

## **Fibonacci Numbers as a Natural Phenomenon**

**Senad Orhani<sup>1</sup>**

<sup>1</sup> Faculty of Education, University of Prishtina "Hasan Prishtina", Prishtina, Kosovo  
senad.orhani@uni-pr.edu

**ABSTRACT-** This paper presents an attempt to explain and experiment with Fibonacci numbers. It is illustrated with examples and concrete cases many of the properties of these numbers which are often found in practice or even are things that we see and touch every day. My goal has been to make a summary of writings, analyzes, studies, games, natural events as well as research by means of examples for famous Fibonacci numbers. The Fibonacci sequence can be observed in a variety of stunning phenomena in nature. Therefore, this study first presents the Fibonacci sequence and also describes some of the Fibonacci sequence phenomena presented in our living world.

**Keywords:** Fibonacci, Golden number, Natural Phenomenon, Relation, Sequence.

### **1. INTRODUCTION**

The famous Fibonacci sequence has captivated mathematicians, artists, designers, and scientists for centuries. Also known as the Golden Ratio, its ubiquity and astounding functionality in nature suggests its importance as a fundamental characteristic of the Universe. A sequence of numbers and a corresponding ratio that reflects various patterns found in nature, from the swirl of a pinecone's seeds to the curve of a nautilus shell to the twist of a hurricane found Fibonacci numbers [1]. Philosophers and mathematicians have, for long, dedicated themselves to the cause of explaining nature, beginning from the very early ventures of ancient Greeks. After all, mathematics is, in its very essence, a search for patterns of all kinds – and what better place to find such irregularities than nature itself? A closer look into nature leads to some very interesting implications about the underlying beauty of our universe. The struggle to find patterns in nature is not just a pointless indulgence; it helps us in constructing mathematical models and making predictions based on those models. As it happens, several living organisms exhibit mathematical patterns too. One such sequence in nature, that is

both common and fascinating, is the Fibonacci sequence [2].

Fibonacci was known in his day and is still known today as one of the "greatest European mathematicians of the Middle Ages." He was born in 1170 and died in 1240 and now there is a statue commemorating what is located at the bottom of the Cemetery Tower in Pisa Cathedral. So, Fibonacci grew up with a North African education in the Moors and later traveled extensively around the Mediterranean coast. He then met with traders, to whom he taught many systems to do arithmetic by greatly assisting them in their activity. He quickly realized the great advantage that the "Hindu-Arab" system had over all others. Fibonacci was one of the first people to introduce the Hindu-Arab system in Europe and thanks to him we already use ten base numbers with decimal points, and a symbol for zero: 1 2 3 4 5 6 7 8 9. and 0 [3, 4]. The concept of Fibonacci numbers is only applicable to whole numbers and decimal numbers from a financial perspective. The first Fibonacci number is always 0 and the second Fibonacci number is always 1 [5]. The Fibonacci sequence can be observed in a variety of stunning phenomena in nature. Therefore, this study first presents the Fibonacci sequence and also describes some of the Fibonacci sequence phenomena presented in our living world.

### **2. MATERIALS AND METHODS**

#### **2.1 Fibonacci numbers**

These series are formed by adding the last two numbers to win the third, starting from 0 and 1:

0 1 - the series starts like this

$0 + 1 = 1$  so, the series is now 0 1 1

$1 + 1 = 2$  and the series becomes 0 1 1 2

$1 + 2 = 3$  and now we have 0 1 1 2 3,

The series would continue like this:

**0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987,**  
... (1)

If a number  $n$  has no factors other than the number 1 and itself, it is called a prime number.

Any Fibonacci number that is greater than 1 [except  $F(6) = 8$  and  $F(12) = 144$ ] has at least one simple factor that is not a factor in any Fibonacci predecessor. This sequence is called the Fibonacci sequence and it's an infinite sequence. Each number in the Fibonacci series or sequence is represented as  $F_n$ . Fibonacci numbers follow a specific pattern. To find the Fibonacci numbers in the sequence, we can apply the Fibonacci formula. The relationship between the successive number and the two preceding numbers can be used in the formula to calculate any particular Fibonacci number in the series, given its position. The formula to calculate the  $(n + 1)^{th}$  number in the sequence of Fibonacci numbers can be given as [5],

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

where,  $n > 1$

$F_{n-1} \rightarrow n^{th}$  Fibonacci number

$F_{n-2} \rightarrow (n - 1)^{th}$  Fibonacci number

## 2.2 Fibonacci Number Relation to the Golden Ratio



Figure 1. The golden ratio satisfies  $x/y = (x + y)/x$ .

We now present the classical definition of the golden ratio. Referring to Fig. 1, two positive numbers  $x$  and  $y$ , with  $x > y$  are said to be in the golden ratio if the ratio between the larger number and the smaller number is the same as the ratio between their sum and the larger number, that is [6],

$$\frac{x}{y} = \frac{x + y}{x} \quad (3)$$

Denoting  $\phi = \frac{x}{y}$  to be the golden ratio, the relation (3) becomes:

$$\phi = 1 + \frac{1}{\phi} \quad (4)$$

There is a unique ratio that can be used to describe the proportions of everything from nature's smallest building blocks, such as atoms, to the most advanced patterns in the universe, like the unimaginably large celestial bodies. Nature relies on this innate proportion to maintain balance, but the financial markets also seem to conform to this "golden ratio". Mathematicians, scientists, and naturalists have known about the golden ratio for centuries. It's derived from the Fibonacci sequence, named after its Italian founder, Leonardo Fibonacci. In the sequence, each number is simply the sum of the two

preceding numbers (1, 1, 2, 3, 5, 8, 13, etc.). But this sequence is not all that important; rather, the essential part is the quotient of the adjacent number that possess an amazing proportion, roughly 1.618, or its inverse 0.618. This proportion is known by many names: the golden ratio, the golden mean, PHI, and the divine proportion, among others. So, why is this number so important? Well, almost everything has dimensional properties that adhere to the ratio of 1.618, so it seems to have a fundamental function for the building blocks of nature [6]. Fibonacci numbers have an intricate relationship with the golden ratio. Closed-form expressions for the Fibonacci that involve the golden ratio are:

$$F(n) = \frac{\phi^n - (1 - \phi)^n}{\sqrt{5}} \quad (5)$$

The golden ratio is defined to be the number [7]:

$$\frac{1 + \sqrt{5}}{2} \approx 1.6180339 \dots \quad (6)$$

The relationship of the Fibonacci sequence to the golden ratio is this: The ratio of each successive pair of numbers in the sequence approximates Phi (1.618...), as:

$$\frac{1}{1} = 1, \quad \frac{2}{1} = 2, \quad \frac{3}{2} = 1.5, \quad \frac{5}{3} = 1.66 \dots$$

$$\frac{8}{5} = 1.6, \quad \frac{13}{8} = 1.625, \quad \frac{21}{13} = 1.61538 \dots$$

The graph below shows how the ratios of the successive numbers in the Fibonacci sequence quickly converge on Phi. After the 40th number in the sequence, the ratio is accurate to 15 decimal places [8].

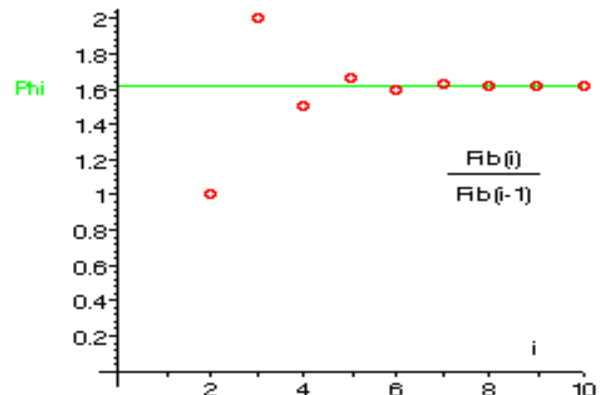


Figure 2. Golden number

$$\frac{233}{144} = 1.618 \dots, \quad \frac{377}{233} = 1.618 \dots, \quad \frac{610}{377} = 1.618 \dots$$

$$\frac{987}{610} = 1.618 \dots, \quad \frac{1597}{987} = 1.618 \dots, \quad \frac{2584}{1597} = 1.618 \dots$$

It doesn't matter if mostly we have approximations or adaptations of this mathematical properties, but since even nature prefers imperfection to solve his problems, the results of these researches are often astonishing. Therefore, in the following section we are presenting the layout of these models in nature.

It doesn't matter if mostly we have approximations or adaptations of this mathematical properties, but since even nature prefers imperfection to solve his problems, the results of these researches are often astonishing. Therefore, in the following section we are presenting the layout of these models in nature.

### 3. FIBONACCI NUMBERS AS A NATURAL PHENOMENON

The Fibonacci numbers is a numbering system that appears everywhere in nature; from the proportions of your fingers, the arrangement of leaves in plants, up to the structure of the DNA. Even living things in nature appear in Fibonacci sequences. A typical example is the sunflower flower which usually gives the number of leaves according to Fibonacci numbers, i.e., 55 or 89 leaves. If one day you decide to count the petals of flowers, if you do not get the Fibonacci number you should know that that leaf has flown [9].

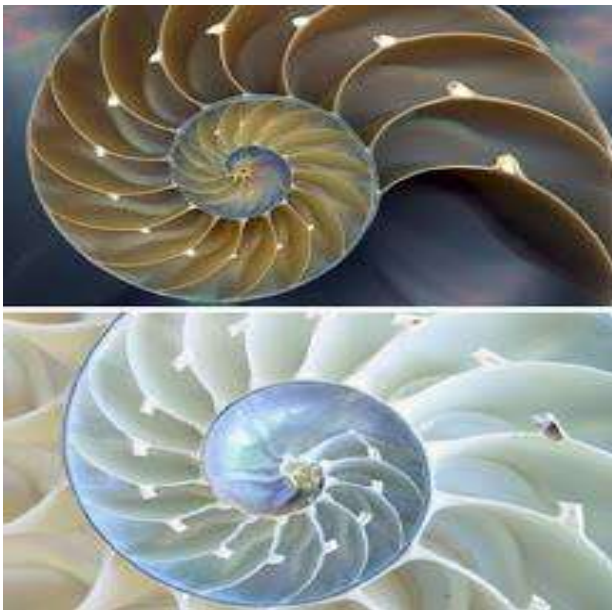


Figure 3. Snails can be seen in the order of Fibonacci numbers

Snails can be seen in the order of Fibonacci numbers. A new-born snail growing in its shell, develops chambers. Each room behind is the sum of the previous two rooms. As are the numbers in the Fibonacci sequence, such as any number is formed by the sum of the previous two numbers [10].

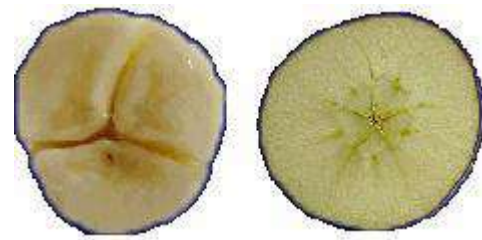


Figure 4. Bananas with Fibonacci numbers

If we cut a banana we will see three rings, if we cut the apple there is a five-pointed star, a date star with 8 edges. So, in conclusion we can say that Fibonacci numbers can be found wherever there is life (living thing).

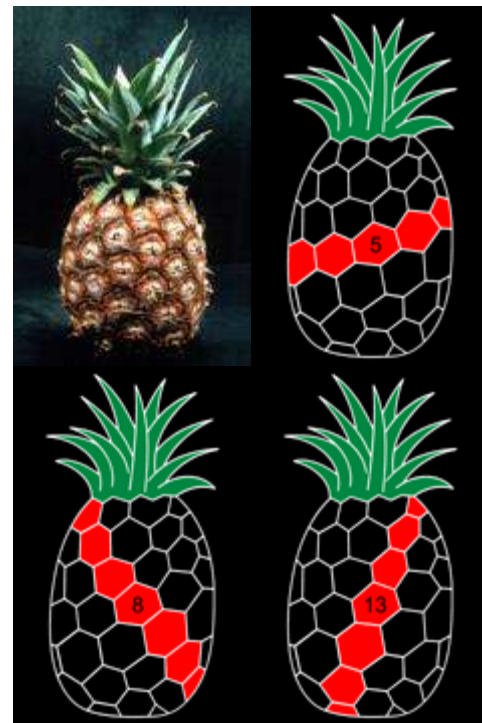


Figure 5. The Fibonacci range in pineapple

The Fibonacci range is also observed in pineapple [11].

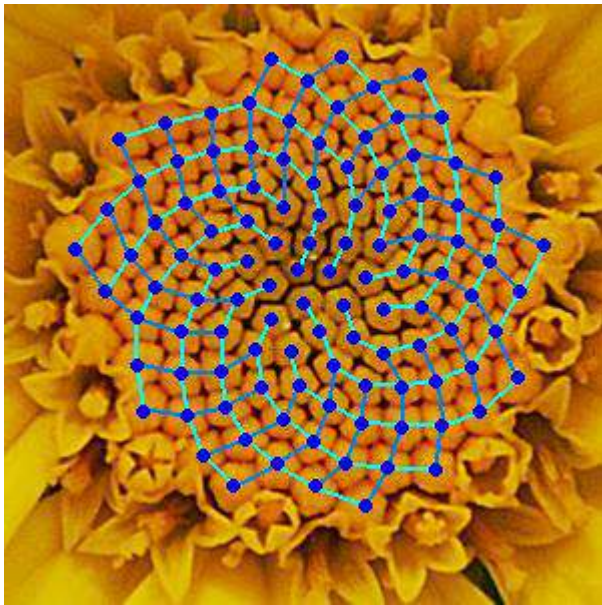


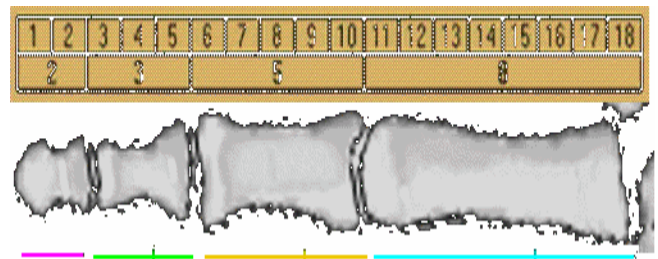
Figure 6. Fibonacci range in yellow chamomile

The Fibonacci range also appears in many plants such as that of yellow chamomile, where it has 21 blue leaves and 13 yellow leaves. Also, in some flowers of different types I am giving some of them [11]:



Figure 7. Flowers of different species with the Fibonacci range

People also display characteristics of the Fibonacci number. The report is seen in parts of one finger. Where in total we have 8 fingers, 5 fingers in each hand, 3 bones in each finger, 2 bones in the thumb and by 1 thumb in each hand [11].



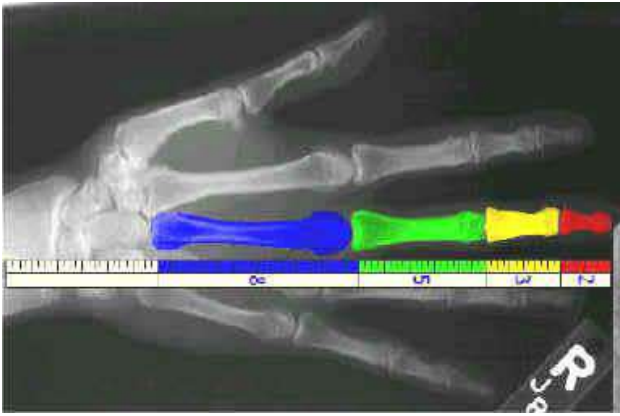


Figure 8. Parts of a finger with Fibonacci numbers

The sequence of the Fibonacci string is a recursive string [12].

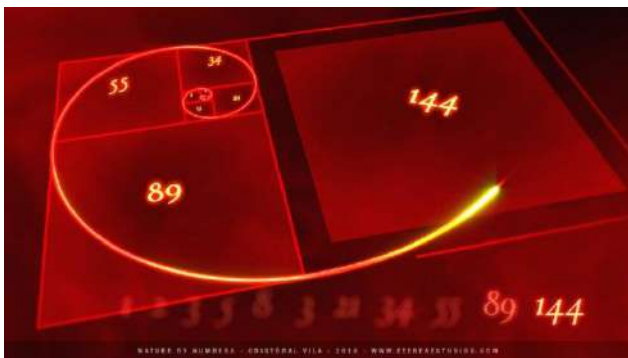
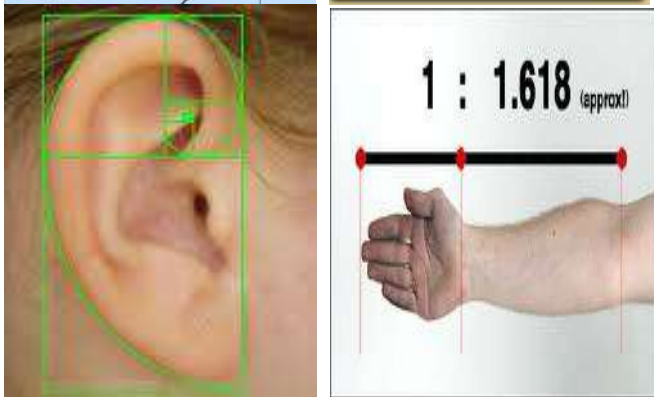
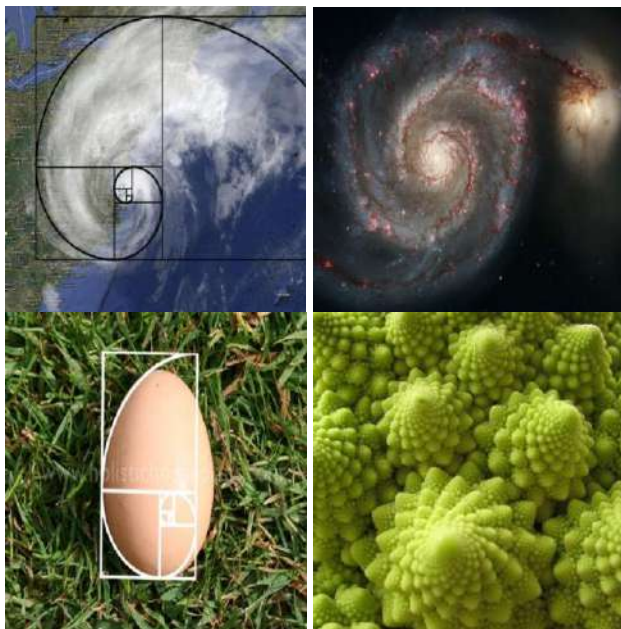
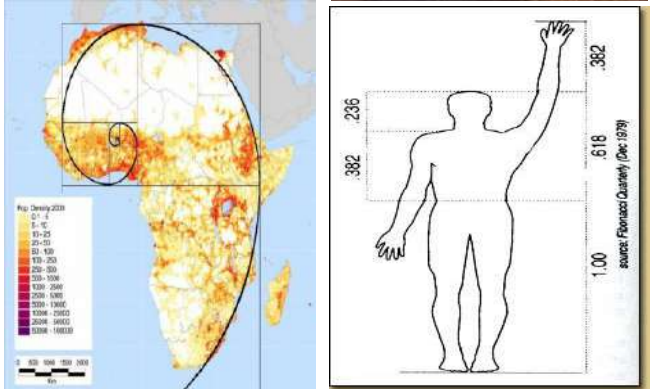


Figure 9. Sequence of the Fibonacci string

We are showing you some very interesting pictures of how the Fibonacci coil is found everywhere in nature [11].



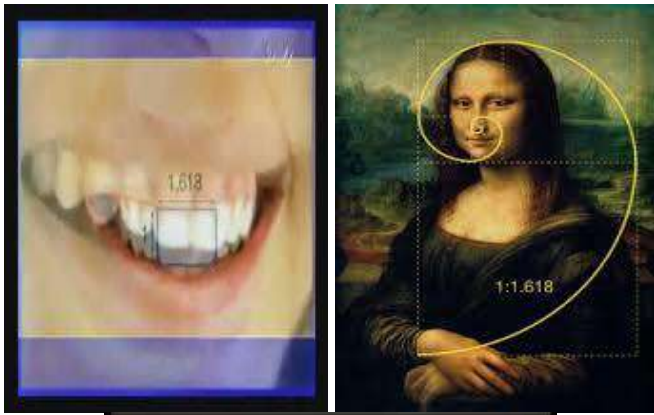


Figure 10. Some pictures of how the golden number is found everywhere in nature

Below we are analyzing the location of Mecca which is in relation to the golden number obtained from the Fibonacci numbers:

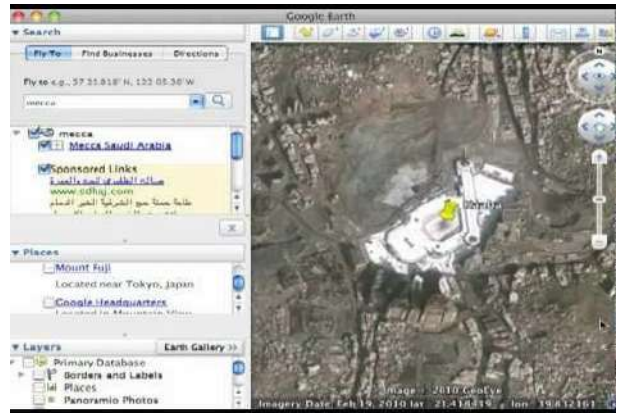
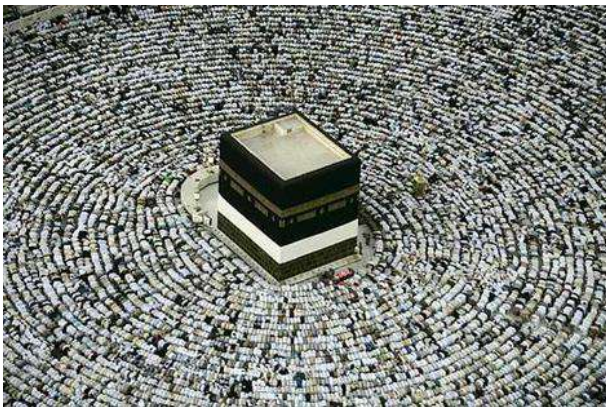


Figure 11. Mecca and Kaaba with golden number

The City of Mecca and Kaaba which the Muslims uses as a Direction for Prayers is situated on the Golden Ratio Zone. You only require simple Golden Ratio Formula and Data such as distances from North to South Pole from Mecca, Likewise West and East from Mecca [13].

The distance between the north pole and the south pole is 19980.00km

The distance between the south pole and Mecca is 12348.32km

By dividing we get  $19980.00/12348.32 = 1.618$

The distance between the north pole and Mecca is 7631.68km

The distance between the south pole and Mecca is 12348.32km

By dividing we get  $12348.32/7631.68 = 1.618$

We also have miracles in the Qur'an. The ratio of the total number of chapters in the Quran (114) which represents the physical design of the Quran divided by the Quran Constant (70.44911244) which represents the mathematical design of the Quran gives 1.6181893; it is amazingly almost equal to the golden ratio [14]. The golden ratio 1.618...is an irrational number which means that it never ends and all its digits can never be counted. Look up Surah Nahl 16:18 in the Holy Qur'an. "If you try to count Allah's blessings, you will not be able to count them." Doesn't this correlation leave you awe struck?! There is no randomness in creation! [15]. The sum of the number of verses and verses in the Qur'an gives the total number of unique ones The sum of the sura number and verse number non-unique gives the number 7.906. The ratio of the non-unique sum of 7.906 to the unique sum of 4883 gives the ratio closest to 34/21 in the 9th row of the Fibonacci index [16].

#### 4. CONCLUSION

The study into the Fibonacci "phenomenon" has been both challenging and fascinating. It is simply impossible for such a phenomenon to be fully investigated. Probably because it is so natural that it can simply be called "a natural phenomenon" which can never be fully studied. Only a small part of this phenomenon is included in this research, with examples and theorems of different authors. Therefore, in the end we can say that the Fibonacci phenomenon is like mathematics "can never be studied to the end" because it is a natural phenomenon.

These were some of the considerations we are able to see and understand in nature in general. By no means are these the only ones, there are thousands of others, some of which we are aware of, but most are dormant and inaccessible to us because of our limited knowledge of nature. One such beauty comes in the form of the Fibonacci sequence which can be seen in many things in our surroundings, including ourselves. The Fibonacci sequence may be looked at as a branch of mathematical application.

#### REFERENCES

1. A. Grigas. The Fibonacci Sequence Its History, Significance, and Manifestations in Nature, Liberty University, 2003.
2. M. Bicknell, A Primer for the Fibonacci Numbers, The Fibonacci Association, pp. 1-186, 1973.
3. L. Belabdelouahab-Fernini, Moorish Stimulus to European Renaissance, Research Gate, 2015.
4. P. Singh. Acharya Hemachandra and the (so called) Fibonacci Numbers, Math. Ed. Siwan, Vol. 20, no. 1, pp. 28-30, 1986.
5. A. Dasdan, Twelve Simple Algorithms to Compute Fibonacci Numbers, Arxiv, pp. 1-33, 2018.
6. T. O. Omotehinwa, S. O. Ramon, Fibonacci Numbers and Golden Ratio in Mathematics and Science, International Journal of Computer and Information Technology, vol. 2, no. 4, pp. 630-638, 2013.
7. T. Clancy, The Fibonacci Numbers, Academics, pp. 1-22, 2022
8. J. R. Chasnov, Fibonacci Numbers and the Golden Numbers, The Hong Kong University of Science and Technology, pp. 1-120, 2016.
9. K. M. Kumari, Expression of Fibonacci Sequences in Plants and Animals, Bulletin of Mathematics and Statistics Research, pp. 26-35.
10. H. Pan, Introduction of New Spiral Formulas from ROTASE Model and Application to Natural Spiral Objects, Academic Journal of Applied Mathematical Sciences, vol. 7 no. 2, pp. 66-76, 2021.
11. S. Sinha. The Fibonacci Numbers and Its Amazing Applications. International Journal of Engineering Science Invention, Vol. 6, no. 9, pp. 7-14, 2017.
12. Ch. W. Wang. Recursion, University of York, 2021
13. A. A. Hamad, Golden Ratio in the Quran, Al-Amin Ali Hamad, ISBN: 9781370889846, 2016.
14. A. Kim, What is golden ratio in Islam?, Theburningofrome, 2021.
15. W. B. Al-Amri, The Grand Qur'an, Madinah, Kingdom of Saudi Arabia, 2021
16. A. Khan, Allah takes a oath of the even and the odd in surah al fajr ayat 3 does He meant the fibonacci number?, Quora, 2020.