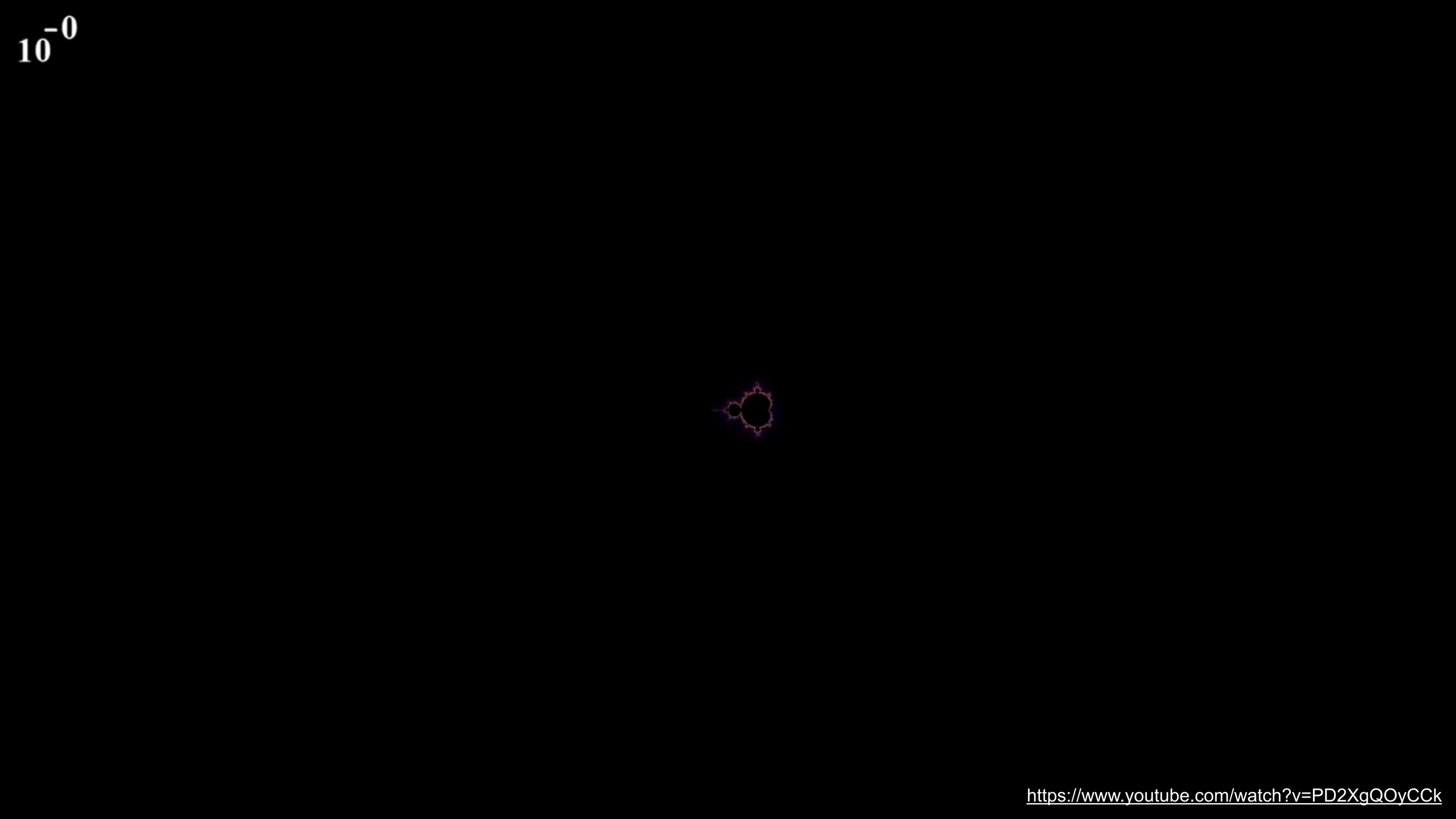




MANDELBROT SET

Benoît Mandelbrot





https://www.youtube.com/watch?v=PD2XgQOyCCk

L-SYSTEMS

https://en.wikipedia.org/wiki/L-system

Example 4: Koch curve [edit]

A variant of the Koch curve which uses only right angles.

variables : F

constants : + −

start : F

rules : (F → F+F−F−F+F)

Here, F means "draw forward", + means "turn left 90°", and − means "turn right 90°" (see turtle graphics).

n = 0:

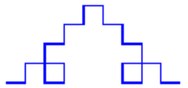
F

n = 1:

F+F−F−F+F

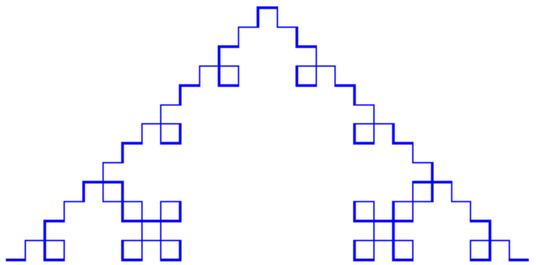
n = 2:

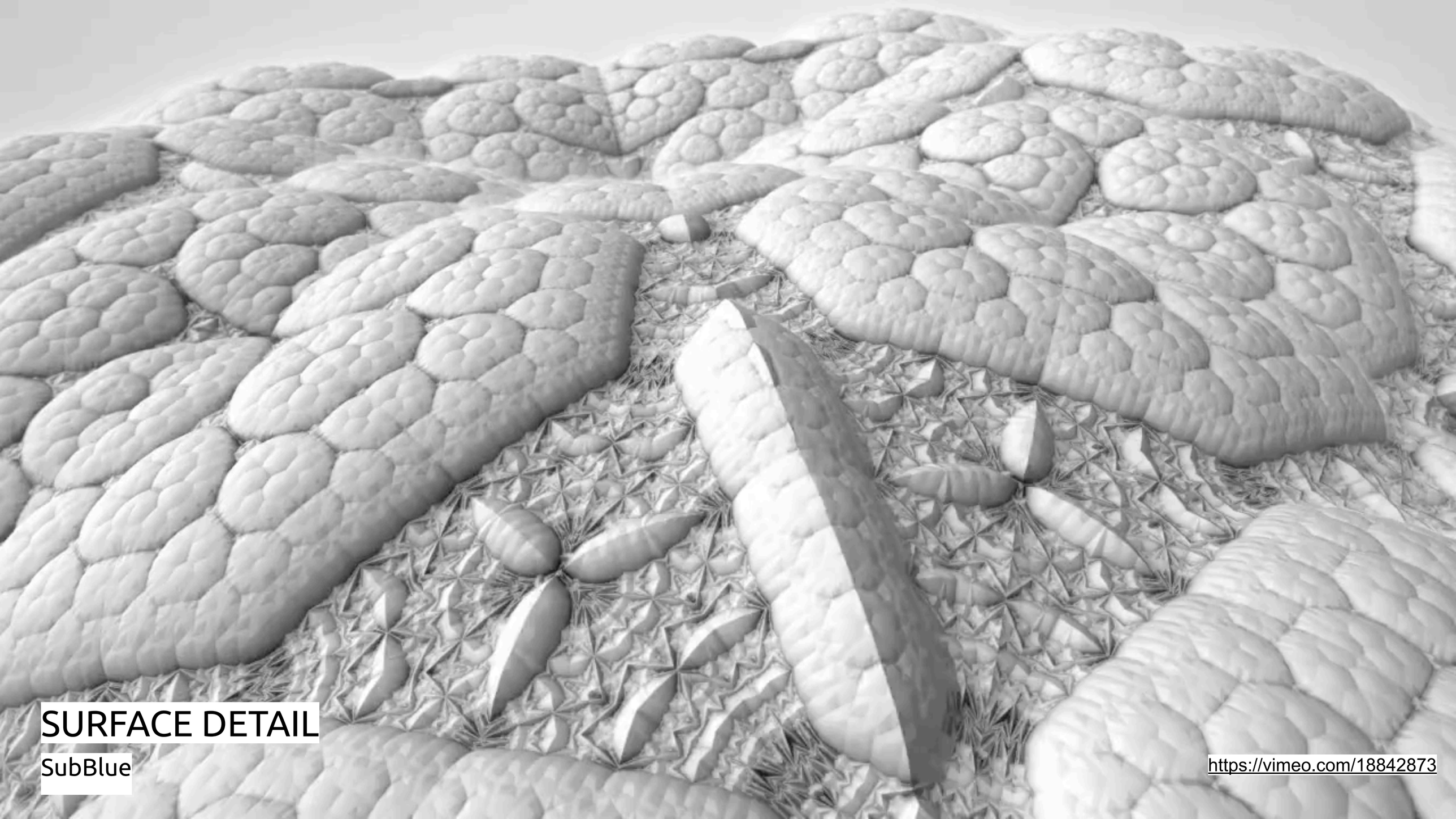
F+F−F−F+F + F+F−F−F+F − F+F−F−F+F − F+F−F−F+F + F+F−F−F+F



n = 3:

F+F−F−F+F+F+F−F−F+F−F+F−F−F+F−F+F−F−F+F+F+F−F−F+F +
F+F−F−F+F+F+F−F−F+F−F+F−F−F+F−F+F−F−F+F+F+F−F−F+F −
F+F−F−F+F+F+F−F−F+F−F+F−F−F+F−F+F−F−F+F+F+F−F−F+F −
F+F−F−F+F+F+F−F−F+F−F+F−F−F+F−F+F−F−F+F+F+F−F−F+F +
F+F−F−F+F+F+F−F−F+F−F+F−F−F+F−F+F−F−F+F+F+F−F−F+F



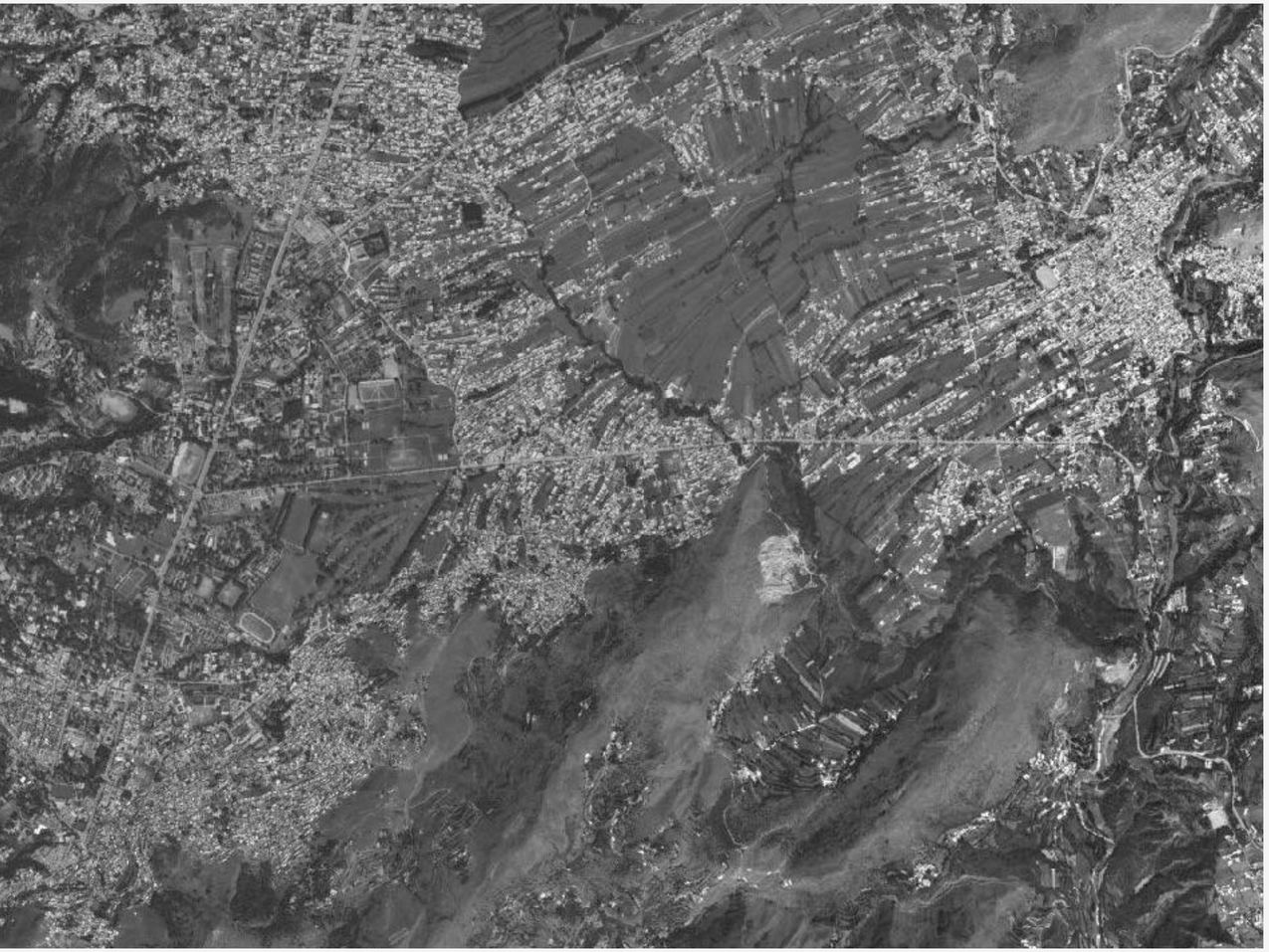


SURFACE DETAIL

SubBlue

https://vimeo.com/18842873


localhost:3004/lab.html#/scene/1873
Demo 4
Account
Settings
Scenes
Explore
Renders
Help
Console
STRUCTURE
Basics
Folding
Rotation
Elements
Translate
Transform
Instancing
Clipping
Complexity
Edit
Mandalay type
Type 1
Scale 2.7778
Offset x 1.40741
Offset y -0.66667
Offset z -0.22222
Radius 0.2222
Bounding radius 1.481
Mandelbrot/Julia 0.000
Mandalay
00:00:00
0s 1s 2s 3s 4s 5s 6s 7s 8s 9s 10s 11s 12s 13s 14s 15s 16s
SEGMENT 01
MEMDOTS
https://vimeo.com/126664436



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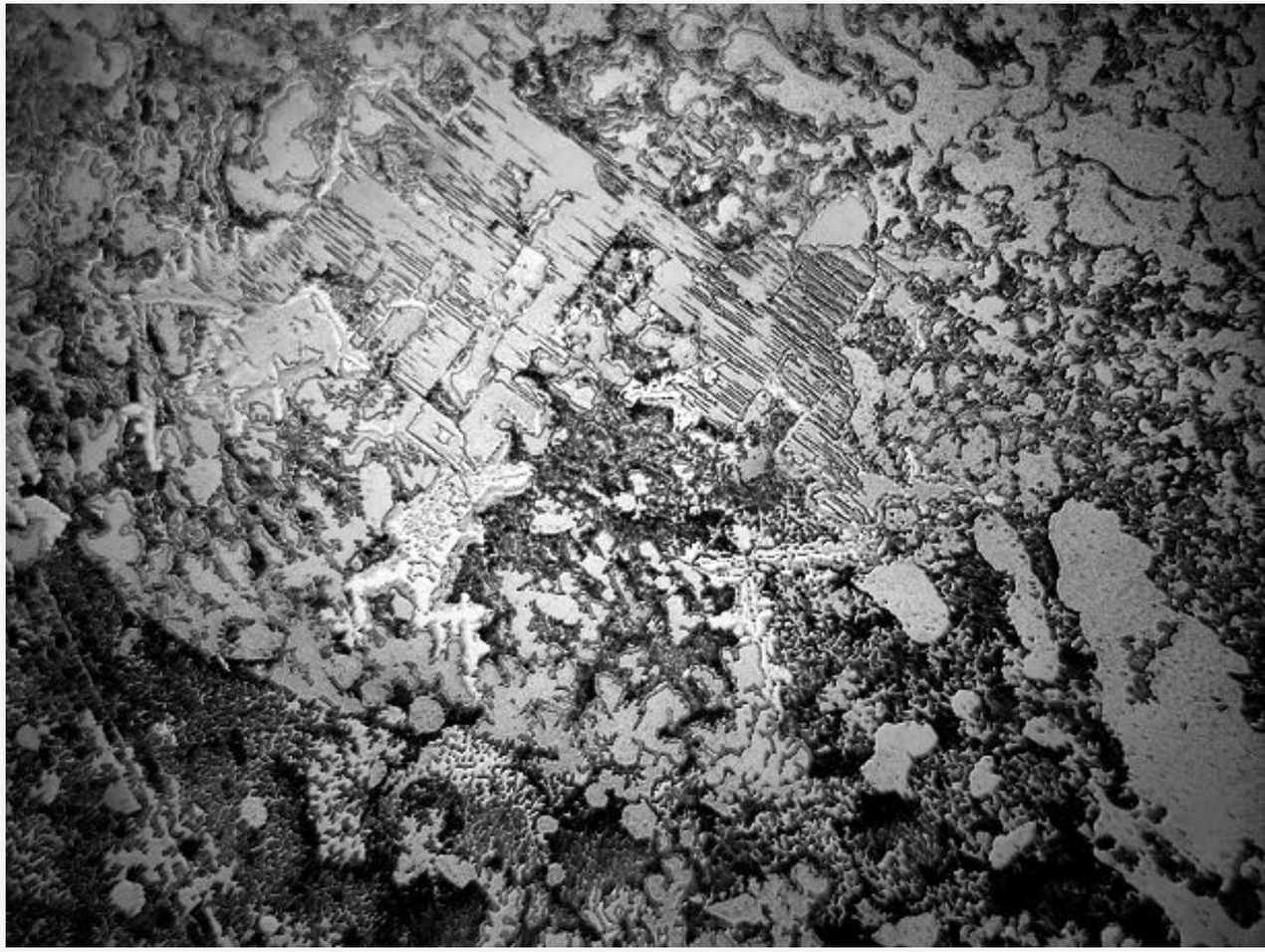

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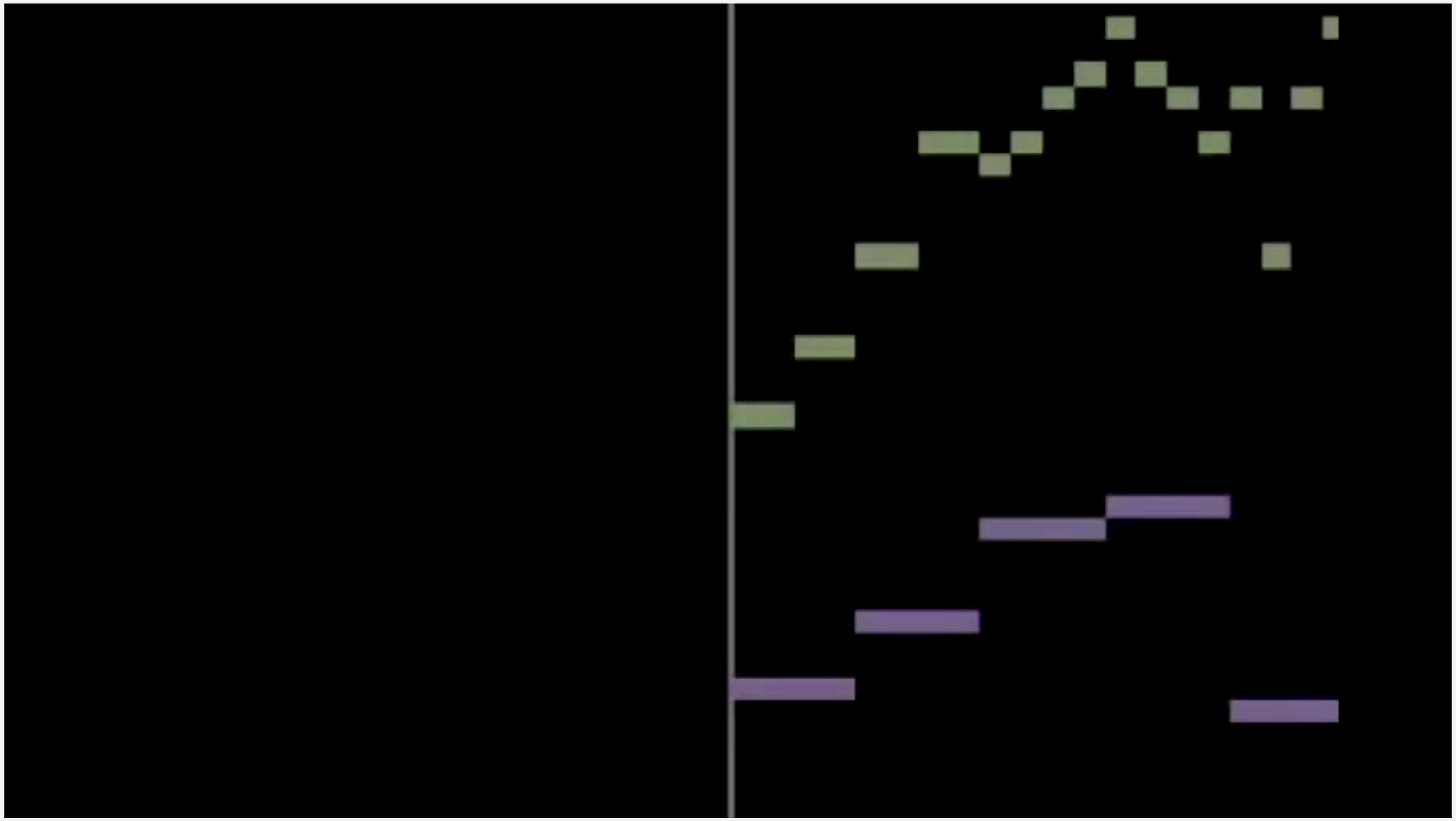
M.C ESCHER



J.S BACH

https://www.youtube.com/watch?v=beNUq_v1fB8

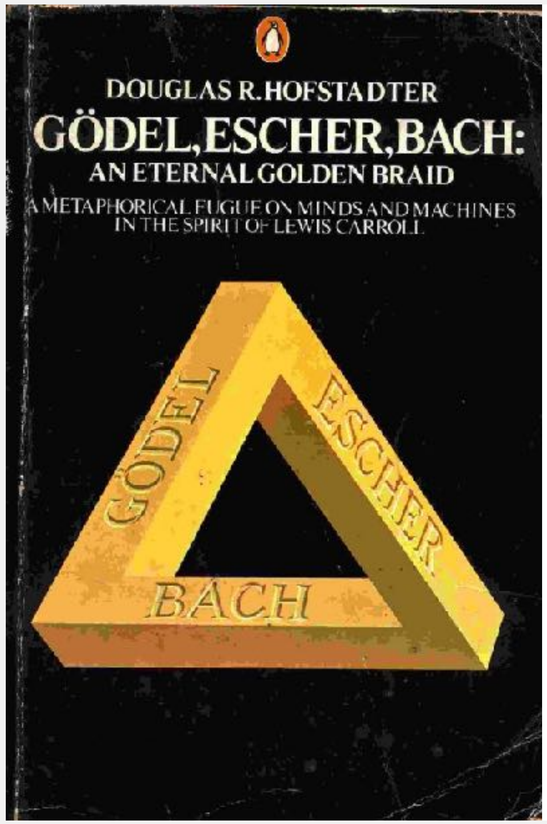
"This mathematical theorem cannot be proved using math"

1. For a given (non-trivial) formal system, there will be statements that are true in that system, but which cannot be proved to be true inside the system.
2. If a system can be proved to be complete using its own logic, then there will be a theorem in the system that is contradictory.

Formal systems cannot be both consistent and complete

KURT GÖDEL

https://simple.wikipedia.org/wiki/G%C3%B6del%27s_incompleteness_theorems
https://en.wikipedia.org/wiki/G%C3%B6del%27s_incompleteness_theorems



(And, twice as quickly as the Meta-Genie did, this MetaMeta-Genie removes from the folds of his robe an object which looks just like the gold MetaLamp, except that it is made of ...)

. .{GOD}

(... swirls back into the MetaMeta-Meta-Lamp, which the Meta-Meta-Genie then folds back into his robe, half as quickly as the Meta-Meta-Meta-Genie did.)

https://en.wikipedia.org/wiki/G%C3%B6del,_Escher,_Bach

THE NATURE OF CODE

DANIEL SHIFFMAN

Chapter 8. Fractals

"Pathological monsters! cried the terrified mathematician
Every one of them a splinter in my eye
I hate the Peano Space and the Koch Curve
I fear the Cantor Ternary Set
The Sierpinski Gasket makes me wanna cry
And a million miles away a butterfly flapped its wings
On a cold November day a man named Benoit Mandelbrot was born"
— Jonathan Coulton, lyrics from "Mandelbrot Set"

Once upon a time, I took a course in high school called "Geometry." Perhaps you did too. You learned about shapes in one dimension, two dimensions, and maybe even three. What is the circumference of a circle? The area of a rectangle? The distance between a point and a line? Come to think of it, we've been studying geometry all along in this book, using vectors to describe the motion of bodies in Cartesian space. This sort of geometry is generally referred to as Euclidean geometry, after the Greek mathematician Euclid.

And for the second line:

```
line(x+len*2/3,y,x+len,y);   becomes ---------->  cantor(x+len*2/3,y,len/3);
```

Show Raw

Leaving us with:

```
void cantor(float x, float y, float len) {
  line(x,y,x+len,y);

  y += 20;

  cantor(x,y,len/3);
  cantor(x+len*2/3,y,len/3);
}
```

Show Raw

And since the `cantor()` function is called recursively, the same rule will be applied to the next lines and to the next and to the next as `cantor()` calls itself again and again! Now, don't go and run this code yet. We're missing that crucial element: an exit condition. We'll want to make sure we stop at some point—for example, if the length of the line ever is less than 1 pixel.

http://natureofcode.com/book/chapter-8-fractals/

TREES

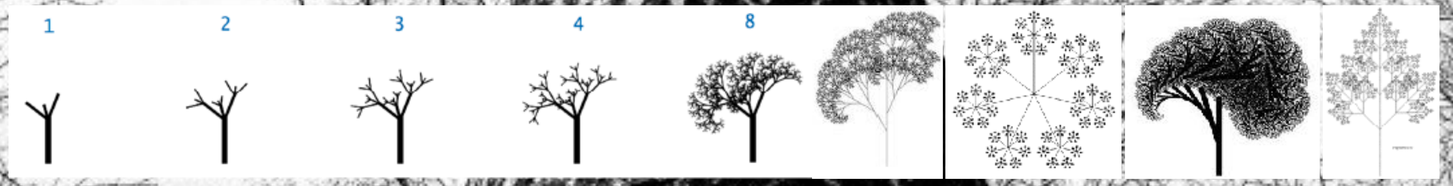


Image source: https://microbialmenagerie.com/2017/03/02/the-underground-social-network-between-trees/

“My life seemed to be a series of events and accidents.
Yet when I look back I see a pattern.”

Benoît Mandelbrot

Honorable mention:

RECURSION

```
for(var i = 0 ; i < 10; i++){
  doSomething();
}

function doSomething(){
  //...
}
```

```
function doSomething(){
  doSomethingElse();
}

function doSomethingElse(){
  //...
}
```

```
function doSomething(){
  doSomething();
}
```

Iteration

Composition

Recursion

ANATOMY OF A RECURSIVE LOOP

outside call →

ending condition →

do something →

recurse →

```
function draw() {
  myRecursiveFunction(10);
}

function myRecursiveFunction(param){
  // always start at the end!
  if(param < 1){
     return;
  }

  // ...

  myRecursiveFunction(param - 1);
}
```

NATURE OF CODE

```
int factorial(int n) {
  if (n == 1) {
    return 1;
  } else {
    return n * factorial(n-1);
  }
}
```

Show Raw

It may look crazy, but it works. Here are the steps that happen when `factorial(4)` is called.

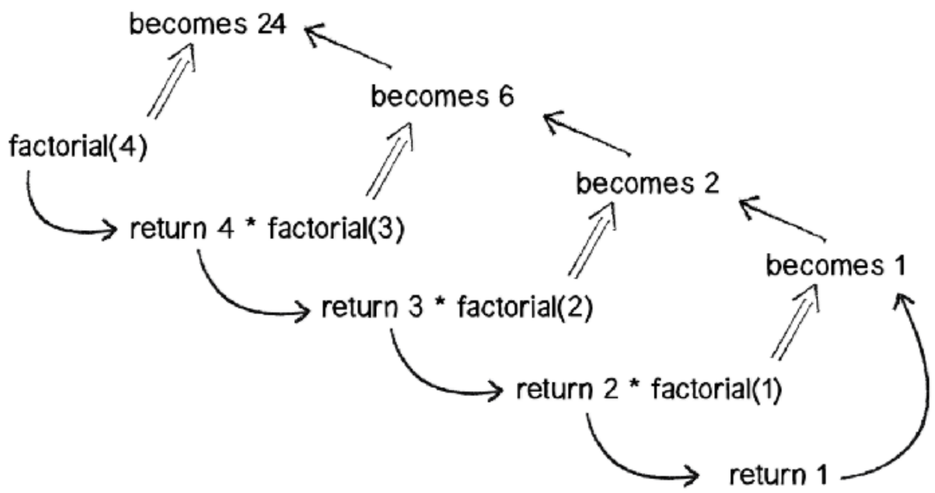
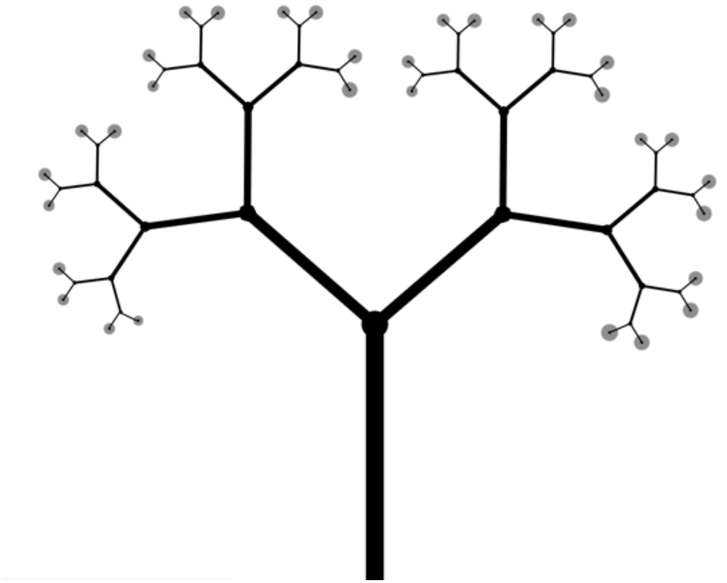


Figure 8.9

http://natureofcode.com/book/chapter-8-fractals/



Let’s create a tree

HOMEWORK #09

Create a Forest.