MTΣ Project

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PROJECT REPORT on
FIBONACCI SERIES

Submitted in complete fulfilment of the requirements for award of the degree of

BACHELOR OF TECHNOLOGY
IN
Engineering Physics

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CONTENT

Chapter 1

Fibonacci Series

1.1 Introduction

- The fibonacci numbers are nature's numbering system
- They occur everywhere in nature, from the arrangement of the leaves in the plants, in the pattern of sunflower flowers.
- They apply to the growth of every living thing..a cell, a grain of wheat, a hive of honey and even the whole human race.

1.2 History

- Italian mathematician Leonardo Bonacci, regarded as a very talented Western mathematician wrote about this sequence in his book is called "Liber Abaci".
- In the book, he solved the rabbit growth problem through this series. This sequence was later noted by an Indian mathematician in the early 6th century.

Chapter 2

FIBONACCI PROPERTIES

Working Rule:

Series is :-
1,1,2,3,5,8,13,21,34,55,78,133

The Rule is :-

$$X_n = X_{n-1} + X_{n-2}$$

(where $n>=2$ and $X_1=X_2=1$)

For Example :-
To find the 9th term in a Fibonacci series

$$X_9=X_{9-1}+X_{7-2}$$

$$X_9=13+21$$

$$X_9=34$$

Properties:

1. Sum of sequence of Fibonacci numbers.

$$\forall n \in \mathbb{Z}_{\geq 0} : \sum_{j=0}^{n} F_j = F_{n+2} - 1$$

2. Sum of odd index Fibonacci series.

$$\begin{aligned} \forall n \geq 1 : \sum_{j=1}^{n} F_{2j-1} &= F_1 + F_3 + F_5 + \cdots + F_{2n-1} \\ &= F_{2n} \end{aligned}$$

3. Sum of even index Fibonacci series.

$$\forall n \geq 1 : \sum_{j=1}^{n} F_{2j} = F_2 + F_4 + F_6 + \cdots + F_{2n}$$
$$= F_{2n+1} - 1$$

4. Cassini's formula:

$$F_{n+1} \cdot F_{n-1} - (F_n)^2 = (-1)^n$$

5. Simson's Relation:

$$F_{n+1} \cdot F_{n-1} + (-1)^{n-1} = (F_n)^2$$

6. Shifting Property:

$$F_{m+n} = F_m \cdot F_{n+1} + F_{m-1} \cdot F_n$$

Examples:

1. Sunflower Seeds.

   The seeds on a sunflower follows the same pattern as a Fibonacci series
   That is :- 1,1,2,3,5,8

2. Leaves of plant.

   Many types of leaves in some plants follows the Pattern as a Fibonacci series.

3. Snail’s Shell.

   Various snails have a similar pattern on their shells As a Fibonacci pattern

Chapter 3

Golden Ratio

3.1 Introduction

- Golden ratio is an irrational mathematical constant
- It is represented by symbol Φ
- The value of Φ is 1.61803398
- Two quantities are in golden ratio if the ratio between the sum of those quantities and the larger one is the same as the ratio between the larger one and the smaller.

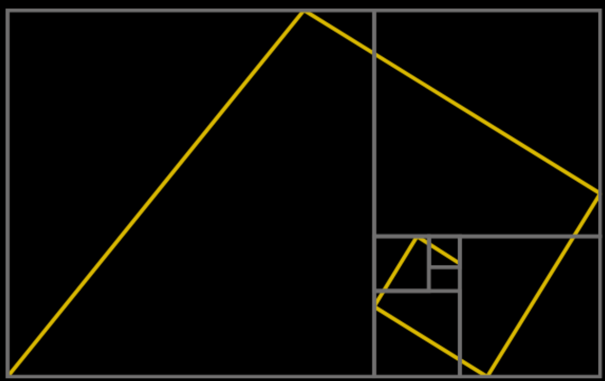
  By definition -

$$\frac{a + b}{a} = \frac{a}{b} = \Phi$$

3.2 Golden Rectangle

- A golden rectangle is a rectangle where the ratio of its length to the breadth is the golden ratio. That is whose sides are in the ratio of 1:1.618.

- These golden rectangle can be further divided into smaller square and golden rectangle.

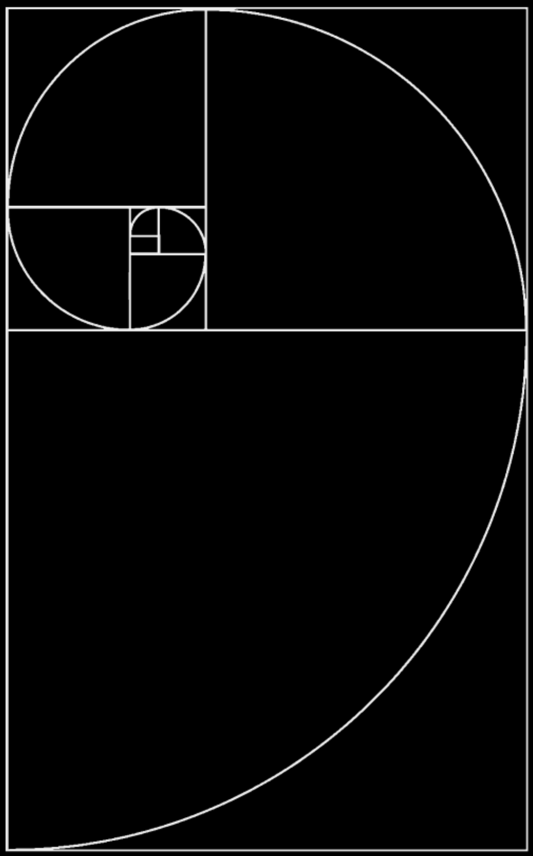


3.3 Golden Spiral

Φ

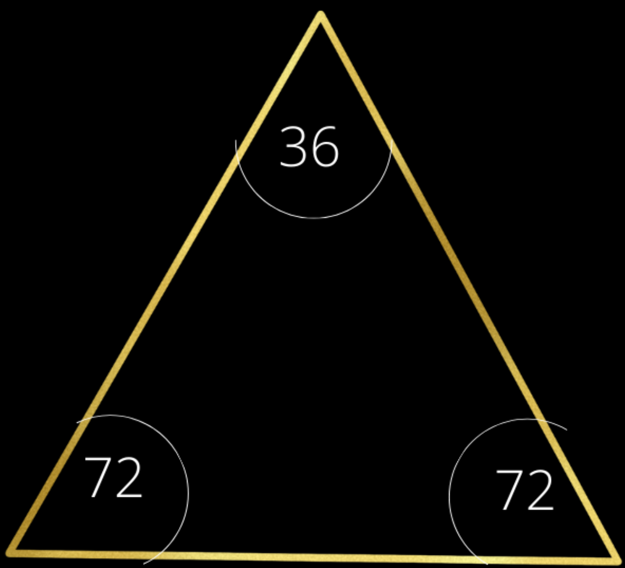
- It is a logarithmic spiral whose growth factor is ,

- Start with the smallest one on the right connecting the lower right corner to the upper right corner with an arc which is one fourth of the circle. Then continue your line into the second square with an arc that is one fourth of the circle ,we will continue this process until each square has an arc inside it.



3.4 Golden Triangle

- It is a type of isosceles triangle.
- The top angle is 36 degrees while bottom two angles are 72 degree each.



3.5 Golden Ratio in real life world

1. **Snail's Shell**

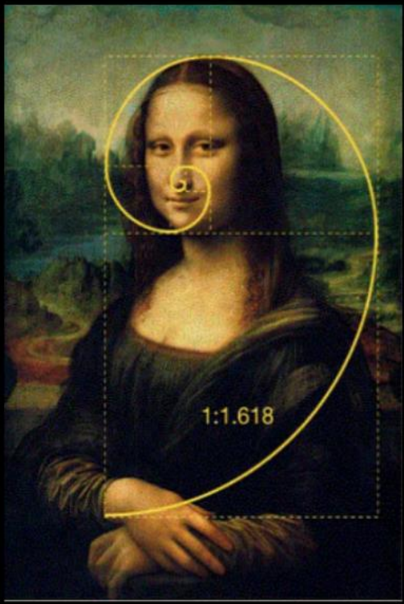
- Shell of the snail follow the logarithmic spiral whose growth ratio is the golden number.

- Spiral is based on Golden Rectangle Rule.

2. Picture of Mona Lisa

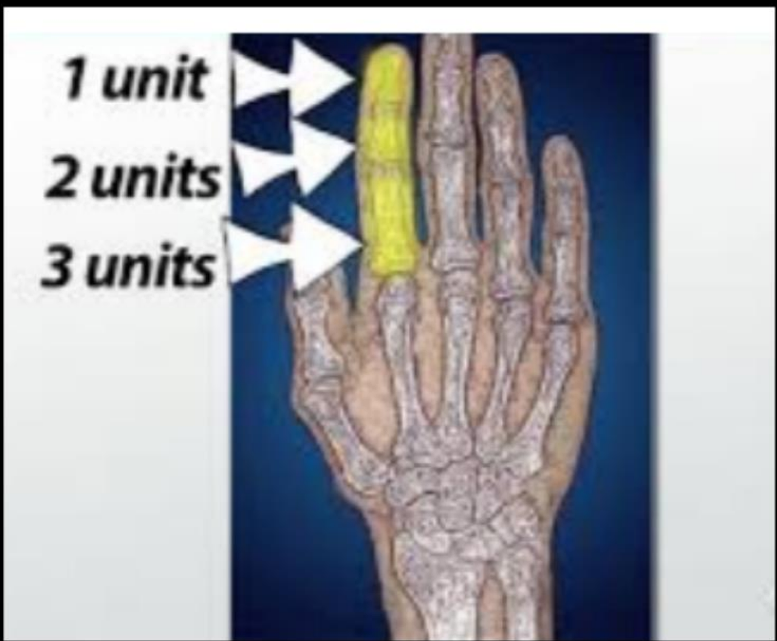
- The face shape of Mona Lisa follows Golden Ratio.

- It is according to the ratio of the width of her forehead compared it to the length of her face.



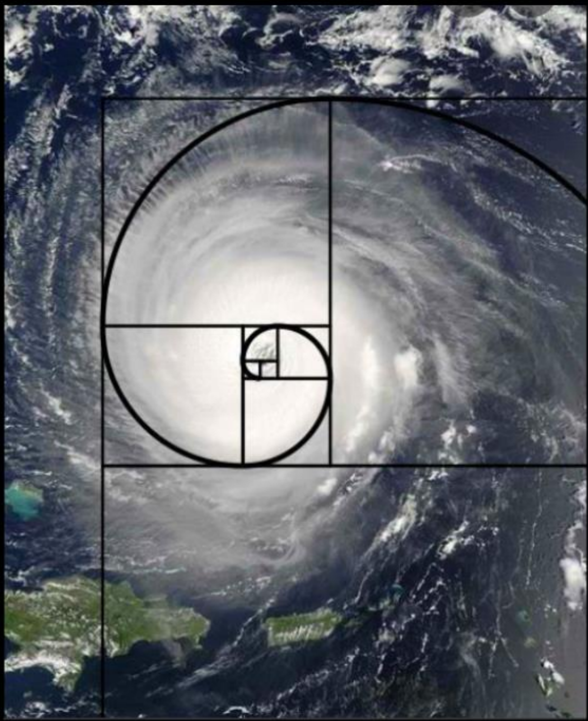
3. Golden Ratio in Fingers

- The length of the bones of fingers are in fibonacci series. i.e., 1, 2, 3, ...



4. Golden Ratio in Hurricane

- The spiral of hurricane is in golden spiral pattern
- The spiral divides the rectangle in the fixed ratio



Chapter 4

Relationship Between Fibonacci and Golden Ratio

Fibonacci Series is:-
1,1,2,3,5,8,13,21,34,55,78,133

On taking Consecutive Terms ratio we notice that:-

2/1	=2	(bigger)
3/2	=1.5	(smaller)
5/3	=1.67	(bigger)
8/5	=1.6	(smaller)
13/8	=1.619	(bigger)
21/13	=1.615	(smaller)
34/21	=1.619	(bigger)
55/34	=1.618	(smaller)
89/55	=1.618	(bigger)

As we go down the Sequence, the ratios seems to converge upon one number

i.e.
THE GOLDEN NUMBER
1.6180339887

Chapter 5

FACTS

Uses Of Fibonacci Series:

Studying of the vast patterns created by the gigantic spiral galaxies.

In the field of Economics.

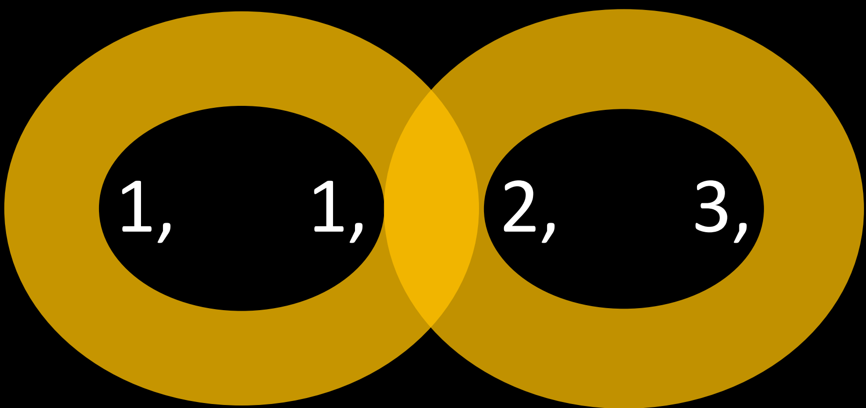
Biological studies of plants.

Some Fun Facts about Fibonacci series:

This Series has defined several Mathematical Concepts.

There is a festival called Fibonacci Series which is Celebrated on

November of 23rd.



Chapter 6

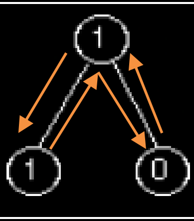
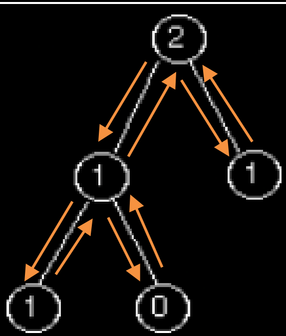
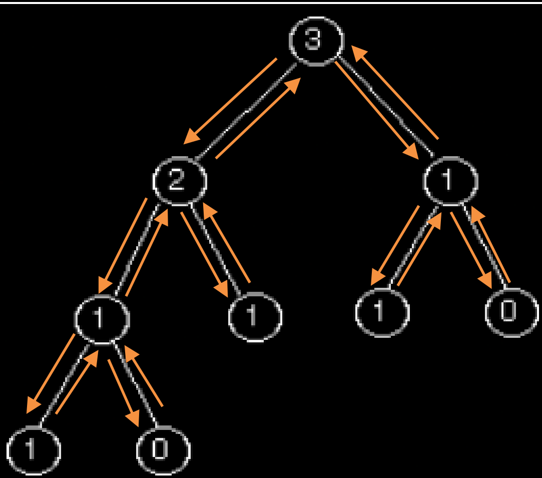
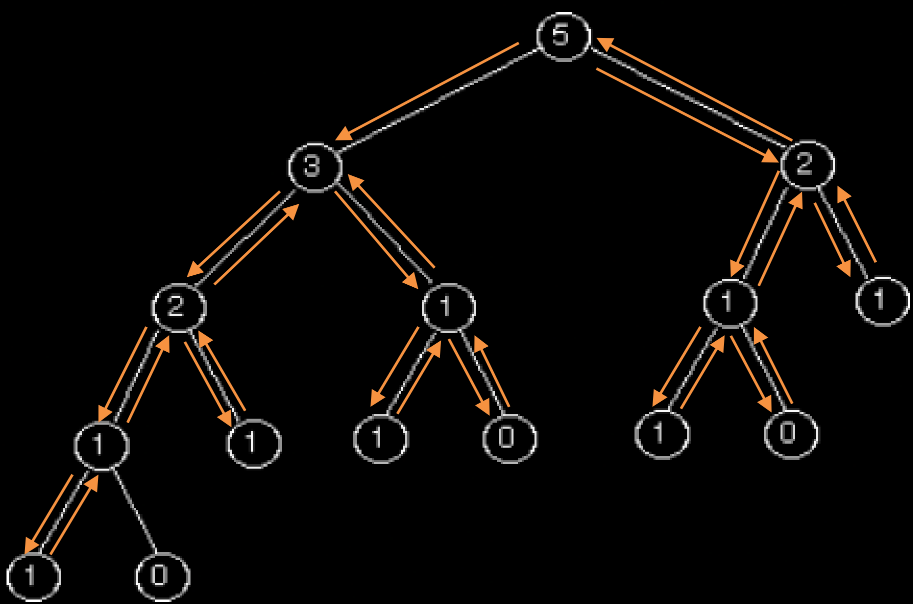
Code (using C++)

```cpp
#include <iostream>
using namespace std;
int fib(int x)
{
    if ((x == 1) || (x == 0))
    {
        return (x);
    }
    else
    {
        return (fib(x - 1) + fib(x - 2));
    }
}
int main()
{
    cout << "Enter the number for fibonacci
    series\n";
    int n; cin >> n;
    for(int i=0;i<n;i++){
        cout<<fib(i)<<" ";
    }
    return 0;
}
```

Output:

```
PS D:\files\C++ course> cd "c:\Users\kshit\OneDrive\Desktop\to print\"
; if ($?) { g++ main.cpp -o main } ; if ($?) { .\main }
Enter the number for fibonacci series
15
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377
PS C:\Users\kshit\OneDrive\Desktop\to print>
```

Tree For The Fib Function in the previous code:

Function	Graph
fib (0)	 returns 0 as value
fib (1)	 returns 1 as value
fib (2)	
fib (3)	
fib (4)	
fib (5)	

Thank You

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