Computer Graphics 4731
Fractals

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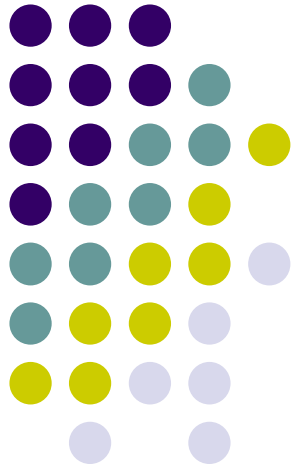
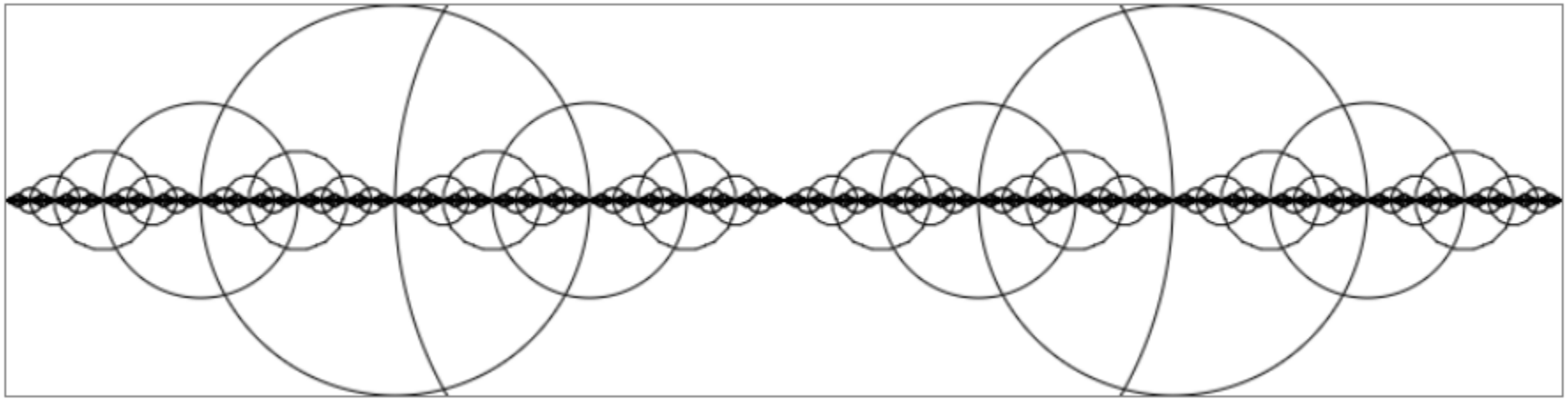
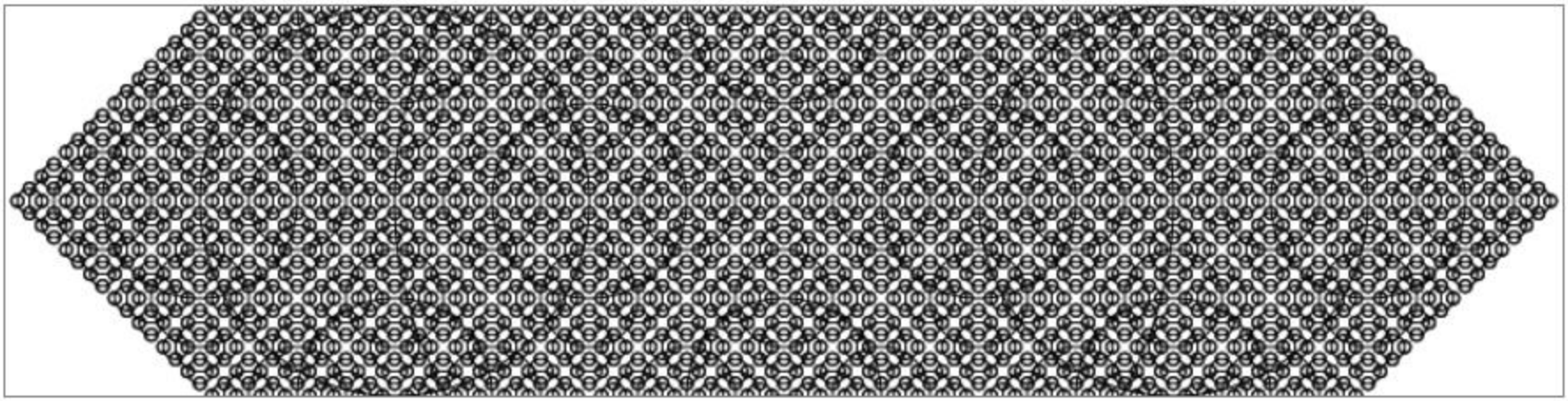


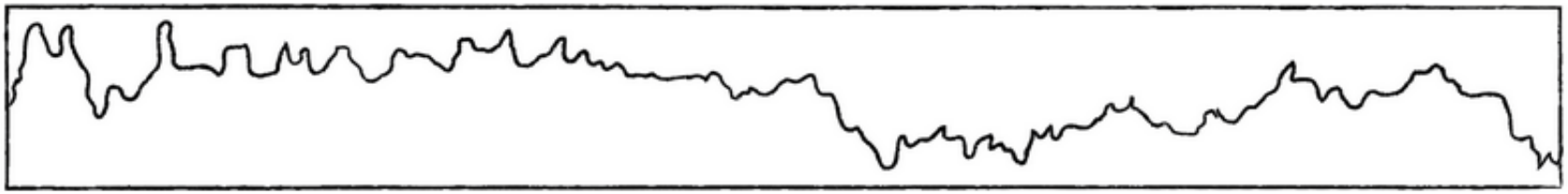
Fractals



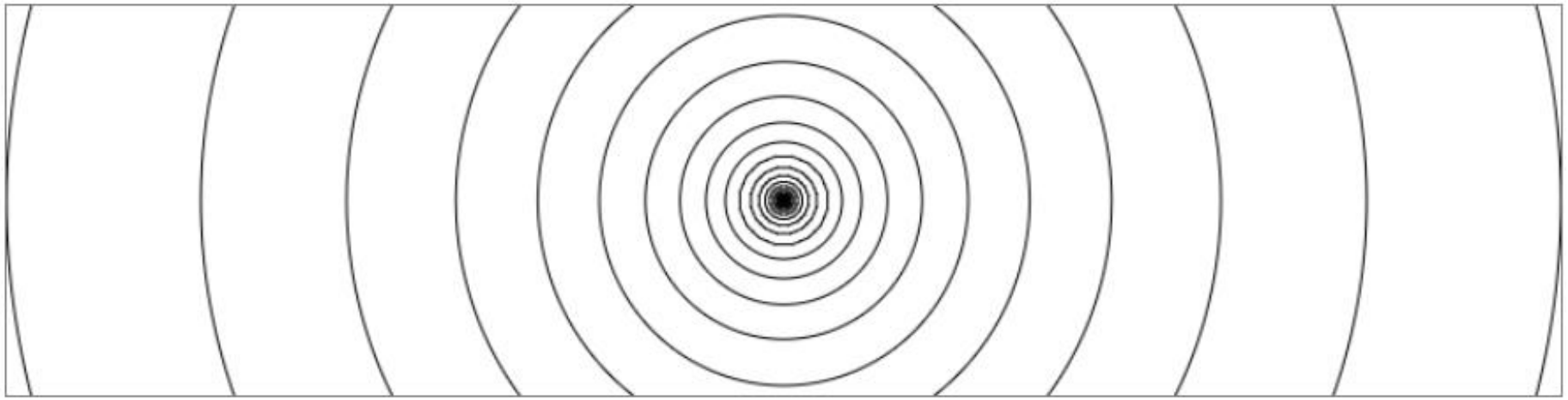
Fractals



Fractals

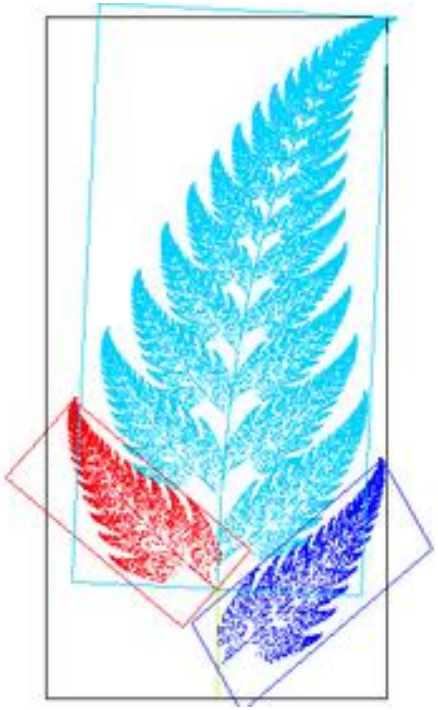


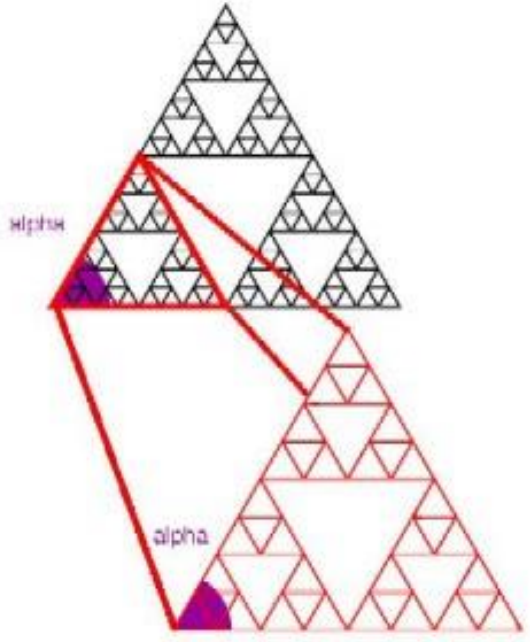
Fractals



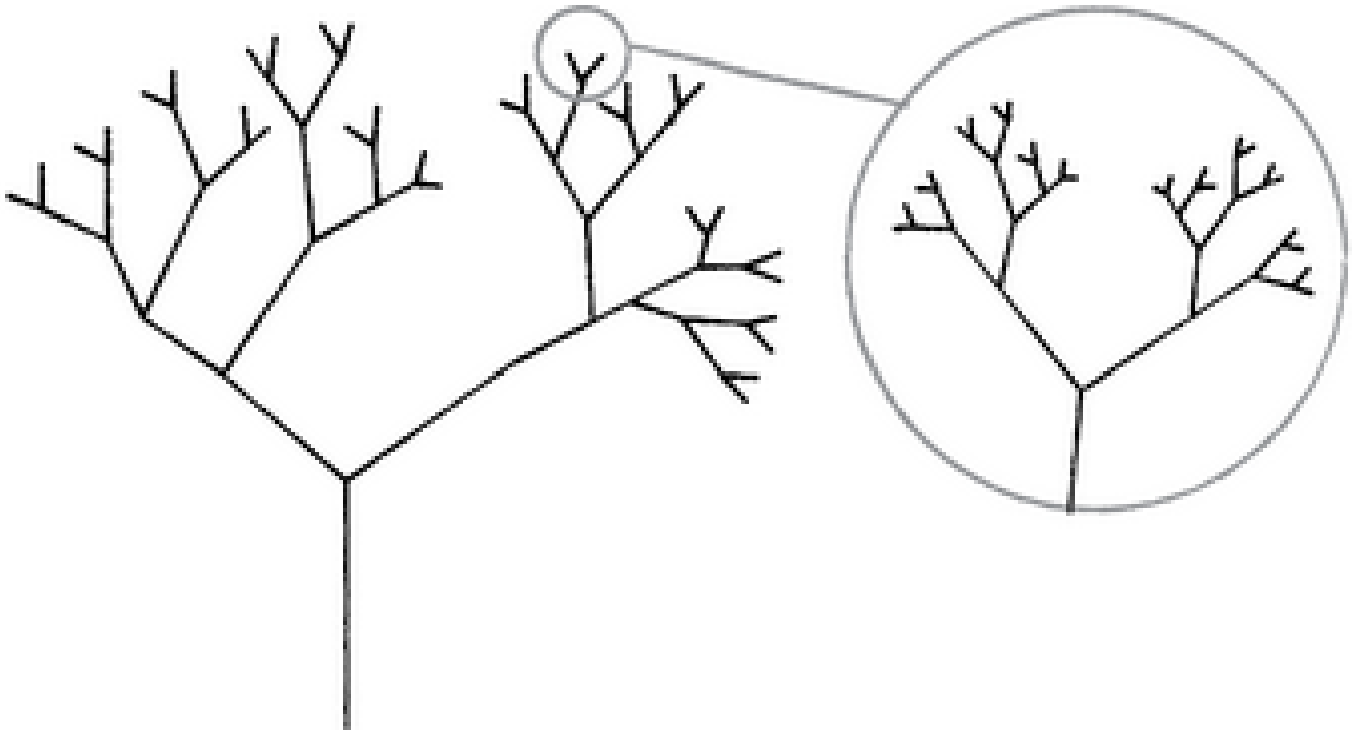
Fractals

- Self-similarity



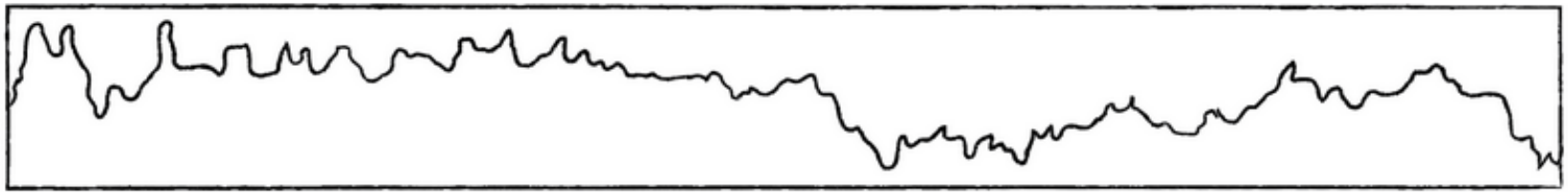


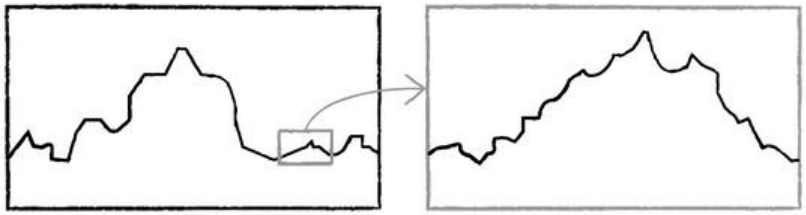
Fractals



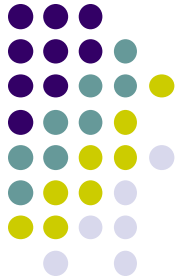
Stochastic Fractals

- Statistical self-similarity



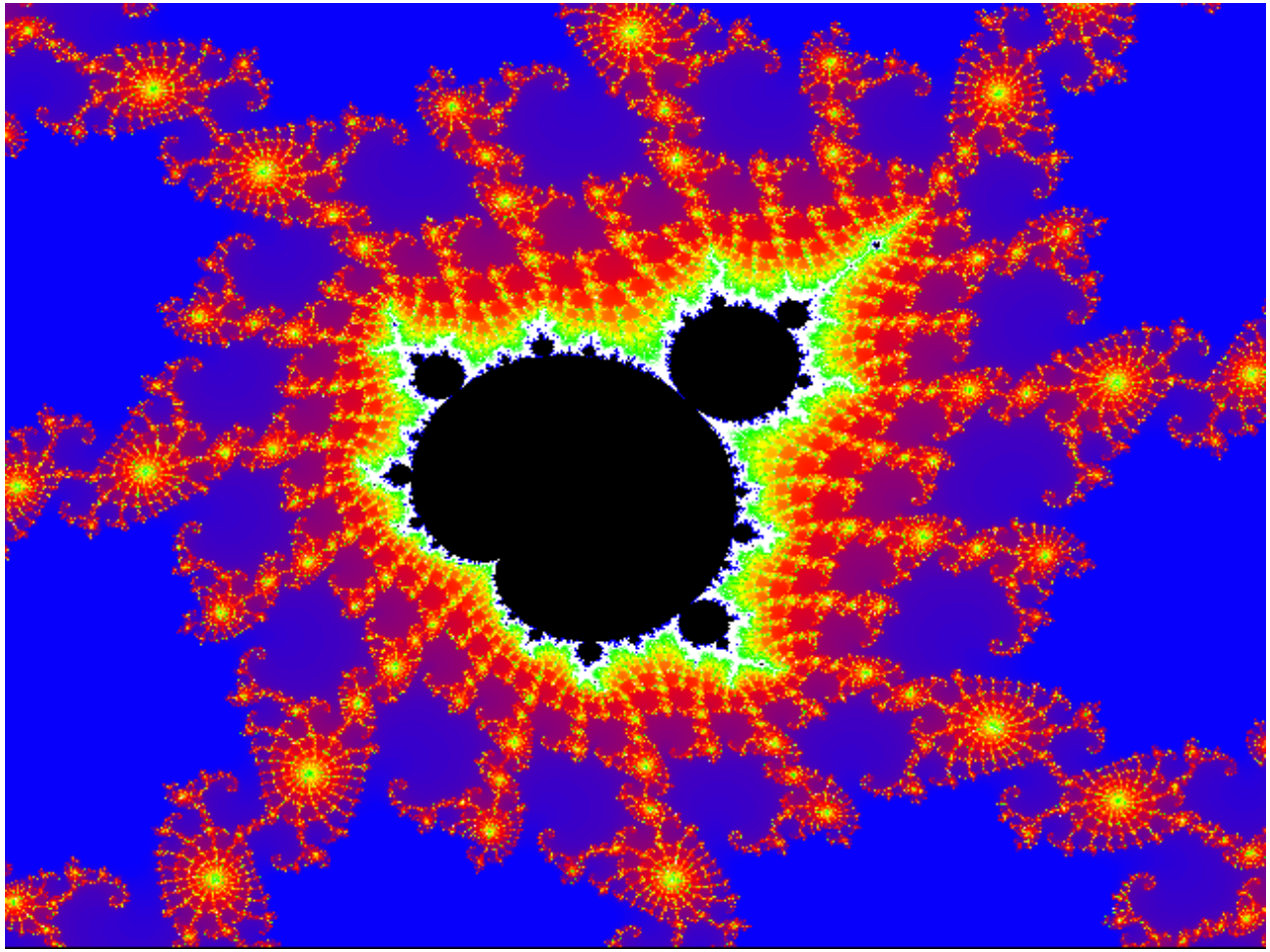


Applications of Fractals

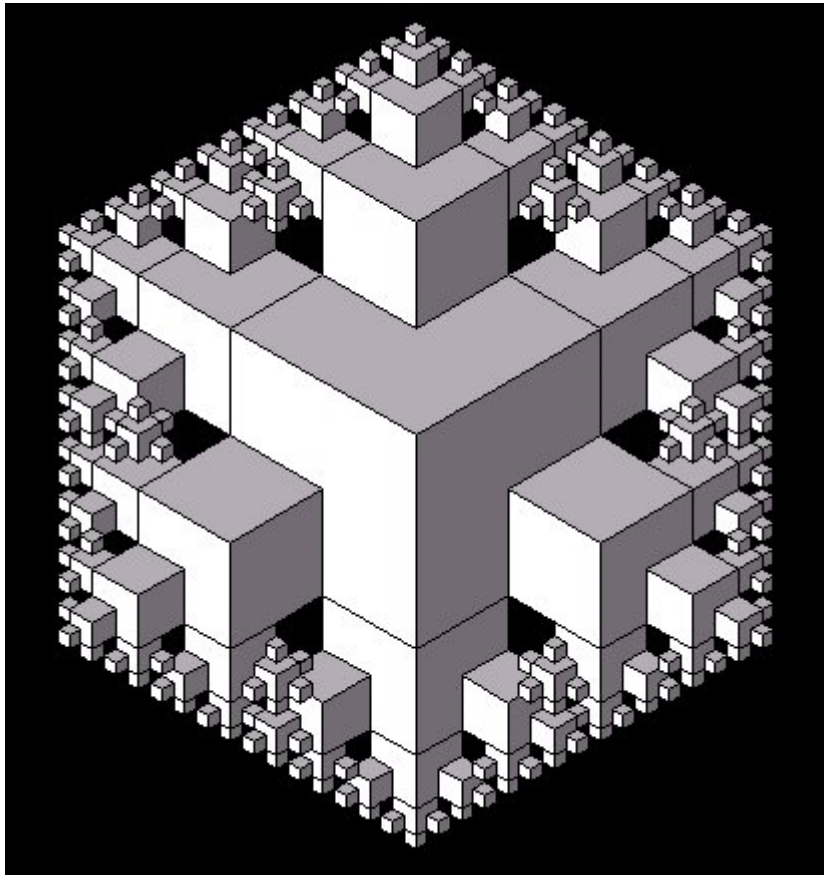


- Clouds
- Grass
- Fire
- Modeling mountains (terrain)
- Coastline
- Branches of a tree
- Surface of a sponge
- Cracks in the pavement
- Designing antennae (www.fractenna.com)
- Statistical analysis
- Etc.

Example: Mandelbrot Set

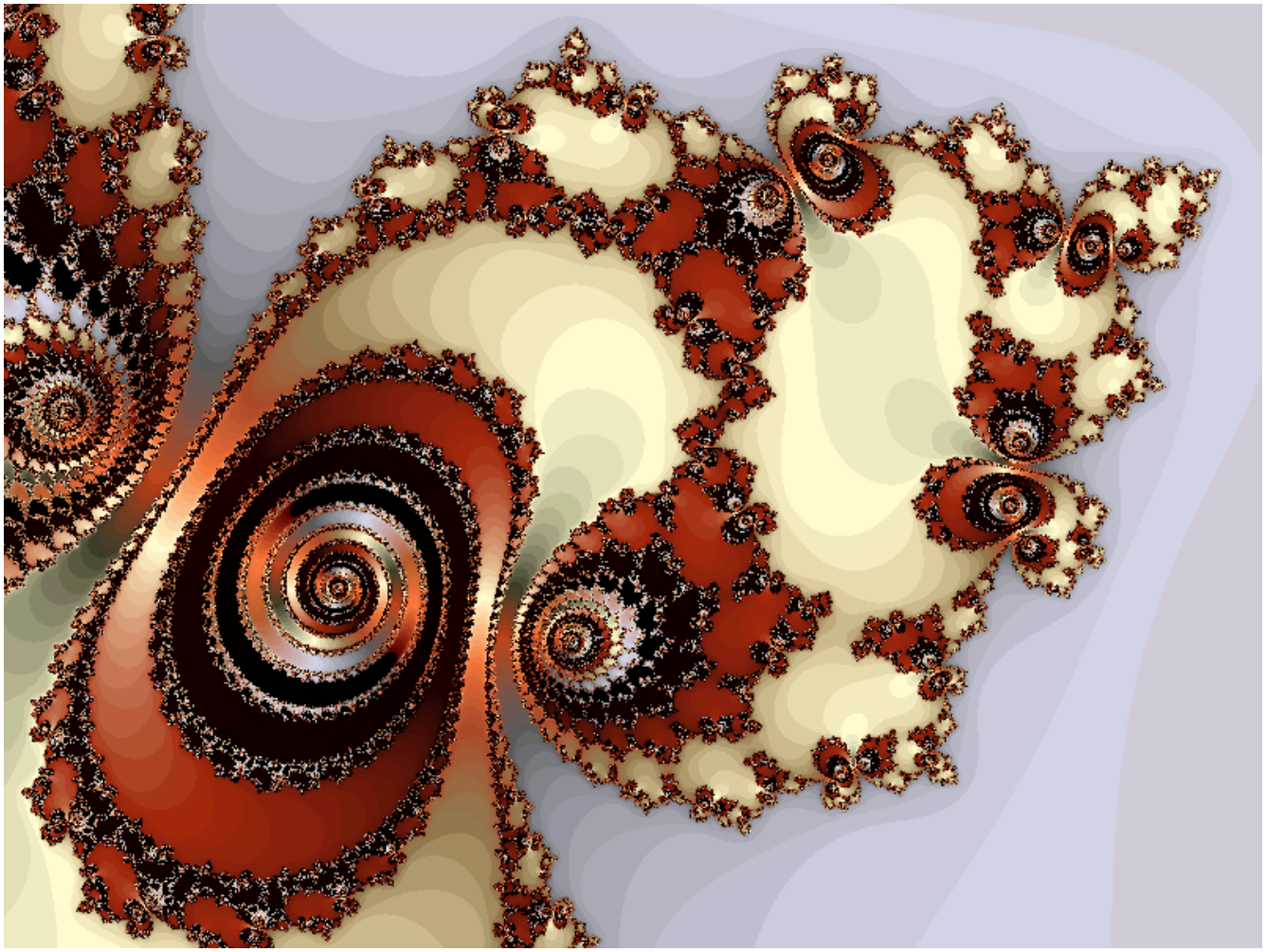


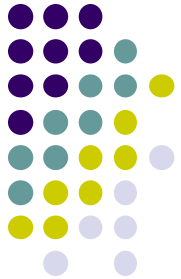
Example: 3D Fractals



Example: Fractal Terrain

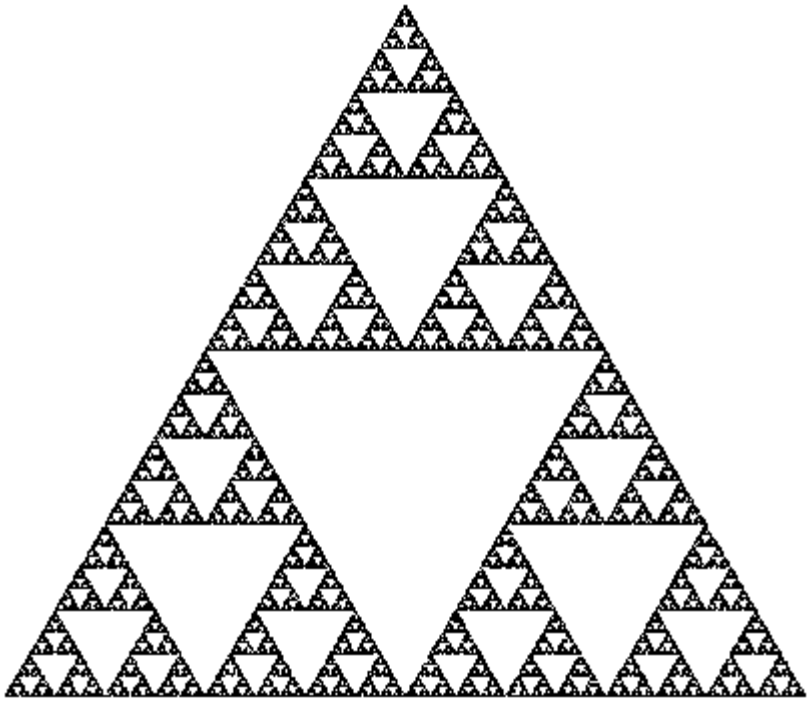
Example: Fractal Art





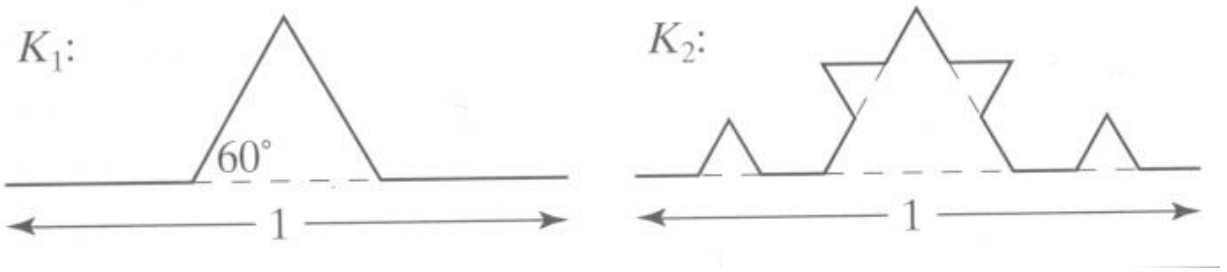
Recall: Sierpinski Gasket Program

- Popular fractal



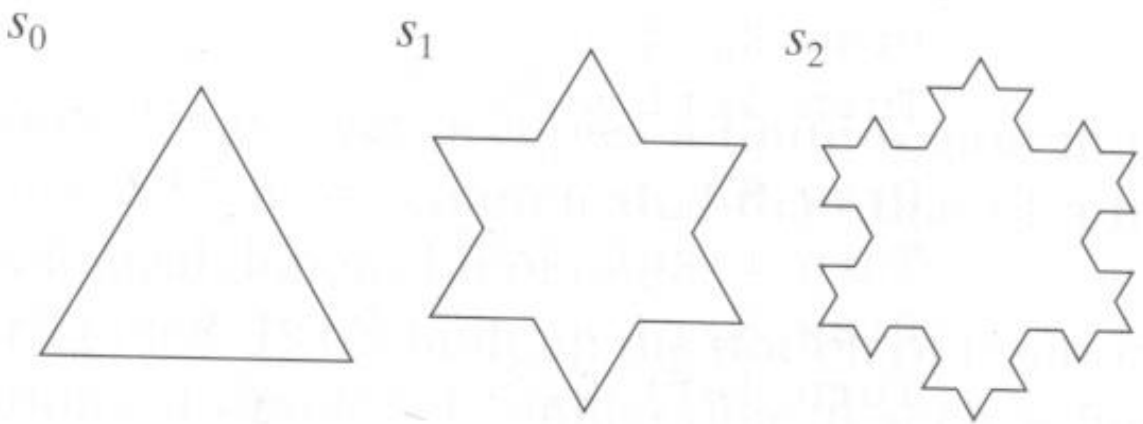
Koch Curves

- Start with straight line of length 1
- Recursively:
  - Divide line into 3 equal parts
  - Replace middle section with triangular bump, sides of length 1/3
  - New length = 4/3

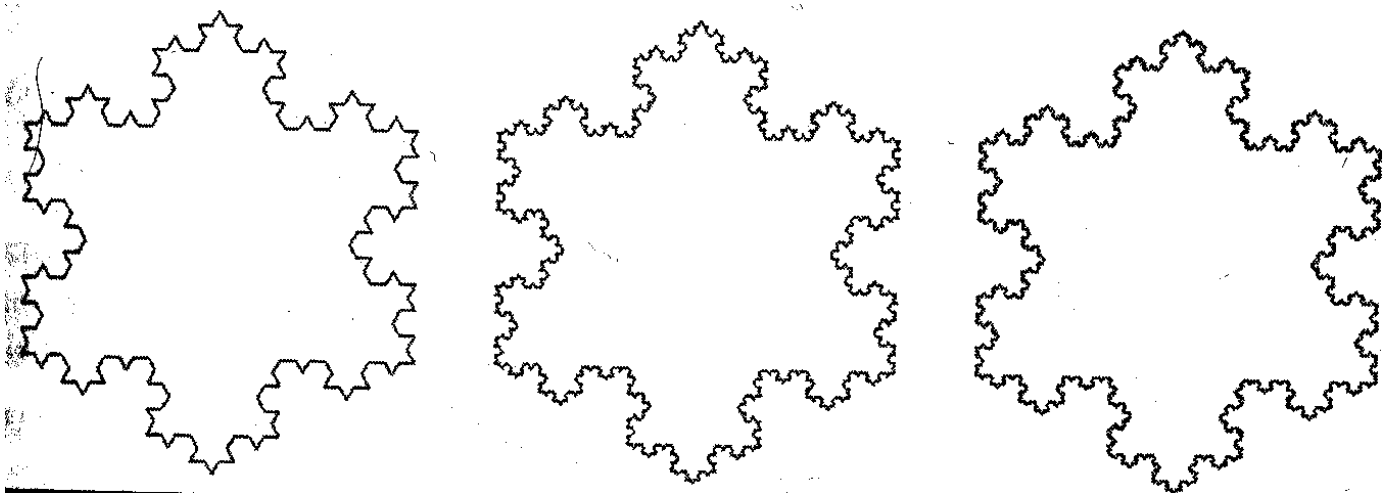


Koch Snowflakes

Can form Koch snowflake by joining three Koch curves



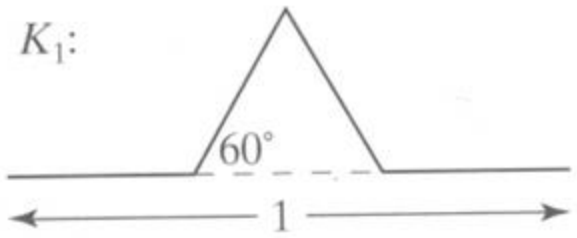
S_3, S_4, S_5,



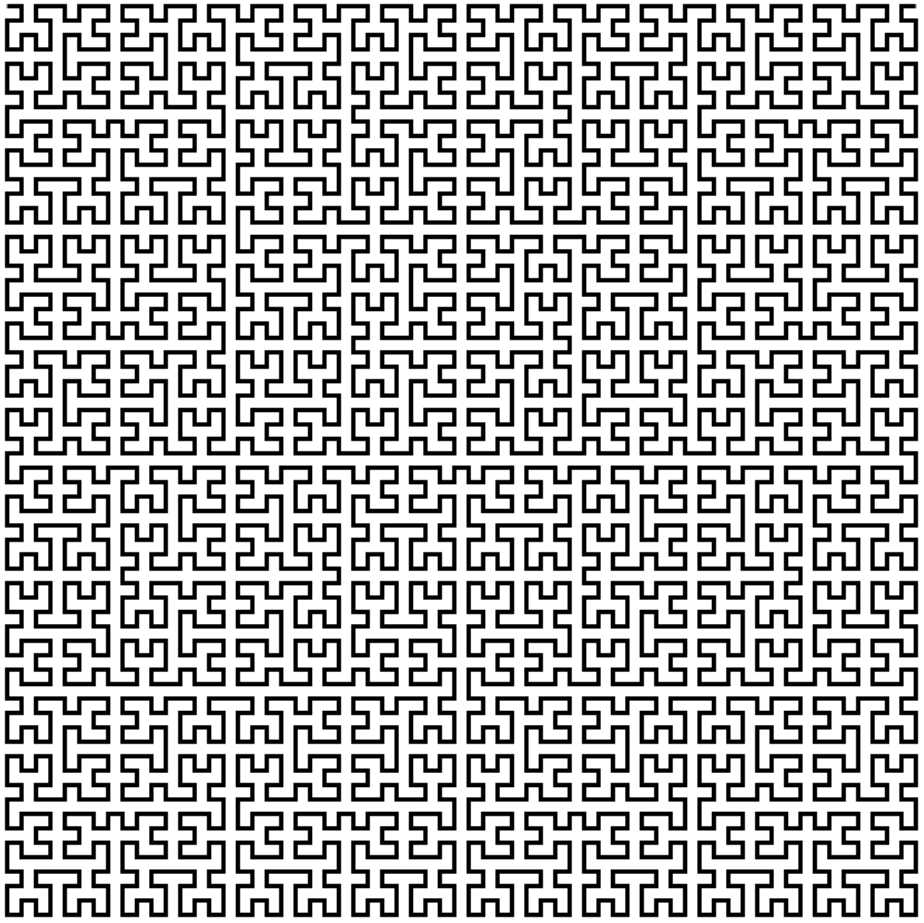
Koch Snowflakes

Pseudocode, to draw K_n:

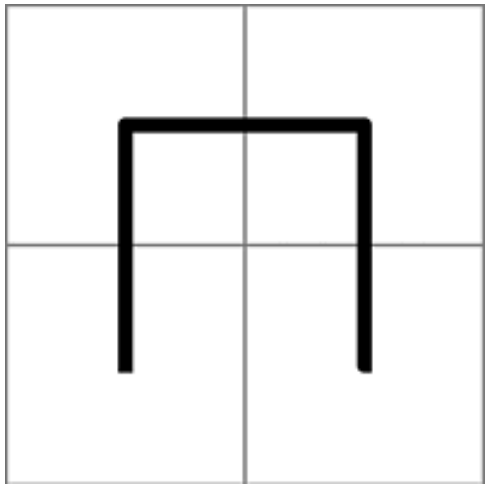
```
If (n equals 0) draw straight line
Else{
        Draw K_{n-1}
        Turn left 60°
        Draw K_{n-1}
        Turn right 120°
        Draw K_{n-1}
        Turn left 60°
        Draw K_{n-1}
}
```



Hilbert (Space-Filling) Curve

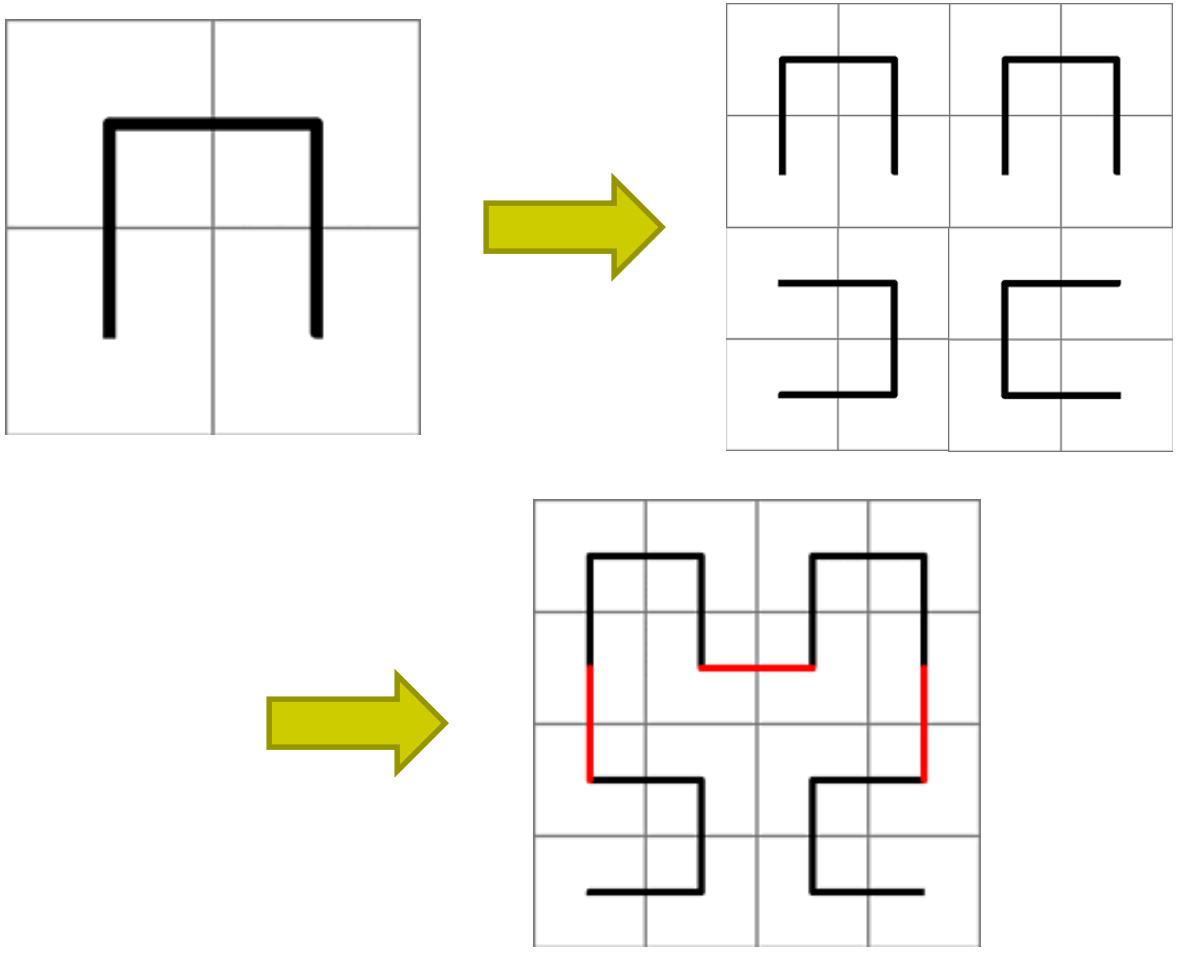


Hilbert (Space-Filling) Curve

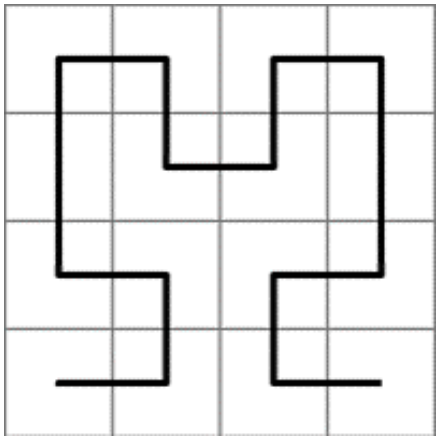


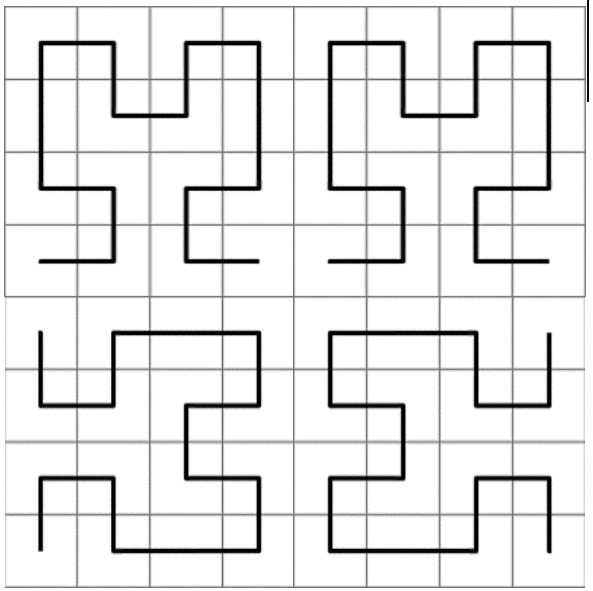
Iteration 0

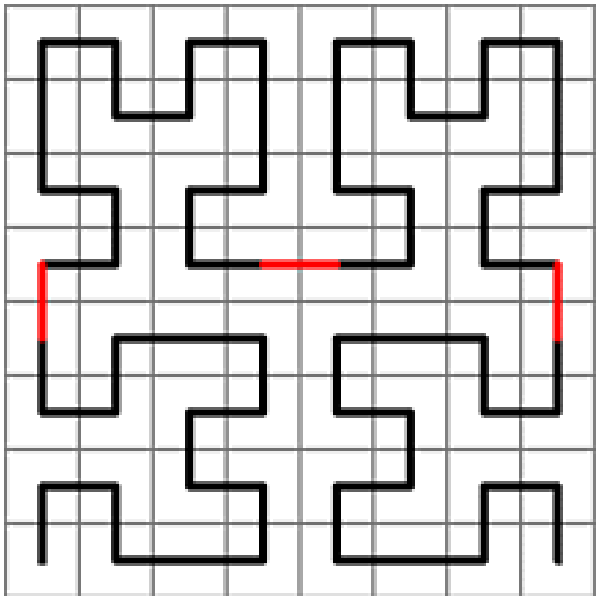
Hilbert Curve: Iteration 1



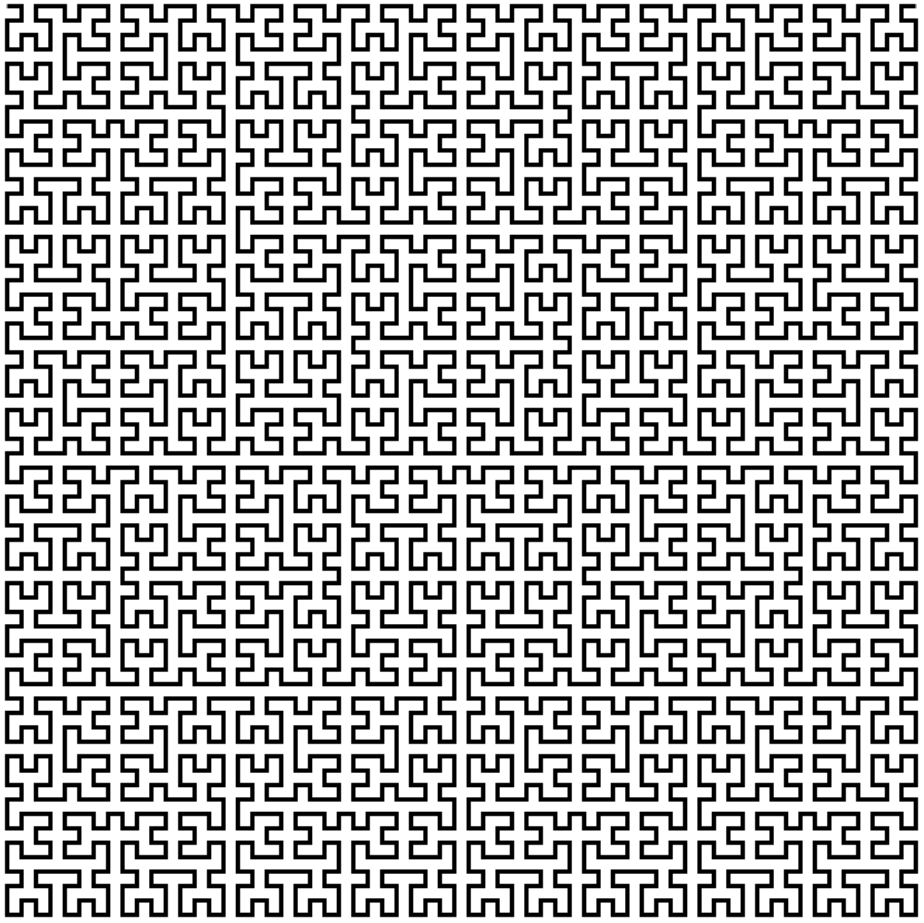
Hilbert Curve: Iteration 2



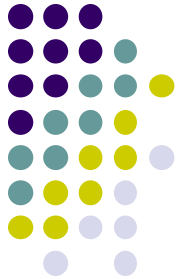




Hilbert Curve: Iteration n



FREE SOFTWARE



- Free fractal generating software
  - Fractint
  - FracZoom
  - 3DFrac