Fibonacci Sequence

Team number: Melrose High-4

School: Melrose High School.

Area of science: Mathematics

Computer Language: NetLogo

Grade Level: 12

Team Members and e-mails:

James Rush (james.rush@melroseschools.org)

Jouie Barnes (jouie.barnes@melroseschools.org)

Teacher: Alan Daugherty

Executive Summary

The Fibonacci sequence is a series of numbers that follow a unique integer sequence. These numbers generate mathematical patterns that can be found in all aspects of life. The patterns can be seen in everything from the human body to the physiology of plants and animals, and in other natural occurrences. The Fibonacci sequence is a fantastic pattern in nature and in math, where numbers are calculated according to a rule. This rule being, $\mathbf{x_n = x_{n-1} + x_{n-2}}$. In a simpler form the next number is the first and second number being added together to become that next number. 0+1=1, 1+1=2, 1+2=3, 2+3=5 and so on. This can also be applied to the Golden Spiral and Golden Rectangle. The Golden Rectangle is a rectangle that looks pleasing to the eye. The Golden Spiral is a logarithmic spiral that follows the Golden Rectangle. We want to use this concept to make a program that will allow the person using it to input a width and it will calculate the length needed to make a golden rectangle, to allow for easy calculations.

Problem and Background

In architecture and in life, proportions are very important to make objects pleasing to the eye. Our project works to solve the problem of finding the best proportions for items based upon the Golden Rectangle. The Golden Rectangle is based upon the symbol phi. To say a little bit of history about the Fibonacci sequence, the exact origination of the sequence is unknown. It is believed that contributions to the theory began is 200 BC by the Indian mathematicians whose studies were based on Sanskrit philosophy. The sequence was introduced to Western Europe in 1202 by Leonardo of Pisa, aka "Fibonacci". His study of the sequence began with the breeding of rabbits in which he found rabbit generations duplicated in accordance with the Fibonacci numbers.

Also, the Greeks found that architectural designs based upon the ratio of the Golden Rectangle were the most pleasing to the eye. They just 'looked right'! This visual appeal is what our project is working to capture.

Our program is made to find the perfect dimensions when calculating the length from a given width to make a Golden Rectangle. So far, we have a slider that allows for one input and the output is calculated by multiplying the width by 1.61 (phi) to come up with the length.

Description

Our model is about the Fibonacci sequence. It includes the Golden Ratio and Golden Rectangle. It can be found in nature such as seashells, flowers, pinecones, music, and even the human body. The Fibonacci numbers directly correspond to the spirals found in seashells. The numbers form what are called Fibonacci rectangles or "golden rectangles". The rectangles are unique because each rectangle has sides equal to the length of the Fibonacci numbers. The beautiful spirals of the sunflower head reveal the astonishing double connection with the Fibonacci series. A pine cones petals spiral in two directions. In music, the intervals between keys on a piano are Fibonacci numbers. The number of petals to go around once is always a Fibonacci number. The face shows a perfect example of a golden rectangle. Also, weather patterns often illustrate Golden Spirals.

Results and Conclusions - Achievements

What we have come up with is a successful working code that makes the Fibonacci square, and secondly, a Golden Rectangle calculator. A user of this code will be able to determine the proper dimensions of a structure by entering one known and desired value. It will then graphically represent the proportions.

Another aspect of our code allowed us to draw a perfect golden spiral, with all of the individual rectangles needed for its construction. We were able to practice some coding skills in the development of this project.

Software

For this project, we used NetLogo to code our program. We found that NetLogo is easier to code with because we have some past experience with it. Every year we are taught more and more about it at the Super Computing Challenge events and from personal practice. We have found that it is possible to figure out how to make simple models with it.

Acknowledgements

We would like to acknowledge our mentor Mr. Alan Daugherty for his help during the year. We also would like to thank Mrs. Rebecca Raulie, for inspiration of our project.

Books:

The Golden Section: Natures Greatest Sequence by Scott Olson

The Mathematics of Patterns by Hannah Fry

Websites:

Fibonacci Sequence: https://www.mathsisfun.com/numbers/fibonacci-sequence.html

https://en.wikipedia.org/wiki/Fibonacci_number

Fibonacci the Man: http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Fibonacci/fibBio.html

Golden Spiral: http://jwilson.coe.uga.edu/emat6680/parveen/golden_spiral.htm