

Fibonacci numbers and nature. Divine proportion in art (architecture, music). Golden Section and human body

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**Fibonacci
(1175 -1240)**

The purpose of the article is to describe connections are made between the Fibonacci numbers and the Golden Ratio, biological nature, and other examples. The contributions to Mathematics made by the thirteenth century Italian, Fibonacci is great. Unfortunately, not much is known about Fibonacci's personal life. Representative connections are set as challenges to the reader.

We are considering both the originality and power of his methods, and the importance of his results, we are abundantly justified in ranking Leonardo of Pisa as the greatest genius in the field of number theory who appeared between the time of Diophantus and Fermat.

Fibonacci and the number of Gold

Golden ratio is an irrational number(1.618033 ...) can be defined in different ways but the most important concept associated with mathematic golden rule is Fibonacci's sequence. Dividing any number to its predecessor, is obtained about the number of gold. First they used were Egyptians, most of the pyramids being built to the number of gold. But the Greeks were the ones who called such, using

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it both in architecture and painting and sculpture. Moreover the number of gold is noted with Greek "phi" (φ), after Phidias. He built the Parthenon from this ratio gold. Let's start with an aesthetic problem. What is the "nice" division of a segment into two parts?

Ancient Greeks found an answer that they felt properly (theorists call "dynamic symmetry"). If the left segment we assign a length $u = 1$, then the right will have a length $v = 0.618...$ About a segment partitioned in this way say that such is divided into section, or division or the proportion of gold (divine). The idea is that: length u is the same part of length $(u + v)$, how length v is from the length u .

In other words:

$$\frac{u+v}{u} = \frac{u}{v}.$$

If we denoted $\varphi = \frac{u}{v}$, we see that $1 + \frac{1}{\varphi} = 1 + \frac{u}{v} = \frac{u+v}{u} = \frac{u}{v} = \varphi$, so $\varphi^2 - \varphi - 1 = 0$.

Hence $\varphi = \frac{1+\sqrt{5}}{2} = 1.6180339887...$ If suppose $u = 1$, then

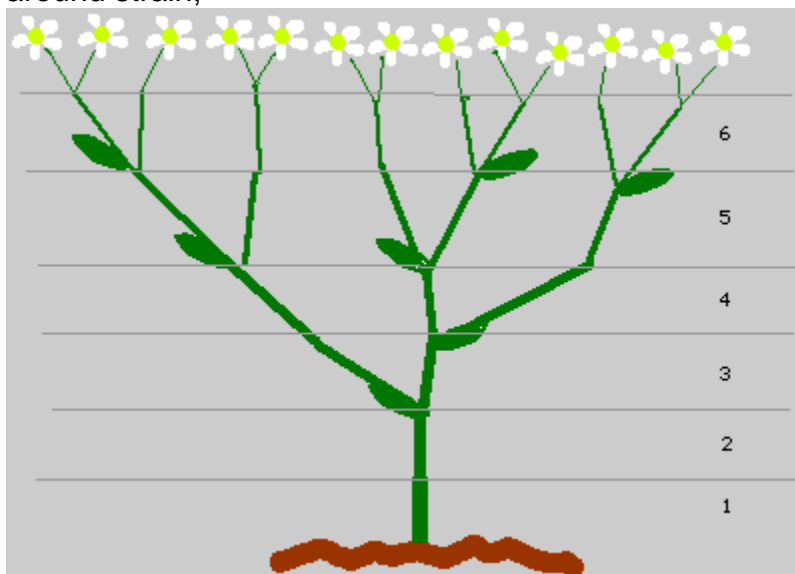
$v = \frac{u}{\varphi} = \frac{1}{\varphi} = \varphi - 1 = \frac{-1+\sqrt{5}}{2} = 0.6180339887...$ Say now that, φ it is closely related

to Fibonacci's sequence. This is a remarkable idea of mathematics.

Fibonacci and plants

Plants do not have to know how to Fibonacci numbers, but develops most effective.

a. many plants have leaves ordered arrangement in a Fibonacci sequence around strain;



b. some pine cones comply with a disposition date of Fibonacci numbers;

c. Sunflower seeds are arranged after a Fibonacci sequence;



- d. rings on the trunks of palm trees meet Fibonacci numbers
- e. the petals of flowers is often a Fibonacci number sequence
 - hold has 1 leaf
 - Euphorbia has 2 petaled
 - iris have 3 petaled
 - tulips, wild rose, and the most flowers have 5 petaled
 - other flowers may have 21 or 34-petaled petals and examples are numerous



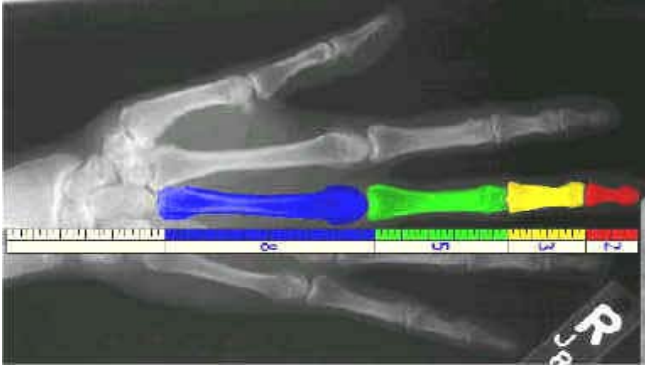
The conclusion is an optimal efficiency of a maximum.
If the sequence of Fibonacci, the leaves of plants can be arranged so as to occupy a smaller space and get as much sun. The idea of leaf arrangement in this regard to consider departing from the angle of 222.5 degrees gold; angle which divided the entire 360 degrees will result in irrational number 0.61803398 ..., known as the ratio of Fibonacci's sequence.

Snail shell, ant and Fibonacci

Snail shell design is a great spiral, a spiral not doable with the pen.

Studied in detail concluded that spiral seeks data sizes of Fibonacci sequence:

- focus on the positive: 1, 2, 5, 13, ...
- focus on the negative: 0, 1, 3, 8, ...



Fibonacci , number of gold and art

If you look at the works of great artists, whether painters, architects, sculptors and photographers, it notes that many of them are based on the rule of gold. According to this, “for a whole divided into unequal parts look nice, must exist between the small and large the same relation between the large and the whole “ (Marcus Pollio Vitruvius, Roman architect). Rudolf Arnheim (psychologist, has dealt with the psychology of art) gives an explanation this way: “This report is considered very satisfactory due to the way in which the unit together with the variety .The whole and piece parts are perfectly divided , so that the whole is predominant without be threatened by a split, and the parties shall retain the same time a certain autonomy. “ (in “ Art and visual perception”). In the painting has been used mainly in the Renaissance, probably the most discussed being used in the painting of Leonardo da Vinci, "Mona Lisa". The head, like the rest of the body is composed using the divine fraction, as he said first da Vinci. In the half of past century painter Piet Mondrian used in his paintings “golden rectangle”, because the ratio of the sides having approximately 1.618 ... In fact, its only consist of such rectangles. This rectangle is considered the most harmonious geometrical shape. If we divided each side of the camera in 8 equal parts (number of thread Fibonacci) and combine the items on the opposite sides corresponding divisions 3 and 5 (string Fibonacci numbers) to obtain the so-called strong lines of the camera. The intersection points of lines are called strengths. We can divide the sides in three equal parts, the result is approximately the same. Se assumes that the subject placed on these lines or points in these results in a smooth distribution of the image so that it is neither symmetrical nor boring, not too unbalanced. For example, two photographs of Robert Doisneau, “L'accordioniste” 1951 and “The cellist”, in 1957 and the picture “ Poplar Trees” by Minor White in which all lines converge towards a strength. Ansel Adams is against the rules. He said “so-called photo rules is invalid, irrelevant and intangible, there are no rules of composition in photography, there are only good photographs”. However in his photos we observed images of the gold division (see photograph "Aspens, 1958). This means that although it was not agreeing with the rules they knew very well. All this shows the importance of this number so that all the great photographers and have taken account of it in the design of a photo. Even the music think in this golden number, it is assumed that Bach or Beethoven were taken of him in their compositions.

When you writing, instinctively go to the middle line of E (as with A, F, B, R, ...) approximately $\frac{2}{3}$ of the base (approximately the gold number).

Conclusion.

Fibonacci numbers to be considered, in fact, the counting of nature, a measurement of divinity, a link between mathematics and art.

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