CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)
Andrew Min

Project Number
22576

Project Title
Proving Symmetry Properties of Mandelbrot Sets

Abstract

Objectives/Goals
To prove Symmetry rules found by the iterations of complex equations by utilizing fractal geometry.

Methods/Materials
Materials: Linux operating system, C code compiler, and knowledge of using Linux and C.

Results
From the data generated by the programs, I noticed that the symmetry of the image seems to be related to the power of the function.
This is pretty interesting because it demands a reason why. The reason why lies in the mathematics. If someone examines the function x^2 or x^3 then that person will notice that for complex numbers, this is a rotation. In the data we saw what happens when we multiply the original function by 2d. The point behind 2d was its relation to the circumference of a circle 2d r. In this case r is assumed to be 1. When simplifie€ the function doesn#t change at all. It acts like the 2d was 1. The 2d created an effect of #circling# all th€ way back around to the same starting place. Since the power was 1, the circle wraps around a whole time producing a totally equal effect. It generates a screen full of black.

But when the function is raised to the 2nd power, things change. Instead of wrapping all the way around on the 2nd power, it only wraps ½ way around. Then it wraps around again. This produces the two symmetric parts we see when we raise the function to the 2nd power. For the 3rd power, we see 3 symmetric parts. For the 4th power, we see 4 symmetric parts.

Conclusions/Discussion
I conclude that complex number equations have symmetry when raised to a certain power. This symmetryx can be proved both thru observing firsthand through empirical observation and mathematical work. Frox this project I learned many things including how to create a fractal and the discovery of the more hidden parts behind fractal images. I learned why fractals have a certain pattern.

Summary Statement
I am trying to prove Symmetry properties of Mandelbrot sets by utilizing a computer

Help Received
Used equipment at Jisan Research Institute under the supervision of Dr. Sanza Kazadi