Procedural Shape Modeling

Simple procedure
Fractal Plants (L-Systems)

• Uses “production rules” applied to a seed “axiom”

• Example:
  Axiom: B
  Rule: B -> A[-B][+B]
L-system Example

Axiom

Replacement Rule

4th Iteration
L-systems example: Koch snowflake
L-systems example: Serpinski Triangle
Procedural Trees and Bushes

- Define a branch structure
- Define a leaf
Procedural Trees from PovTree

http://propro.ru/go/Wshop/povtree/tutorial.html
Interactive Fractal Tree Design
Algorithmic Plants

• Excellent web resource with a free online book: http://algorithmicbotany.org/

• Numerous papers by Przemyslaw Prusinkiewicz and colleagues
Procedural Terrain Modeling

- Has a gross structure
- Also with some randomness
- Want a height map $z=h(x,y)$

F.K. Musgrave
1D case

Start with a single horizontal line segment. Repeat for a sufficiently large number of times
{
    Find the midpoint of the line segment.
    Displace the midpoint in Y by a random amount.
    Recursively apply this operation for the resulting two segments
    with reduced range for the random numbers (by a factor $0 < f < 1$).
}
Start with a single horizontal line segment. Repeat for a sufficiently large number of times

\{ 
  \text{Find the midpoint of the line segment.}
  \text{Displace the midpoint in Y by a random amount.}
  \text{Recursively apply this operation for the resulting two segments with reduced range for the random numbers (by a factor 0<f<1).}
\}\n
Want a function \( y = h(x) \)

Results with different f
2D case

- Subdivide and Displace
2D case

F.K. Musgrave
Texture mapping

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Adding water

• Use an elevation threshold ($z < z_{\text{water}}$)