Review of Workshop 4: Fractals in Nature and Science
The Koch Curve
Can you describe it?

Remember each line segment is divided into 3 pieces \((r = 1/3)\) resulting in 4 new self-similar pieces \(N = 4\).
Fractal Dimensions
Dimensions in Euclidean Geometry

• A point · has zero dimension.

• A line (segment) is 1 dimensional.

• A portion of a plane, such as a tabletop or the wall of a classroom, is 2 dimensional.

• A portion of space, such as a box or a classroom is 3 dimensional.
Koch Curve

- Self-similar
- Has the same shape under scaling
- At each point in its construction, the length of the curve increases by a factor of 4/3.
- The resulting figure has infinite length in a finite area of the plane without intersecting itself.
- The curve is more than a line (> 1 D) and yet has no breadth (< 2D).
Fractal Dimension

The conventional Koch curve has a dimension of 1.26 --more than 1 but not 2. Fractal Dimension: measures the degree of irregularity/roughness regardless of how much we zoom in on the curve.
Some Relatives of the Koch Curve

Each is made with
N = 4 pieces but scaled
from \( r = 0.25 \) to \( 0.5 \)
The dimensions of the shapes change from 1 (a line segment) to 2 (a solid triangle in the plane).

To play the animation, double click on it. The animation is provided by Prof. Michael Frame from the Mathematics Department at Yale University.

Zoom in on the Koch Curve

Zooming in on Koch curve with a dimension approx. =1.26.

To play the animation, double click on it. The animation is provided by Prof. Michael Frame from the Mathematics Department at Yale University.

Fractal Coastlines

South Africa  
Fractal dimension  
= 1*

Great Britain  
Fractal dimension  
= 1.25*

Norway  
Fractal dimension  
= 1.52*

Notice that as the fractal dimension increases, the coastline is rougher.


15. Hand calculations led to the following results: South Africa from Hotagterslip to southeast of Heidelberg: close to 1, Great Britain in the Holyhead region: 1.2 and Norway from south of Namsos to Nesna: 1.5.
Jackson Pollock

• Jackson Pollock was an action painter.

• His canvases were large; he laid them on the floor.

• He used the "tool of gesture" of his own human body, to drip (sometimes with sticks), cast (like seeds), spill, spray, splatter, spot, squirt, smear, throw, whip, hurl, and stamp the paint (and other materials at times) on the canvas.


Photographs of Pollock’s Studio by AR, April 2000
Jackson Pollock


Jackson Pollock

• Click here to see a movie clip of Jackson Pollock painting: (http://www.nga.gov/feature/pollock/process3qt.shtm)

• Get QuickTime plug in: http://www.apple.com/quicktime/

• View the VHS, Jackson Pollock: Portrait (Strokes of Genius series), by filmmaker, Amanda Pope, for Cort Productions, winner of the Blue Ribbon, American Film Festival; CINE Gold Eagle (ISBN: 1-55974-191-0)
Fractal Dimensions determined by Taylor, Micolich and Jonas using “Box Counting” method

“Composition with Pouring II” (1943) by Jackson Pollock

© 2008 The Pollock-Krasner Foundation / Artists Rights Society (ARS), New York
Pollock, Jackson. Composition with Pouring II 1943, Oil and enamel paint on canvas, 25 x 22 1/8 in. (63.5 cm x 56.2 cm.) Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Washington DC

“Number 14, 1948” by Jackson Pollock

Fractal Dimension: 1.45

© 2008 The Pollock-Krasner Foundation/Artists Rights Society (ARS), New York
Pollock, Jackson. *Number 14, 1948: Grey*, 1948: Grey. Oil and enamel paint on canvas, 25 x 22 1/8 in. (63.5 cm x 56.2 cm.) Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Washington DC

Fractals occur in art too! Here is a painting of Jackson Pollock who sometimes dripped paint on the canvas laid at his feet.

“Autumn Rhythm: Number 30” (1950)
by Jackson Pollock

Fractals occur in art too! Here is a painting of Jackson Pollock who sometimes dripped paint on the canvas laid at his feet.

"Blue Poles: Number 11" (1952) by Jackson Pollock

Dimension: 1.72

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Pollock, Jackson. Blue Poles: Number 11, 1952, Enamel and aluminum paint with glass on canvas, 6 ft. 11 in. x 16 feet (210.8 x 487.6 cm.) Collection: Australian National Gallery, Canberra, Australia

Activity: Building a Fractal Tetrahedron with Envelopes:

Each student makes 4 pieces and then the activity continues with building additional stages.

Tetrahedron: A solid figure with four sides

Four Stages of a Sierpinski Tetrahedron

- The Sierpinski tetrahedron has a fractal dimension of 2.
- Notice how empty a 2-dimensional object can be in 3-dimensional space!