General Information

What is a fractal? Why are they important?
Have you ever heard of fractals before?

Fractal Geometry is an amazing new field of science that includes areas in math, computer science, and natural sciences. The following is a concise and hopefully easy to understand summary of the concept of fractals.

The definition of a fractal has not yet been fully developed. There are so many types and they are so diverse that it is hard to classify them under one definition. Here is one attempt as stated by Benoit Mandelbrot:

Fractal: A shape made of parts similar to the whole in some way.

Click on the first two graphics on the left to see some examples of fractals.
[1]
[2]

Here are some other definitions that will be used throughout to describe fractals.

Fractal Geometry: The mathematical study of fractals.

Imaginary Number: An imaginary number is the square root of a negative real number.
The simplest imaginary number is denoted by i, i = -1.
Imaginary numbers are usually written in the form $z = a + bi$ where z is the imaginary number, and a and b are real numbers.

`EX: 2.046 + 1.05i is an` **`Imaginary Number`**
a (2.046) is known as the real part, and b (1.05) is known as the imaginary part.
Imaginary numbers can be graphed on the X-Y axis by replacing a and b with x and y, the number now becomes $z = x + yi$.
To plot the imaginary number z, just plot the point (x,y) on the graph.

Function: You can think of a function as a black box. You put one number in, and get another number out.
Functions with real numbers are written in the form:
f(x) = equation, where x is the input number, and the equation is what is done by the function.

EX: $f(x) = x^2$, $x = 2$, $f(2) = 2^2 = 4$

1 ~BMP: kochis.bmp
2 ~BMP: fncyfrac.bmp

|Functions with imaginary numbers are written f(z) but the rest is the same.

ITERATE: To repeat any operation, using the previous output value as new input. The first input value is known SEED.

EX:

let $f(x) = x^2$ (the function is f(x) - input value is x)

let $x_0 = y_2$ (the seed x_0 is given the value of 2)

$x_1 = f(x_0) = 2^2 = 4$

$x_2 = f(x_1) = f(f(x_0)) = f^2(x_0) = 4^2 = 16$

$x_3 = f(x_2) = f(f(f(x_0))) = f^3(x_0) = 16^2 = 256$

x_4 = ... 65536 and so on

ORBIT: The sequence of numbers obtained from an iteration.

EX: The orbit of the above example is 2, 4, 16, 256, ···

SELF-SIMILARITY: The property of looking the same no matter how much an object is zoomed in. Fractals exhibit self-similarity.

EX: A cloud is self similar, you cannot tell how big a cloud is just by looking at it.

FRACTAL DIMENSION: 1-D objects exist in 1 plane - X. A Line is 1-D.
2-D objects exist in two planes - X and Y. A drawing on a piece of paper is 2-D.
3-D objects exist in three planes - X, Y, and Z. A chair is a 3-D object.
Fractals fall in the cracks between 1,2, and 3-D objects.
Their dimensions are not integers like 1,2,3 they are real numbers, like 1.2535.
This comes from the fact the fractals have an infinite amount of detail. No matter how far you zoom in, there is always more to see. This makes fractals fun to EXPLORE.

Go on to the next section to learn about CREATING FRACTALS.