Fractals

CS116B

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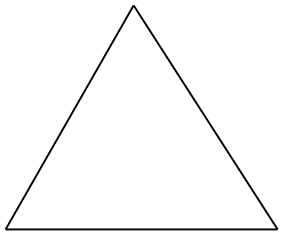
Outline

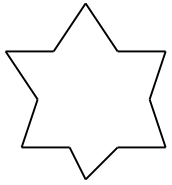
- Constructing Self-Similar Fractals
- Constructing Affine Fractals
- Random Midpoint Displacement Method

Constructing Self-Similar Fractals

- Start with a given shape called an initiator

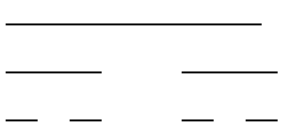


- Subparts of the initiator are replaced with a pattern called a generator

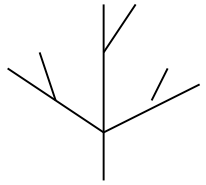


More on Self-Similar Fractals

- Can also use generators with disjoint components :



- Simple plants and tree can be modeled using these techniques.



Statistically Self-Similar Fractals

- To add variability we could have a list of available generators to use.
- Then choose randomly from this list at each step.
- Another technique involves taking the midpoints of the sides of the figure constructed so far and calculating a random displacement to this midpoint

- To create gnarled and contorted we can apply twisting functions as well as scaling functions.

Constructing Affine Fractals

- Realistic terrain can be generated using *fractional Brownian motion*.
- In this set up one starts from some point and picks an angle and draws a line segment using that angle.
- Then one picks a new angle and continues the angle from that point.
- If one adds a parameter which controls the fractal dimension of this path one gets fractional Brownian motion.
- Can extend to two directions to generate a surface.

Random Midpoint Displacement Method

- Slow to use fractional Brownian motion to generate terrain.
- Idea is given two endpoints of a line calculate $y_{mid}=1/2[y(a)+y(b)]+r$ where r is a random number.
- To approximate a given fractal dimension D choose r according to a Gaussian distribution with a mean of 0 and a variance of $|(b-a)|^{2H}$ where H= 2-D and D>1.