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PATTERN IN NATURE – THE FIBONACCI SERIES

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Abstract: - Natural patterns are observable regularities of shape found in the natural world. These patterns recur in a variety of circumstances and, in some cases, can be mathematically engineered. Organic examples incorporate balances, trees, twisting, whirls, waves, froth, decorations, crevices, and stripes.
The Fibonacci sequence is found throughout nature, too. It is a naturally occurring pattern
The Fibonacci sequence:
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, ….

Keywords: Natural pattern, Fibonacci sequence

"Mathematics is the science of patterns, and nature exploits just about every pattern that there is.'' By John Stewart

1. INTRODUCTION

Patterns in nature are visible regularities of form found in nature. These examples repeat in a assortment of settings and can once in a while be numerically designed. Balances, trees, twisting, wanders, waves, froths, decorations, breaks, and stripes are instances of natural examples.
Fibonacci numbers are also of interest to biologists and physicists, which would be why they've been found in a plethora of different objects and activities. Fibonacci numbers control the branching patterns of trees and leaves, and also the distribution of seeds in a raspberry.
The sequence was first studied in Europe by Leonardo of Pisa (nicknamed Fibonacci) in the early 13th century, while it can be dated back to around 200 BCE in Indian literature. This series has resulted in a substantial quantity of literature and has linkages to numerous disciplines of mathematics.
However, Pingala, a Sanskrit grammarian, is credited with the primary notice of the number succession at some point between the fifth and 6th hundreds of years B.C. also, in the middle of late third century A.D. Since Fibonacci acquainted the series with Western development, it has had an irregular prominent. The Fibonacci sequence, for e.g., is part of an important clue in The Da Vinci Code. One more delineation of a section in which the progression of syllable numbers each line follows Fibonacci's example is the Fibonacci sonnet.
The Fibonacci sequence is related to the golden ratio, a proportion seen frequently in nature and applied in many domains of human endeavors (approximately 1:1.6). The Fibonacci arrangement and the brilliant proportion, in addition to other things, are utilized to direct the plan of design, sites, and UIs.

2. FASCINATION TO UNDERSTAND NATURE

Abstract designs can be seen in living creatures such as orchids, hummingbirds, and the peacock's tail, which may have a beauty of form, pattern, and hue that creators battle to equal. The magnificence that individuals see in nature has been caused at different levels, numerous quite in the science that oversees what examples can actually frame, including among living regular things the impacts of normal choice, which administer how examples advance.
Mathematics seeks to discover and explain all kinds of abstract patterns or regularities. Chaos theory, fractals, logarithmic spirals, topology, and other mathematical patterns each have explanations for visual patterns in nature. For example, L-systems, can be used to create realistic models of various tree growth patterns.
Physics laws apply mathematical abstractions to the real world, frequently as if it were perfection. A crystal, for example, is perfect if it has no structural deficiencies such as dislocations and is completely symmetric. Only approximate mathematical perfection can approximate solid objects. Physical principles regulate visible patterns in nature; for example, meanders might well be explained using fluid dynamics.
Natural selection in biology can induce the evolution of patterns in biological systems for a multitude of reasons, including camouflage, sexual selection, and multiple kinds of communication, including such mimicry and cleaning symbiosis. The designs, hues, and patterns of insect-pollinated flowers, such as the lily, have adapted to attract insects such as bees. Vivid radial patterns and stripes, some only visible in ultraviolet light, act as nectar guides that can be seen from a distance.

3. CONTRIBUTION TOWARDS PATTERNS IN NATURE

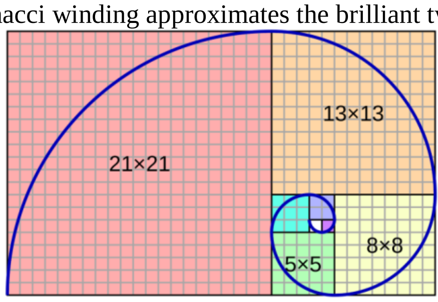
In the nineteenth century, Belgian physicist Joseph Plateau explored cleanser films, which drove him to foster the idea of a base surface. Ernst Haeckel, a German biologist and artist, painted hundreds of aquatic species to highlight their symmetry. D'Arcy Thompson, a Scottish scientist, was a pioneer in the study of growth patterns in both plants and animals, demonstrating that simple equations could explain spiral growth. Alan Turing, a British mathematician, hypothesized mechanisms of morphogenesis that give rise to spot and stripe patterns in the twentieth century. Aristid Lindenmayer, a Hungarian biologist, and Benoît Mandelbrot, a French American mathematician, demonstrated how fractal mathematics might be used to produce plant growth patterns.
HISTORY OF FIBONACCI SERIES

Leonardo Pisano Bigollo (1180-1250), normally recognized as Leonardo of Pisa (Pisano means "from Pisa") and Fibonacci, discovered the Fibonacci sequence (which means "son of Bonacci").
Fibonacci grew up in a Medieval Ages trading community in North Africa, the son of an Italian merchant from Pisa. During the Middle Ages, Italians were among the most skilled businessmen and merchants in the Western world, and they used arithmetic to keep track of their economic transactions. The Roman number system (I, II, III, IV, V, VI, etc.) was used for mathematical operations, but it made addition, subtraction, multiplication, and division difficult. Merchants needed a division to keep track of their transactions.
The Fibonacci succession emerged from a numerical issue about hare rearing tended to in the Liber Abaci. The issue was this: Beginning with a solitary pair of bunnies (one male and one female), the number of sets of hares will be brought into the world in a year, expecting to be that Every month, each male and female rabbit produces a new pair of rabbits, which then produces additional pairs of rabbits.

FIBONACCI SERIES FORMULA
$F0 = 0, F1 = 1$
$Fn = Fn\text{-}1 + Fn\text{-}2$

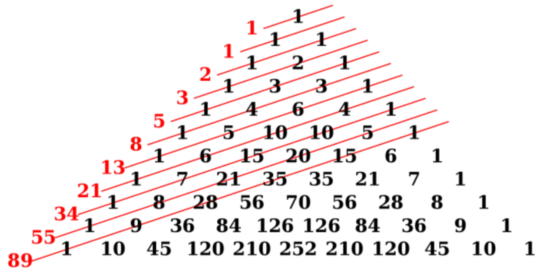
4. FIBONACCI SERIES SPIRAL

The Fibonacci twisting is an example created by the Fibonacci numbers in a matrix .The Fibonacci twisting starts in a plane looking like a square shape whose aspects (length x width) comply with the guideline of a "Brilliant Ratio"(1.618), and is so known as a "Brilliant Rectangle.". The Fibonacci winding is portrayed in the realistic beneath, which starts with a square shape separated into two squares. The Fibonacci winding approximates the brilliant twisting



‘’As Buckminster Fuller once said , in light of the fact that our universe is based on mathematical connections like the Golden Ratio and the Fibonacci Series, pondering calculation all the time permits you to orchestrate and fit your existence with the design of the world.’’

FIBONACCI SERIES AND PASCAL’S TRIANGLE
Pascal's triangle is one more fascinating methodology for deciding the numbers in a Fibonacci series. In arithmetic, Pascal's triangle is a three-sided cluster of binomial coefficients. Fibonacci numbers can be gotten from a Fibonacci series by ascertaining the amount of components on the rising inclining lines in Pascal's triangle.



FIBONACCI IN NATURE
“Learn how to see. Realize that everything connects to everything else.”
By Leonardo da Vinci

The Fibonacci Sequence can likewise be found in nature. It is an example that happens normally. Here are a few instances of Fibonacci in nature…
Tree Branches
Despite the fact that we as a whole generally see trees wherever in our everyday life, how frequently have you searched for the examples in them ? The Fibonacci grouping starts in the development of the storage compartment and twistings outward as the tree becomes bigger and taller.
We can likewise see the brilliant proportion in their branches, as they start with one trunk that parts into two, then, at that point, one of the new branches stems into two, etc.

Seashells
At the point when nautilus shells are cut open, they structure a logarithmic twisting comprised of chambered segments called camerae. Each new chamber is a similar size as the two camerae before it, bringing about the logarithmic twisting. Since the nautilus develops at a steady rate for the duration of its life until it arrives at its standard, it shows corresponding development.

Flower Petals
The petals of a blossom develop as per the Fibonacci arrangement Lilies, which have three petals, and buttercups, which have five petals, are two of the most noticeable Fibonacci groupings in plants.
Galaxies
Assuming you look carefully, you can see the brilliant twisting looking like cosmic systems' "arms." . We can't

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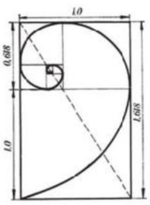
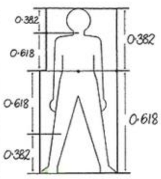
figure out whether universes follow an ideal twisting since we can't precisely quantify a cosmic system, yet we can gauge it and see its size on paper.

Flower Heads
Normally, seeds rise up out of the focal point of the blossom take and move off. Sunflowers, with their spiraling examples, are a fantastic illustration of this. On occasion, their seed heads become so thickly stuffed that their absolute number can arrive at 144 or higher. The number is quite often Fibonacci while examining these twistings.

YOU!
You are an illustration of the excellence of the Fibonacci Sequence. From your face to your ear to your hands, the human body has various representations of the Fibonacci Sequence extents. You have now been mathematically proven to be stunning.





FIBONACCI USING JAVA
1. USING LOOP

```
import java.util.Scanner;
public class Fibonacci{

   public static void main(String[] args) {

      int count, Num1 = 0, Num2 = 1;
      System.out.println("How many numbers you want in the sequence:");
      Scanner scanner = new Scanner(System.in);
      count = scanner.nextInt();
      scanner.close();
      System.out.print("Fibonacci Series of "+count+" numbers:");

      int i=1;
      while(i<=count)
      {
         System.out.print(Num1+" ");
         int sumOfPrevTwo = Num1 + Num2;
         Num1 = Num2;
         Num2 = sumOfPrevTwo;
         i++;
      }
   }
```

2. USING RECURSION

```
import java.util.Scanner;
Pubic class Fibonacci
{
   static int fib(int n)
   {
   if (n <= 1)
     return n;
   return fib(n-1) + fib(n-2);
   }

   public static void main (String args[])
   {
   int n = 9;
   System.out.println(fib(n));
   }
}
```

FIBONACCI USING PYTHON

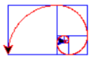
```
import turtle
import math

def fiboPlot(n):
         a = 0
         b = 1
square_a = a
square_b = b
                  x.pencolor("blue")

         # Drawing the first square
         x.forward(b * factor)
         x.left(90)
         x.forward(b * factor)
         x.left(90)
         x.forward(b * factor)
         x.left(90)
         x.forward(b * factor)

         # Proceeding in the Fibonacci Series
         temp = square_b
         square_b = square_b + square_a
         square_a = temp
         # Drawing the rest of the squares
```



```
        for i in range(1, n):
                x.backward(square_a * factor)
                x.right(90)
                x.forward(square_b * factor)
                x.left(90)
                x.forward(square_b * factor)
                x.left(90)
                x.forward(square_b * factor)

                temp = square_b
                square_b = square_b +
square_a
                square_a = temp

                x.penup()
        x.setposition(factor, 0)
        x.seth(0)
        x.pendown()

        #plotting pen to red
        x.pencolor("red")

                x.left(90)
        for i in range(n):
            print(b)
                fdwd /= 90
                for j in range(90):
                        x.forward(fdwd)
                        x.left(1)
                temp = a
                a = b
                b = temp + b

factor = 1

# Taking Input for the number of
# Iterations our Algorithm will run
n = int(input('Enter the number of iterations (must be > 1): '))

# Plotting the Fibonacci Spiral Fractal
# and printing the corresponding Fibonacci Number
if n > 0:
        print("Fibonacci series for", n, "elements :")
        x = turtle.Turtle()
        x.speed(100)
        fiboPlot(n)
        turtle.done()
else:
        print("Number of iterations must be > 0")
```

OUTPUT:

```
Enter the number of iterations (must be > 1): 10
Fibonacci series for 10 elements :
1
1
2
3
5
8
13
21
34
55
```



5. APPLICATIONS OF FIBONACCI SERIES

The Fibonacci series tracks down application in various fields in our everyday lives The Fibonacci series can be found in an assortment of spaces going from nature to music to the human body. A portion of the utilizations of the Fibonacci series are given as,

- It is used in the grouping of numbers and used to study different other special mathematical sequences.
- It finds application in Coding (computer algorithms, distributed systems, etc). Fibonacci series, for instance, are huge in the computational run-time investigation of Euclid's calculation, which is utilized to ascertain the GCF of two numbers.
- It is utilized in an assortment of logical areas like quantum physical science, cryptography, etc.
- Fibonacci retracement levels are ordinarily used in specialized examination in monetary market exchanging.
- At the point when a light bar sparkles at a point through two stacked straightforward plates of various materials with fluctuating refractive files, it might reflect off three surfaces: the top, center, and lower part of the two plates. The Fibonacci number is the quantity of conceivable pillar pathways that have k reflections for k > 1. (At the point when k = 1, notwithstanding, there are three reflection courses, not two, one for every one of the three surfaces.)
- Fibonacci numbers are used in a polyphone version of the merge sort algorithm in which an unsorted list is divided into two lists whose lengths correspond to sequential Fibonacci numbers – by isolating the rundown with the goal that the two sections have lengths in the estimated extent φ.
- A Fibonacci tree is a twofold tree whose kid trees (recursively) contrast in stature by precisely 1. So it is an AVL tree, and one with the least hubs for a given stature — the "most slender" AVL tree.

6. CONCLUSION

At long last, Fibonacci numbers are generally utilized in the public arena. It's astounding how these assortments of ceaseless numbers are used in more ways than one. Fibonacci numbers are uncommon from other numerical regions attributable to its capacity to register pi and their utilization in craftsmanship.

Fibonacci numbers are an infinite sequence of natural numbers. A boundless succession of regular numbers has no outcome and no end.

And even after all the findings attributed to Fibonacci numbers, they still have the potential to uncover more mysteries of our world one just need to find a way to look for it.

"The path isn't a straight line, it's a spiral. You continually come back to things you thought you understood and see deeper truths." -Pinterest

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