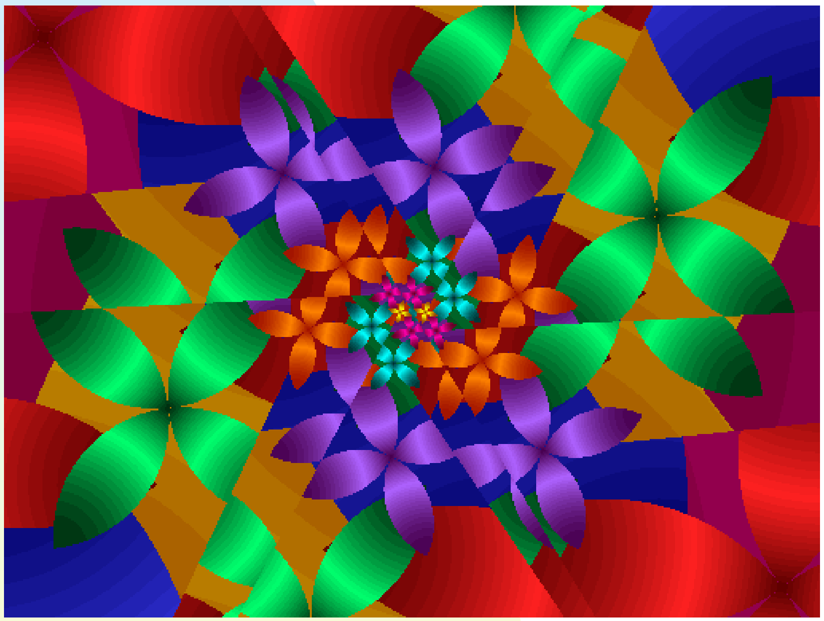
Session overview



- Dimension
- Linear fractals program

An approach to dimension - 1

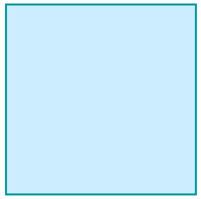
- Consider a line segment of length 1:

- There is one piece (N = 1), of length 1 (s = 1, 1/s = 1)
- Now consider the same line segment divided into thirds:

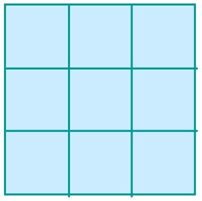
- Now there are 3 pieces (N = 3), each of length 1/3 (s = 1/3, 1/s = 3)
- $3 = 3^1$

An approach to dimension - 2

- Now consider a square of length 1:



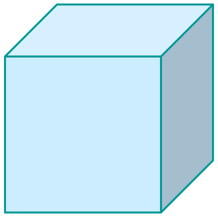
- There is one piece ($N = 1$), of length 1 ($s = 1$, $1/s = 1$)
- Now consider the same square divided into thirds:



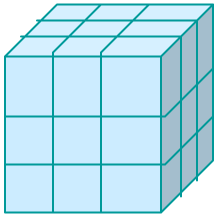
- Now there are 9 pieces ($N = 9$), each of length 1/3 ($s = 1/3$, $1/s = 3$)
- $9 = 3^2$

An approach to dimension - 3

- Now consider a cube of length 1:



- There is one piece (N = 1), of length 1 (s = 1, 1/s = 1)
- Now consider the same cube divided into thirds:



- Now there are 27 pieces (N = 27), each of length 1/3 (s = 1/3, 1/s = 3)
- $27 = 3^3$

Recap

Dimension	Relationship
1	$3 = 3^1$
2	$9 = 3^2$
3	$27 = 3^3$
…	
N	________

In general, $N=(1/s)^D$

Self-similarity dimension

- From the previous slides, we observe that $N = (1/s)^D$
- Solve for D
- $\log N = \log (1/s)^D$
- $D = \log N / \log (1/s)$
- For the Koch curve,
  - N = 4 and s = 1/3, so D = 1.262
- For the middle-thirds Cantor set,
  - N = 2 and s = 1/3, so D = 0.631

It’s not enough

- There are many definitions of dimension
- We’ll look at more later this week:
  - Box-counting
  - Hausdorff

`LinearFractals.cpp`

- The `LinearFractals` program generates fractals that can be drawn with straight lines (without lifting the pen)
- Fractals are described by:
  - an initiator (level 0 of the recursion)
  - a generator to take the initiator to the first level image

The Koch curve

- The initiator for the Koch curve is

- The generator for the Koch curve is

- Input for `LinearFractals` for the Koch curve:
  - # of pieces = 4
  - contraction factor = 0.333333
  - angles = 0, 60, -120, 60
  - levels of recursion
  - maximum time to draw

Source code

- `LinearFractals.cpp` source code is on the ANGEL course web site and in the handout.
- Homework 0 due Thursday– make this program work on your laptop if you haven't
- Experiment with using it now
- Project 1: Modify it to draw Sierpinski's gasket.