Natural Modeling

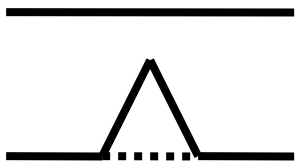
CS 418

Interactive Computer Graphics

John C. Hart

von Koch Snowflake Curve

- Snowflake curve is made out of smaller copies of itself
  - 4 copies
  - Each 1/3 scale

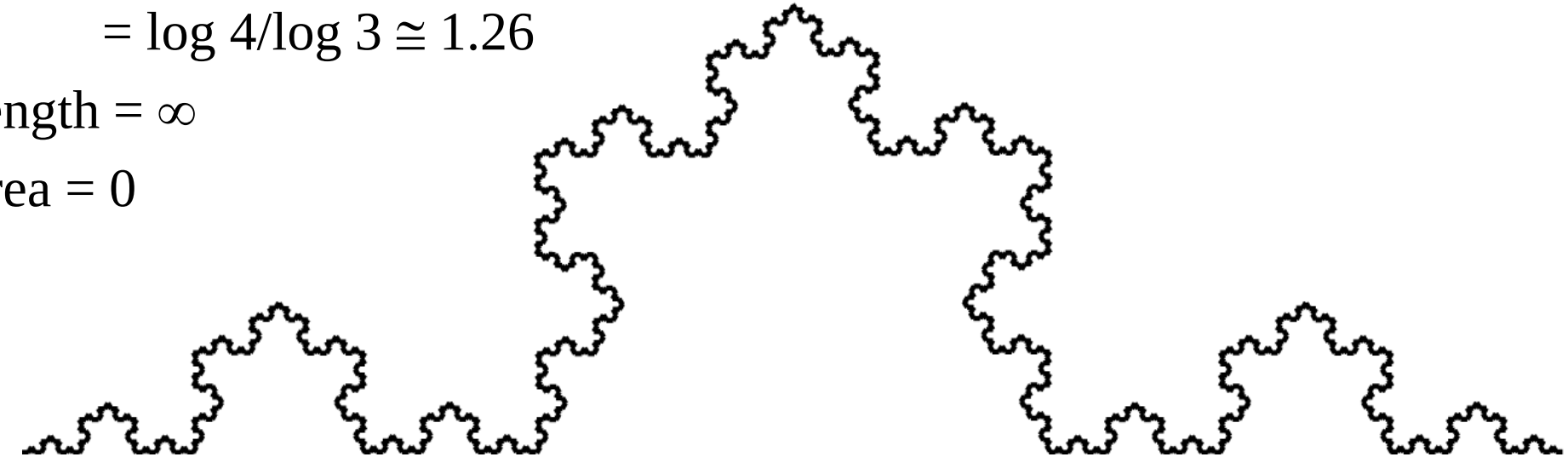


- Dimension of snowflake curve

$$D = (\log N)/(\log 1/s)$$

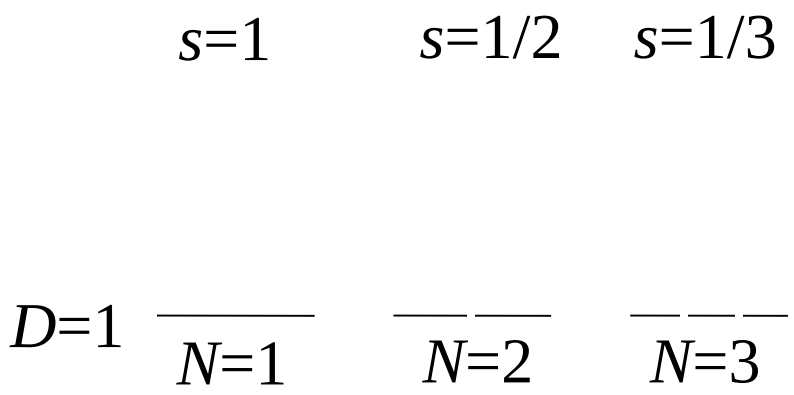
$$= \log 4/\log 3 \cong 1.26$$

- Length = ∞
- Area = 0



Fractal Dimension

- Self-similarity dimension
- Make a *D* dimensional object out of *N* smaller copies scaled by *s*



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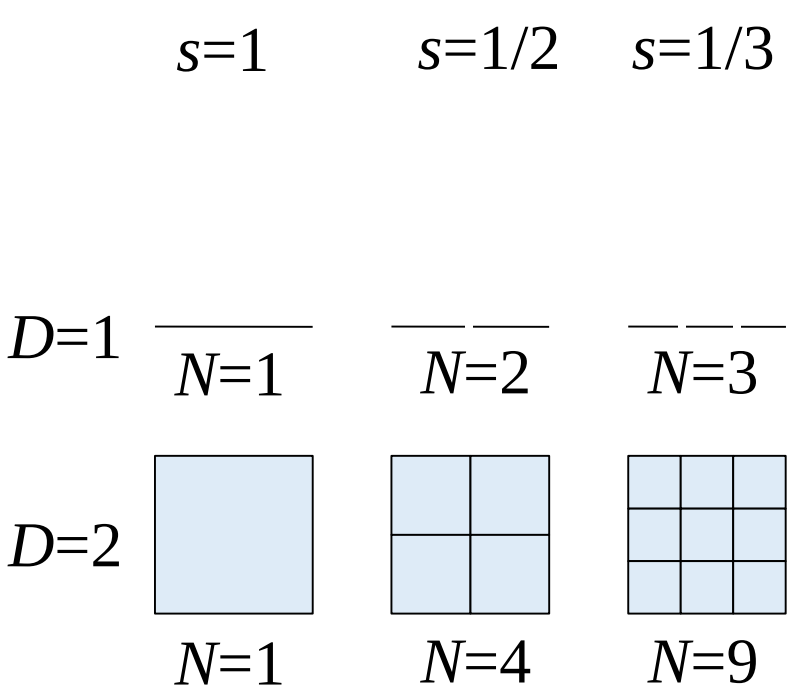

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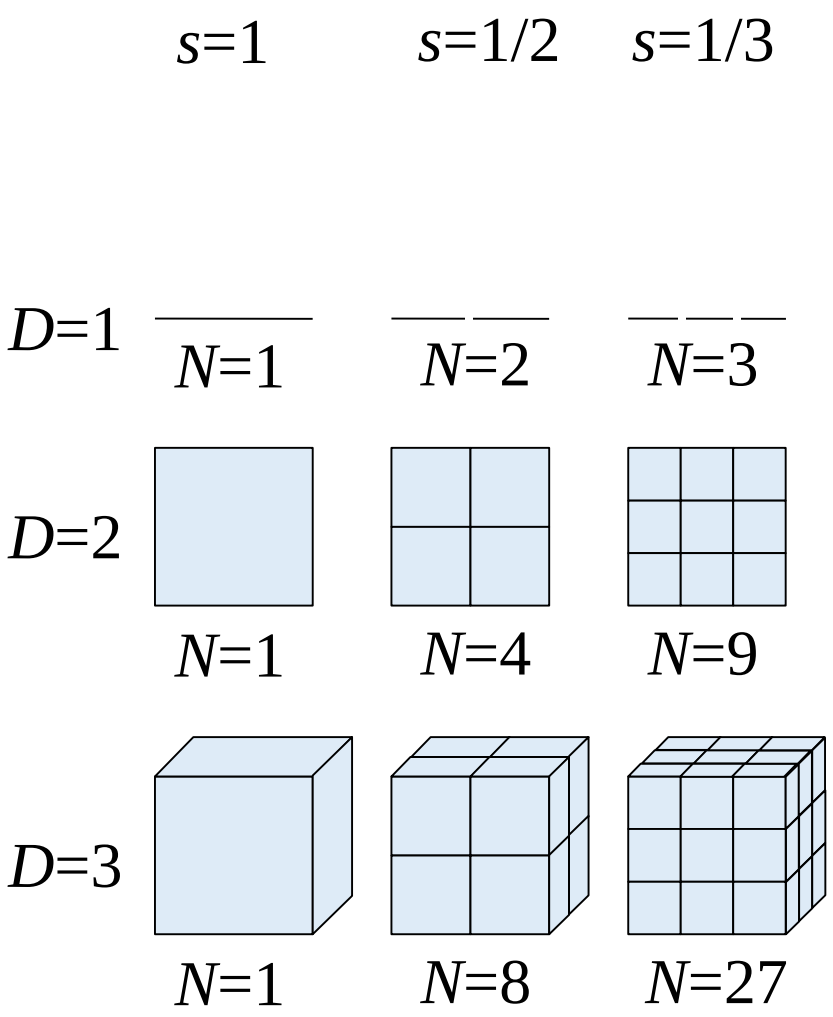

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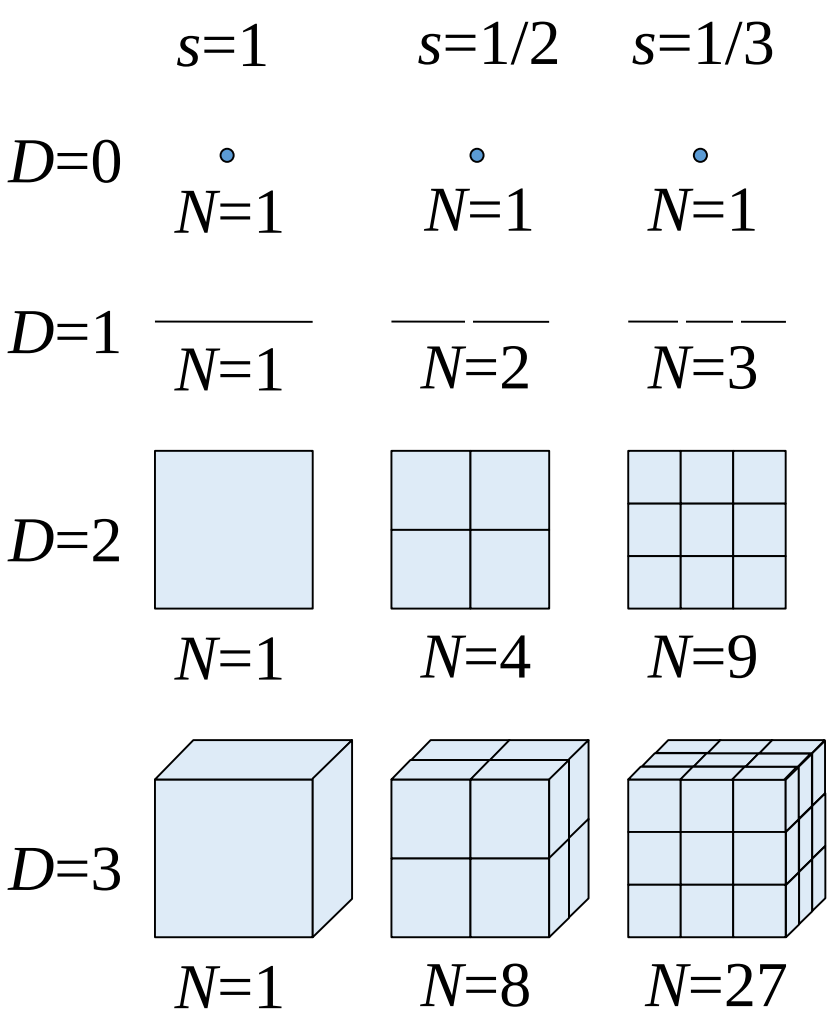


Fractal Dimension

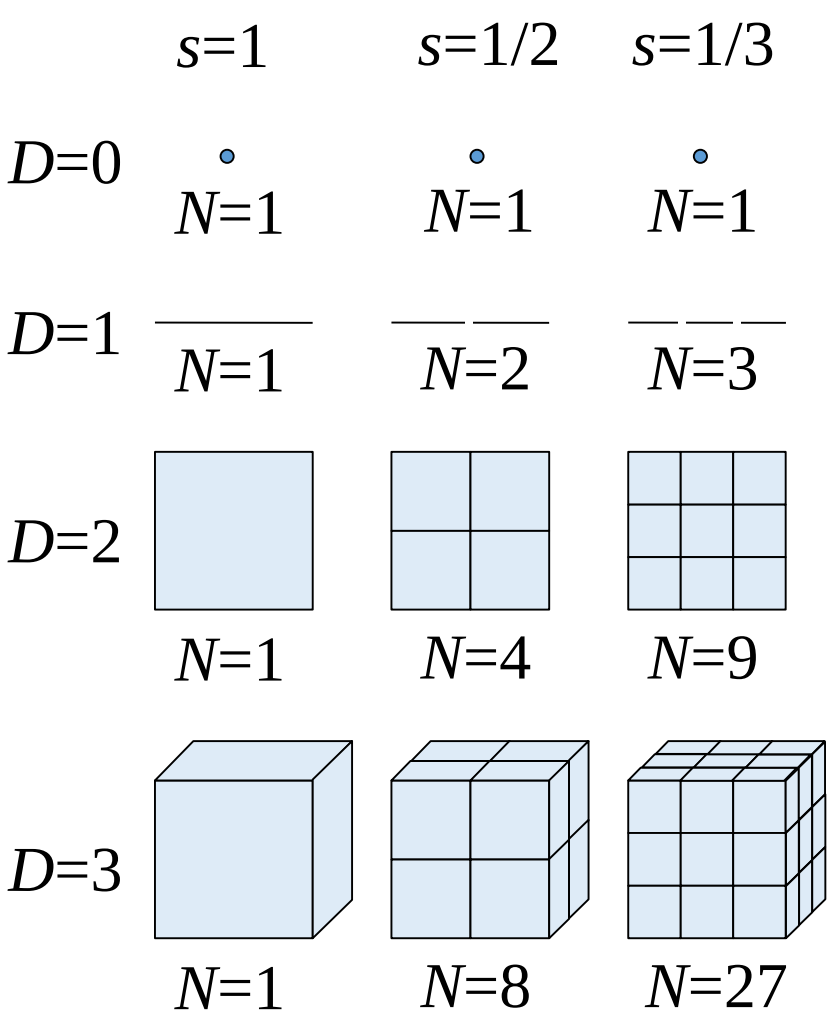
- Self-similarity dimension
- Make a D dimensional object out of N smaller copies scaled by s

$$N = (1/s)^D$$

- Can solve for dimension D

$$\log N = D \log 1/s$$

$$D = (\log N)/(\log 1/s)$$



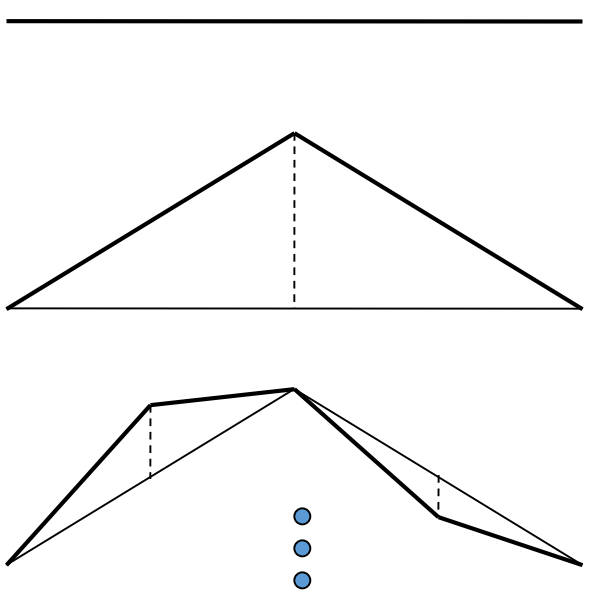
Terrain Modeling

- In nature, amplitude inversely proportional to frequency
- “Large things are farther apart”

Nimbus,
Ken Musgrave,
1987

Midpoint Subdivision

- Fournier, Fussell & Carpenter
- To make terrain, subdivide a horizontal mesh and perturb the new vertices vertically
- Amount of perturbation should be proportional to length of subdivided edge
- Random perturbations should be Gaussian (more likely zero than extreme)
- Can lead to some creasing artifacts



Carolina,
Ken Musgrave,
1989

Mesh Subdivision

- Triangle subdivision
  - three perturbed edge midpoints
  - four new triangles
- Quad subdivision
  - four edge midpoints plus one face midpoint
  - four new quads
- Cracking
  - Use same perturbation on neighboring elements to avoid cracks
  - Generate random displacement from hash function on midpoint location