How do we define them?

How do we use them?

Christian Gentry

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Examples

How do we define them?

How do we use them?
Koch Snowflake

Examples

How do we define them?

How do we use them?

Zoom In
Barnsley Fern
Julia Set
Mandelbrot Set

Examples
How do we define them?
How do we use them?
Hilbert Curve
Where do they come from?

- Recursion Relations
- Continuous, but not Differentiable Functions
- The Father of Fractals: Benoit Mandelbrot
Fractal Definitions

Working Definition

- A geometric pattern that is repeated at ever smaller scales to produce irregular shapes and surfaces that cannot be represented by classical geometry.

Mandelbrot Definition

- 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.

Mathematical Definition

- A set of points whose fractal dimension exceeds its topological dimension.
Fractal Dimension

- A statistical index of complexity comparing how detail in a pattern changes with the scale at which it is measured. It has also been characterized as a measure of the space-filling capacity of a pattern that tells how a fractal scales differently than the space it is embedded in.

Topological Dimension

- The dimension of a space should be the maximum of its local dimensions where the local dimension is defined as one more than the dimension of the lowest dimensional object with the capacity to separate any neighborhood of the space into two parts.
Hilbert Curve
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Fractal Patterns are observed in:

- Bacteria Cultures
- Chemical Reactions
- Human Anatomy
- Molecules
- Plants
- Population Growth
- Matter Density in the Universe
- Coastlines
Fractals are used in:

- Fractal Landscapes and Image Generation
- Image Compression Software
- Modeling Complex Processes
Questions?