Fractal animation introduction

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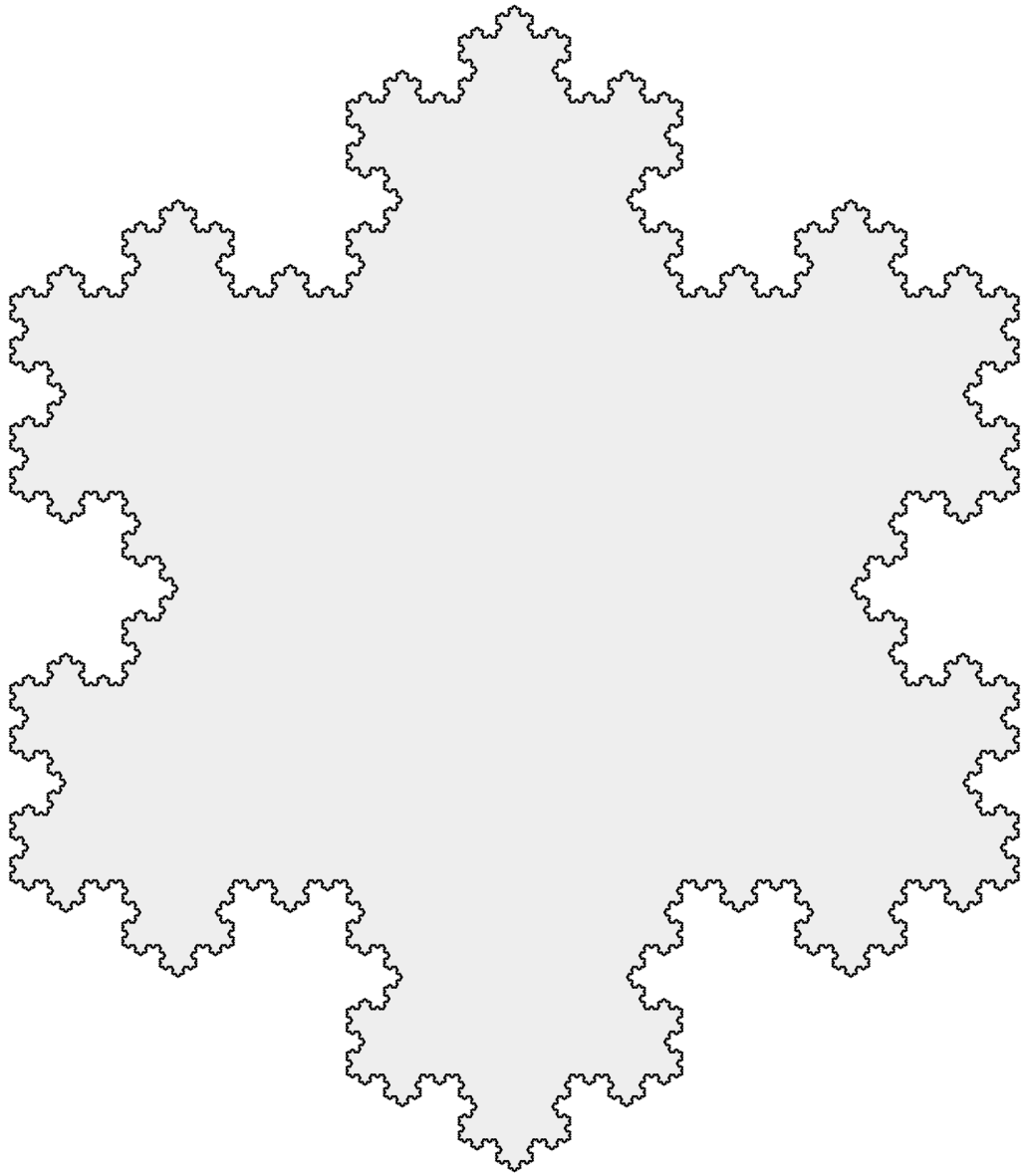
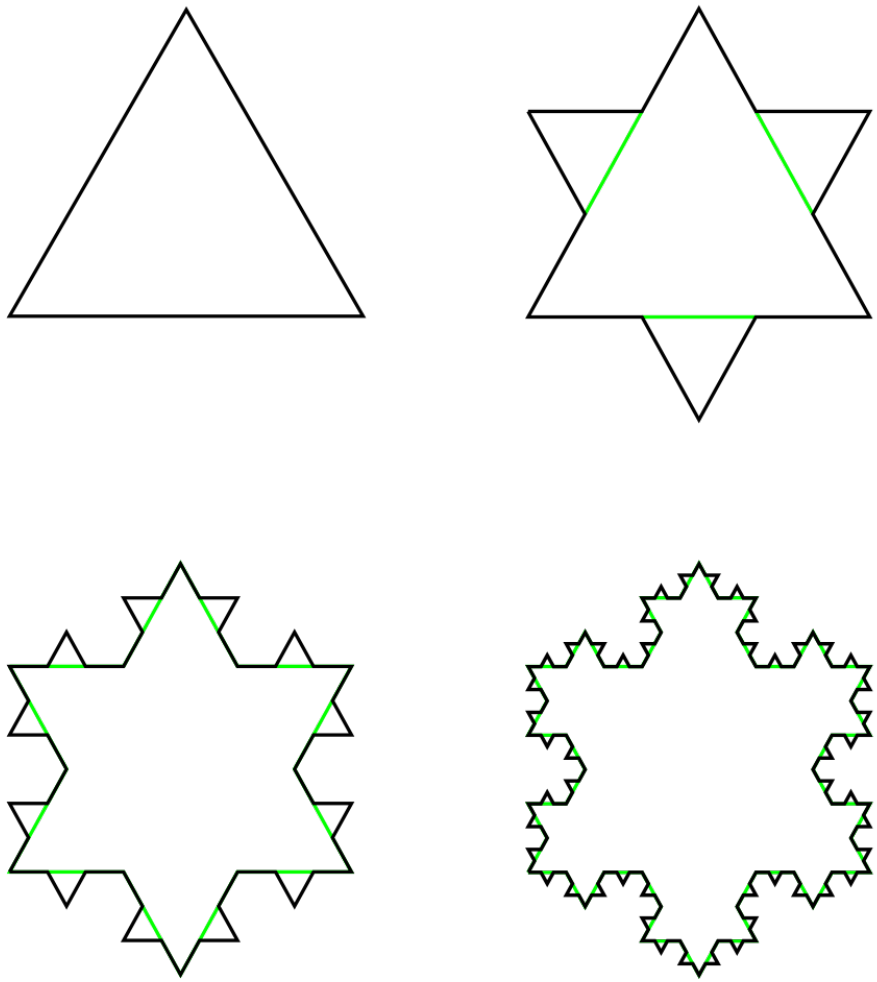
What are fractals?

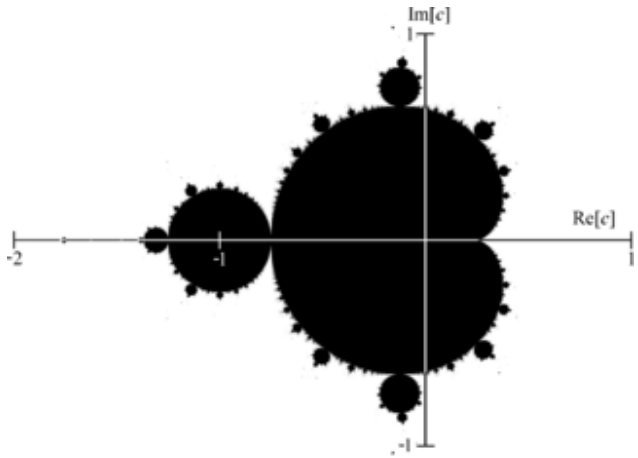


Koch snowflake



Pythagora's tree demo

Mandelbrot set



Complex numbers and complex plane

$$c = ai + b$$
$$i^2 = -1$$

The *norm* of a complex number is its euclidiean distance to 0:

$$c = ai + b$$
$$|c| = \sqrt{a^2 + b^2}$$

```
In [1]: c = complex(1, 2)

In [2]: c
Out[2]: (1+2j)

In [3]: c + complex(0,3)
Out[3]: (1+5j)

In [4]: c * c
Out[4]: (-3+4j)
```

Mandelbrot set

Function to iterate

The formula that generates everything is the following one:

$$z_0 = c$$
$$z_{n+1} = z_n^2 + c$$

For each pixel (x, y) of the screen, we compute the corresponding complex number $c_{x,y}$.

Now we compute a fixed number of terms of the sequence above starting with $z_0 = c_{x,y}$.

$$\begin{aligned} z_0 &= c_{x,y} \\ z_1 &= c_{x,y}^2 + c_{x,y} \\ z_2 &= z_1^2 + c_{x,y} = \left(c_{x,y}^2 + c_{x,y}\right)^2 + c_{x,y} \\ &\dots \\ z_{100} &= z_{99}^2 + c_{x,y} \end{aligned}$$

Function interpolation with Python

```
f_square = lambda x: x ** 2
f_cube   = lambda x: x ** 3
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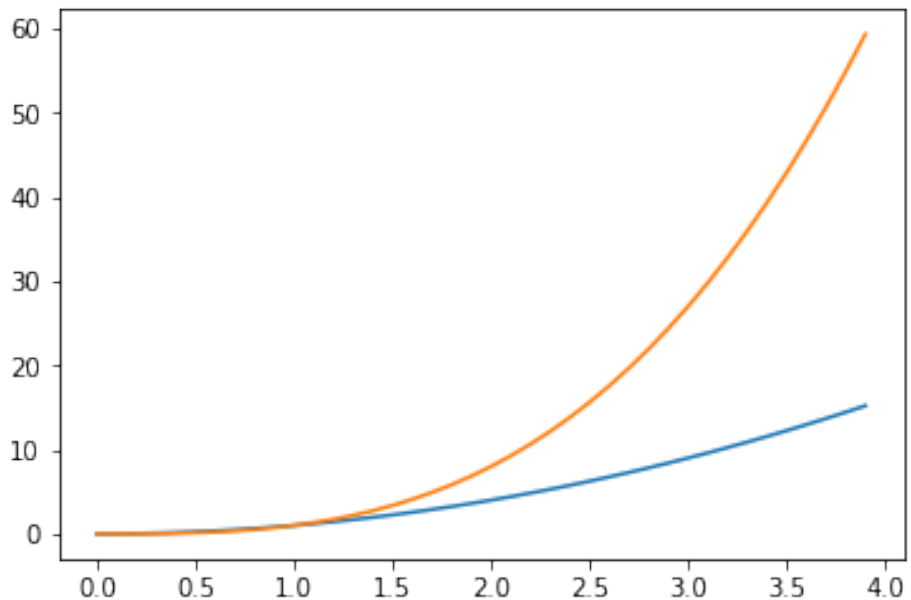

Mandelbrot set

mandelbrot image.