Programming
Snazzy Fractals

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Seattle Expanding Your Horizons
Euclidean Geometry

- Triangles
- Circles
- Squares
- Rectangles
- Trapezoids
- Pentagons
- Hexagons
- Octagons
- Cylinders
Can We Describe Nature Using Euclidean Geometry?

- Tree
  - cylinders
- Mountains
  - triangles
- Clouds
  - circles
- Leaves
- Rocks
Well...

- We can describe man made structures using **Euclidean geometry**
- But nature is full of rough edges and non uniform shapes
- Geometry of irregular shapes, non-smooth edges, infinite details, and infinite length
- **Fractal geometry is the formula of nature!**
Let’s Watch!

- Fractal Zoom – Mandelbrot
- Animation
- Animation
- Flying in Fractal Mountain
What is a Fractal?

- Geometric figures just like circles and rectangles, but they also have some special properties
- Structural self-similarity
  - All over nature
    - Flowers, trees, mountains, stalagmite, snow flakes, ...
- Fractals are objects that look the same regardless of the magnification
Why Should You Care about Fractals?

- Fractal Landscape
  - Movies (e.g., Star Trek)
  - Computer Graphics
  - Computer and video games
- Medicine
- Fractal art and music
- Where can you find fractals?
  - Bacteria cultures
  - Galaxies
  - Your own body!
The Koch Snowflake

First step

After 2 steps

Length = 1

Length = \frac{4}{3}

Length = \left(\frac{4}{3}\right)^2
After 3 Steps
After \( n \) Steps

\[
\text{Length} = \left(\frac{4}{3}\right)^n
\]
Well, The Snowflake

- Koch Snowflake is 6 of these put together
Did You Notice....

- The perimeter of the Koch snowflake is infinite ...
  - but that the area it bounds is finite
    (sure enough, it is contained in the white square).
Do You See a Pattern?

- We have to do something over and over and over again
  - It’s hard!
  - It’s tedious!
- Can we get help?
What Can Computers Do?

- Computers are really good at:
  1. Following instructions
  2. Processing data you provide (names, numbers, etc.)
  3. Making decisions according to rules you specify
  4. Repeating, repeating, repeating and repeating

- Let’s look at some examples from Python Programming Language
1) Following Instructions

- Load the software (the Python interpreter) that will obey your commands!
- Find the shortcut to Python on your desktops.
- You will see the interpreter's prompt: >>>
  This prompt tells you that the interpreter is waiting for another command.
Try the Following

```python
>>> print "hello"

>>> print "Emily"

>>> theName = "Emily"

>>> print "hello " + theName
```
2) Processing Data You Provide

- Let's use the Python interpreter as a calculator to see how it processes numbers.

```python
>>> 3*8 + 4
>>> 2342*8973 + 345/3
```
Calculations....

```python
>>> x = int(input('Enter number: '))
>>> 56
>>> y = int(input('Enter number: '))
>>> 12
>>> x * y
560
>>> x + y
68
```
3) Making Decisions According to Rules You Specify

```python
>>> theWord = raw_input('Enter a word: ')
>>> if (theWord is theName):
...    print "Hello Master " + theName
... else:
...    print "Who are you?"
```
4) Repeating, Repeating and Repeating

```python
>>> for i in range(1, 100):
...    print theName

>>> for i in range(1, 10):
...    for j in range(1, 5):
...        print theName,
...    print " is great!"
```
Advanced Loops

>>> for i in range(1, 10):
...     print theName + " is "
...     for j in range(1,5):
...         print "cool, ",
...         print "cool!"
Do we have to type everything all the time? Can we store some instructions to be used later on?

```python
>>> def WordCompare(someWord):
    ... if (someWord is myName):
    ...     print "Hello, oh great master " + myName
    ... else:
    ...     print someWord + " is not recognized"
```
Now Let’s do Some Fractal Programming!
Resources

- Download Python Interpreter:
  - [http://www.python.org](http://www.python.org)

- For this presentation go to:
  - [http://fac-staff.seattleu.edu/roshanak/fractals](http://fac-staff.seattleu.edu/roshanak/fractals)

- Questions? Send me an email:
  - roshanak@seattleu.edu
THANK You!

Hope you had an awesome time! 😊