OpenGL Notes [a] [b]

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[a] Most material is adapted from: OpenGL ARB, et. al, "The OpenGL Programming Guide", Third Ed., Reading: Addison-Wesley, 1999

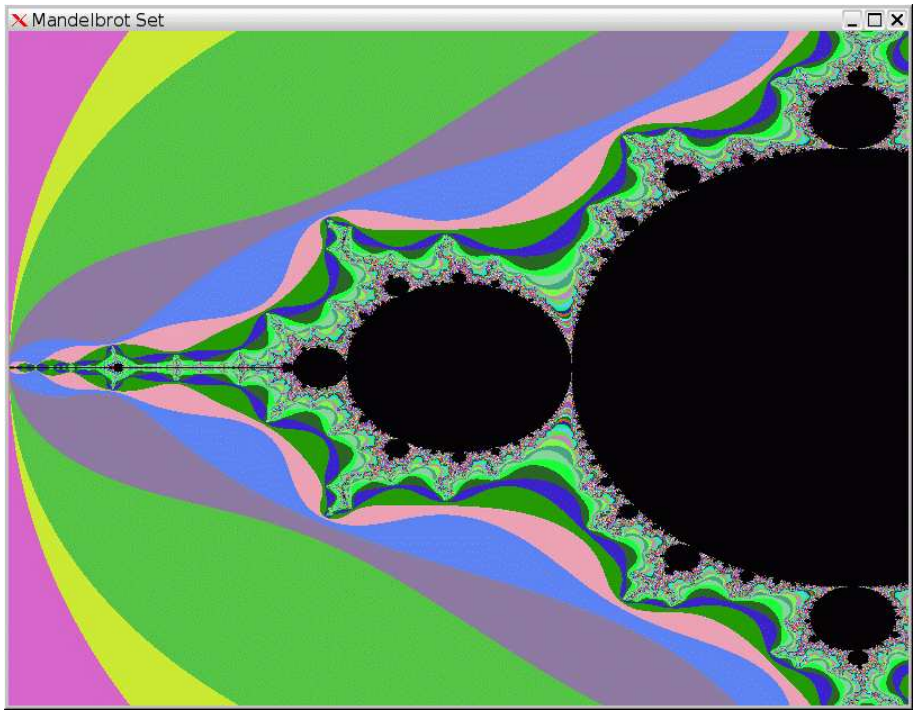
[b] Additional material from Wikipedia

Introduction to Fractals

- What is a fractal ?
  - "a rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced-size copy of the whole"
    – Benot Mandelbrot
  - The mathematics behind fractals began to take shape in the 17th century when philosopher Leibniz considered recursive self-similarity.
  - In 1975 Mandelbrot coined the word "fractal" to denote an object whose Hausdorff-Besicovitch dimension is greater than its topological dimension.

Introduction to Fractals

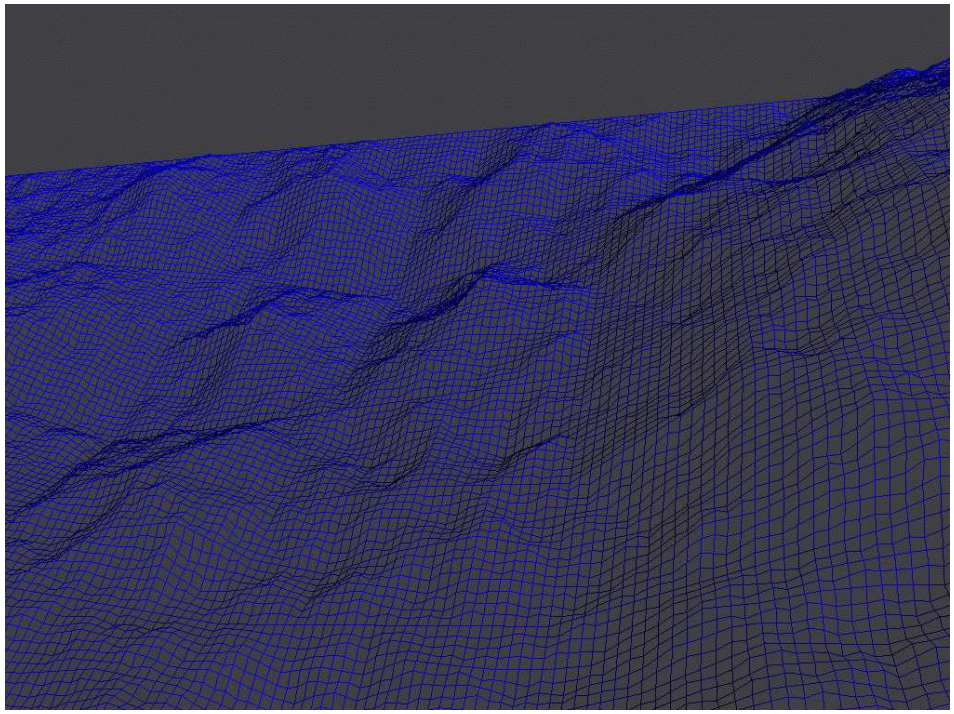
The Mandelbrot set, a deterministic fractal



The *boundary* (where color and black meet) of the Mandelbrot set has a Hausdorff dimension of 2 and a topological dimension of 1.

Introduction to Fractals

Landscape, a stochastic fractal



The landscape has a statistical self similarity.

Generating a Stochastic Fractal

One way to generate a fractal is using the **Midpoint Displacement Algorithm**.

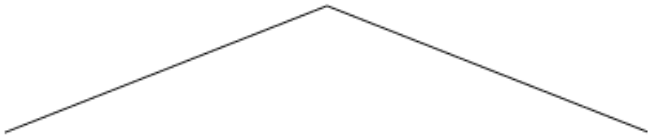
Imagine generating a random ridge line, or mountain, in the distance. A one dimensional problem.

In One Dimension, the midpoint displacement algorithm is:

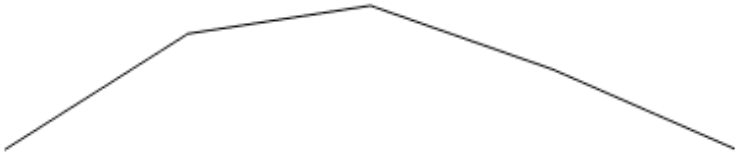
1. Start with a single horizontal line segment.
2. Repeat for a sufficiently large number of times:
   (a) For each line segment
      i. Find the midpoint of the line segment.
      ii. Displace the midpoint in Y by a random amount.
   (b) Reduce the range for random numbers.

Generating a 1D Stochastic Fractal

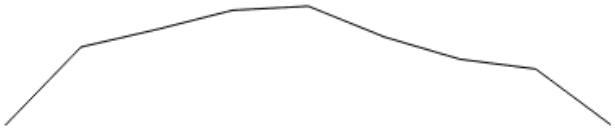
Displacement range [-1,1]



Displacement range [-0.5,0.5]



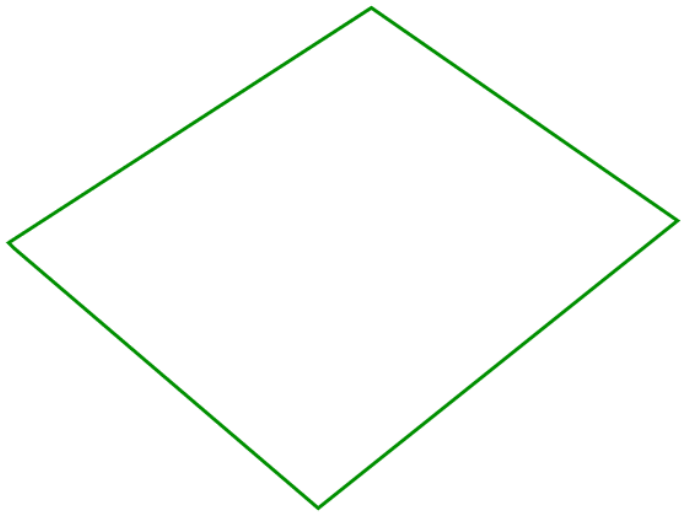
Displacement range [-0.25,0.25]



See `http://www.gameprogrammer.com/fractal.html`

Generating a 2D Stochastic Fractal

The Midpoint Displacement Algorithm in 2D.



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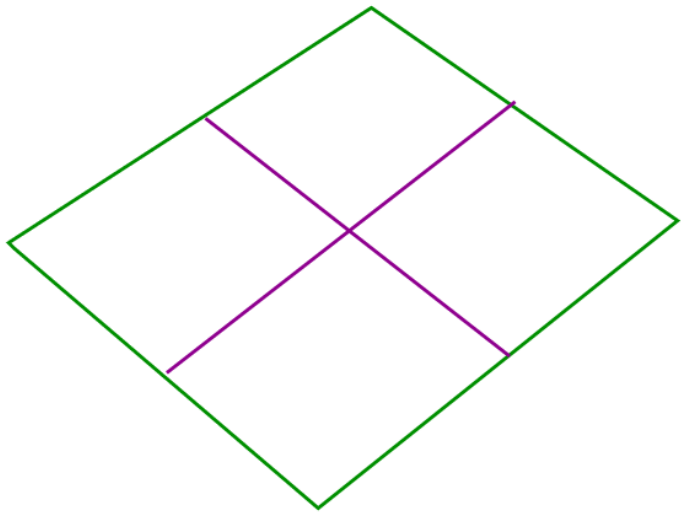

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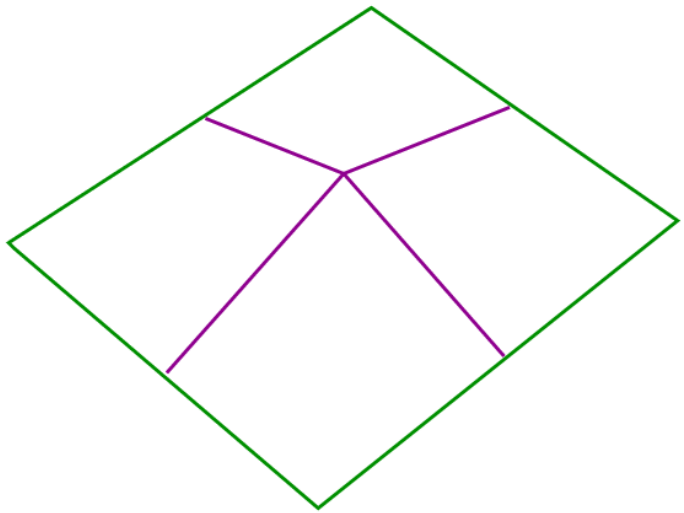

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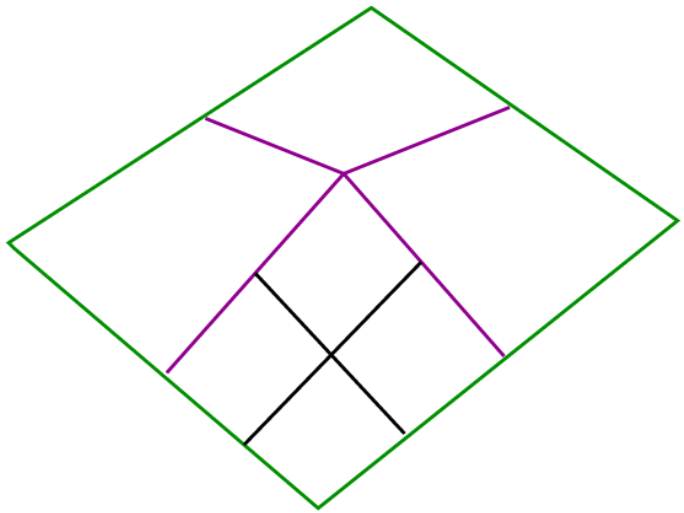

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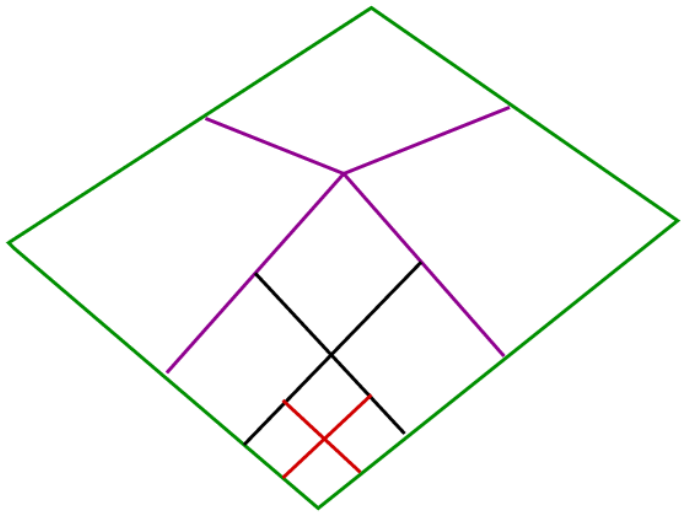

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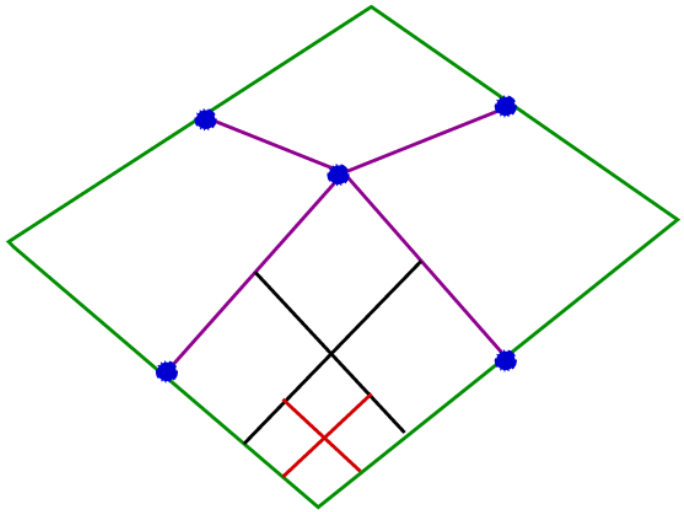

The blue dots represent the points saved at this step.

Generating a 2D Stochastic Fractal

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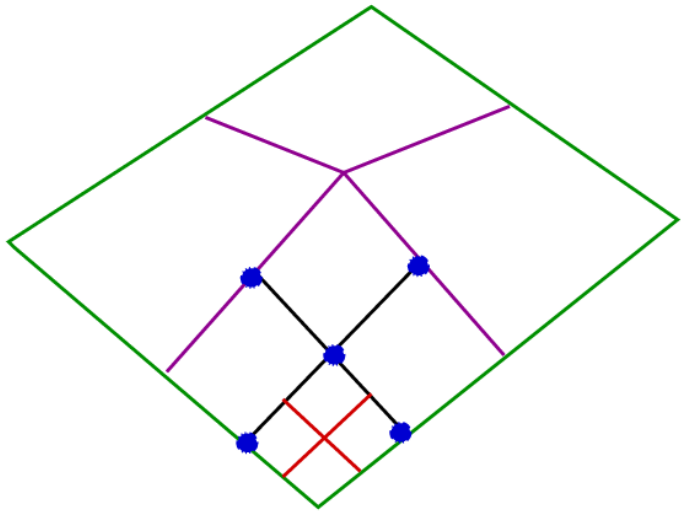

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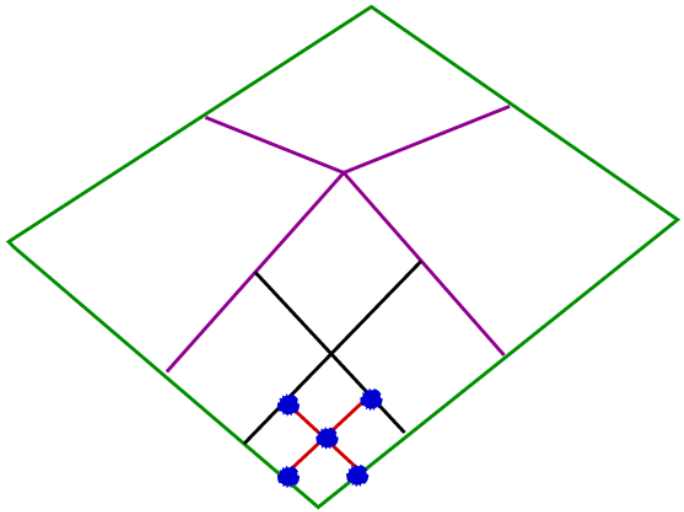

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