GOLDEN RATIO
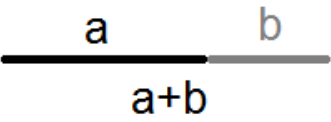
ANGEL GROUP
*Composer: **Oliver***

1. Introduction

Have you ever seen this number – an irrational number – (1,618…)? It's very special, it appears every where in human life. And… what is it? Why is it special? Where does it appear? You'll have the answer after our presentation – a presentation about **GOLDEN RATIO**!!!! Thank you…thank you…^^

2. Definition

In mathematics and the arts, two quantities are in the **golden ratio** if the ratio of the sum of the quantities to the larger quantity is equal to (=) the ratio of the larger quantity to the smaller one.

The golden ratio is an irrational mathematical constant, approximately **1.6180339887**. Other names frequently used for the golden ratio are the **golden section** (Latin: *sectio aurea*) and **golden mean.** The golden ratio is often denoted by the Greek letter **Phi** (from Phidias – Greek mathematician), usually low case φ.

The figure on the above illustrates the geometric relationship that defines this constant. Expressed algebraically:

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

$a+b$ is to a as a is to b

3. History

- Phi (*Golden Ratio*) as a mysterious number has been discovered in many places, such as art, architectures, humans, and plants.
- You might wonder where and when Phi first appeared? Who was the discoverer?
- According the history of mathematics, Phi was first understood and used by the ancient mathematicians in Egypt, two to three thousand years ago, due to its frequent appearance in Geometry.
- Phidias (500BC-432 BC), a Greek sculptor and mathematician, studied Phi and used the Phi in many designs of his sculptures, such as the statue of the goddess Athena in Athena, and the state of god Zeus in Olympiad.
- And Euclid Alexandria (365BC-300BC) had once described the Phi as "dividing a line in the extreme and mean ratio" in his Book VI of Elements.

- The name "*Golden Ratio*" appears in the form *sectio aurea* (Golden Section in Greek) by Leonardo da Vinci (1452-1519) who used this the Golden ratio in many of his masterpieces, such as The Last Supper and Mona Lisa.
- In 1900s, an Maerican mathematician named Mark Barr, represented the *Golden Ratio* by using a greek symbol Φ.

4. Golden ratio in maths

- The first, can you find the positive solution of this equation? $x^2 - x - 1 = 0$, and you can only get one, that is $\dfrac{1+\sqrt{5}}{2} \approx 1,618...$

The value of continued fraction: $1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + ...}}}} \approx 1,618...$

- Exact trigonometric formulas for φ include: $2\cos(\dfrac{\pi}{5}) \approx 1,618...$

- A representation in terms of a nested radical is: $\sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + ...}}}}} \approx 1,618...$ This is equivalent to the recurrence equation: $a_n^2 = a_{n-1} + 1$ with $a_1 = 1$ and $\lim\limits_{n\to\infty} a_n = \varphi$

- The Fibonacci Sequence is an infinite sequence, which means it goes on for ever, and as it develops, the ratio of the consecutive terms converges (becomes closer) to the *Golden Ratio*, ~1.618. For example, to find the ratio of any two successive numbers, take the latter number and divide by the former. So, we will have:

$$\frac{1}{1} = 1$$
$$\frac{2}{1} = 2$$
$$\frac{3}{2} = 1,5$$
$$...$$
$$\frac{55}{34} \approx 1,618...$$
$$...$$

- The golden ratio also appears in comparing consecutive elements of certain kinds of sequences, most notably, the **Fibonacci sequence**, but other sequences also. For instance, take two numbers at random, say 2 and 6. Add them to get 8. Add 6 and 8 to get 14. Add 8 and 14 to get 22. If you keep this going indefinitely, then the ratio of successive numbers approaches the golden ratio as a limit. Hence, for starters:

$$2 + 6 = 8 \qquad (8/6 = 1,33...)$$
$$6 + 8 = 14 \qquad (14/8 = 1,75)$$
$$8 + 14 = 22 \qquad (22/14 = 1,57...)$$
...
$$58 + 94 = 152 \qquad (152/94 = 1,617... \approx 1,618...)$$
...

- The **Golden Rectangle** can be subdivided into squares and additional smaller Golden Rectangles, again a process that seemingly could go on indefinitely. In the figure below the figures 1, 2, 3, 4, and 5 are all squares. In each square a quarter circle can be drawn in such a way that a spiral is created
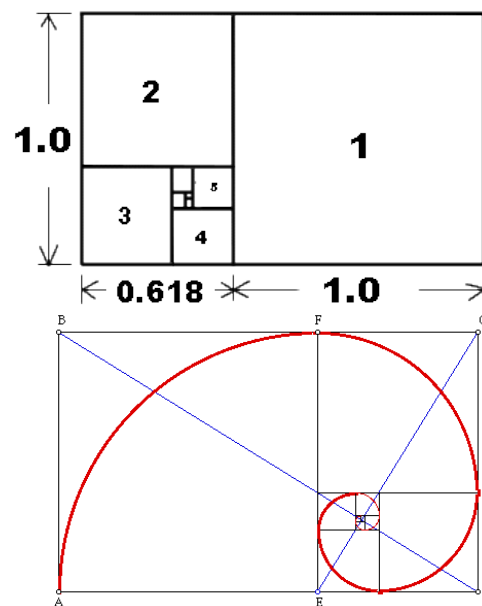
- The **Gold parallelogram** has golden ratio, you can recognize it by finding the ratio of longer side to the shorter side.
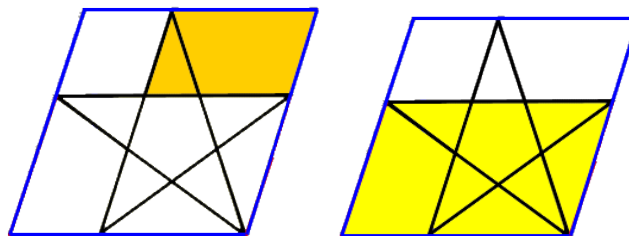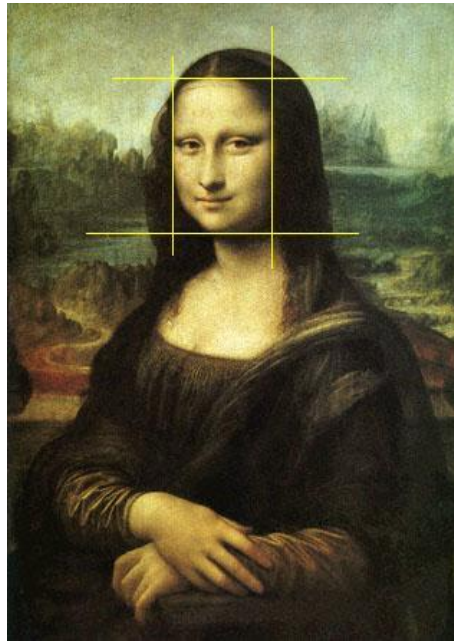
5. The golden ratio exists on everywhere in our life

The golden ratio number on Parthenon (Athens - Greece)
*The ratio of temple's length to temple's height and others… is approximately **1.618***


Monalisa (a Da Vinci's masterpiece)
Mona Lisa's face is a perfect golden rectangle, according to the ratio of the width of her forehead compared to the length from the top of her head to her chin.
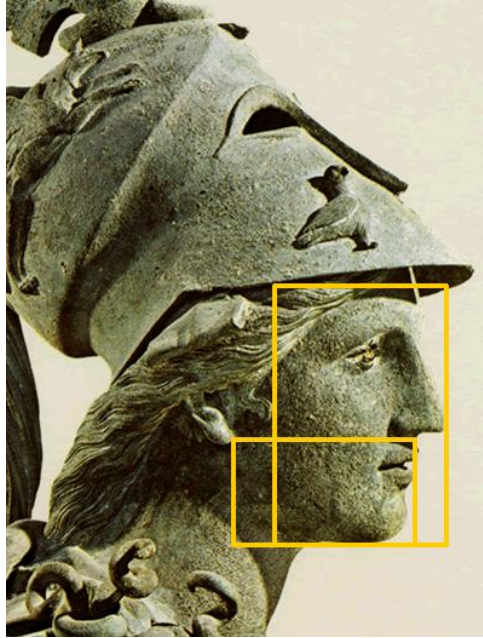
In the Status of Athena (the goddess of wisdom in Greek mythology)
Tthe first Golden Ratio *is the length from the front head to the ear opening compared with the length from the forehead to the chin. The second one appears in the ratio of the length from the nostril to the earlobe compare with the length from the nostril to the chin.*
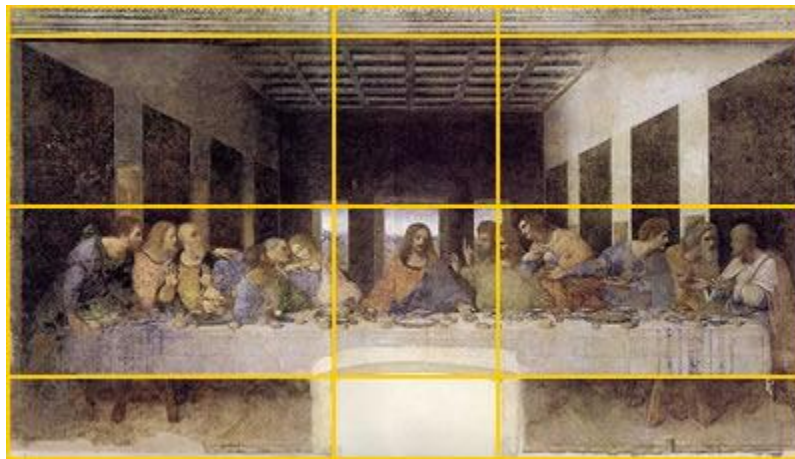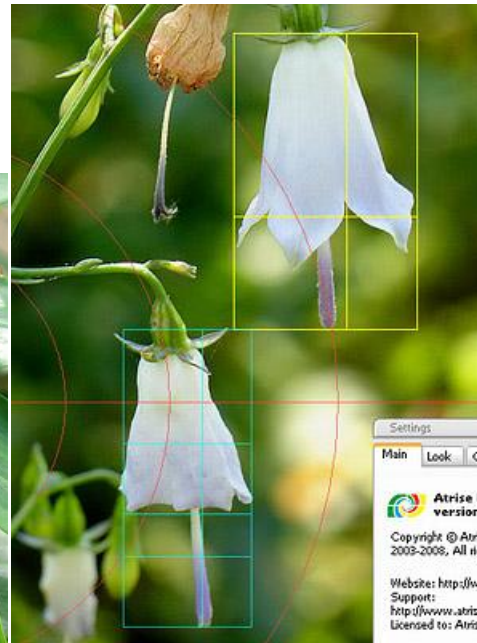

The masterpiece "Last Supper" (another masterpiece of Da Vinci)
It contains a golden ratio in several places, appearing in both the ceiling and the position where the people sit.
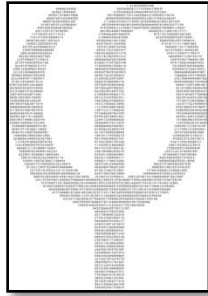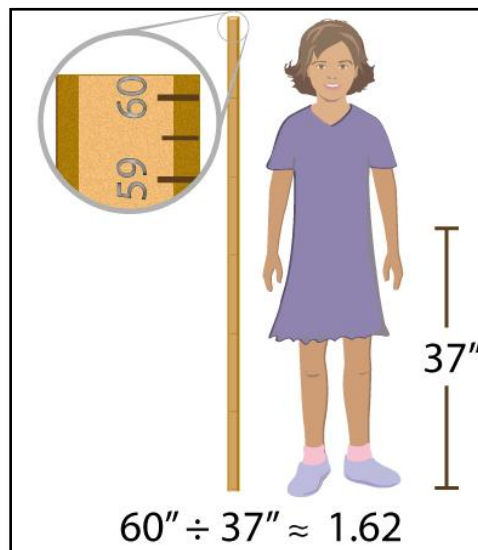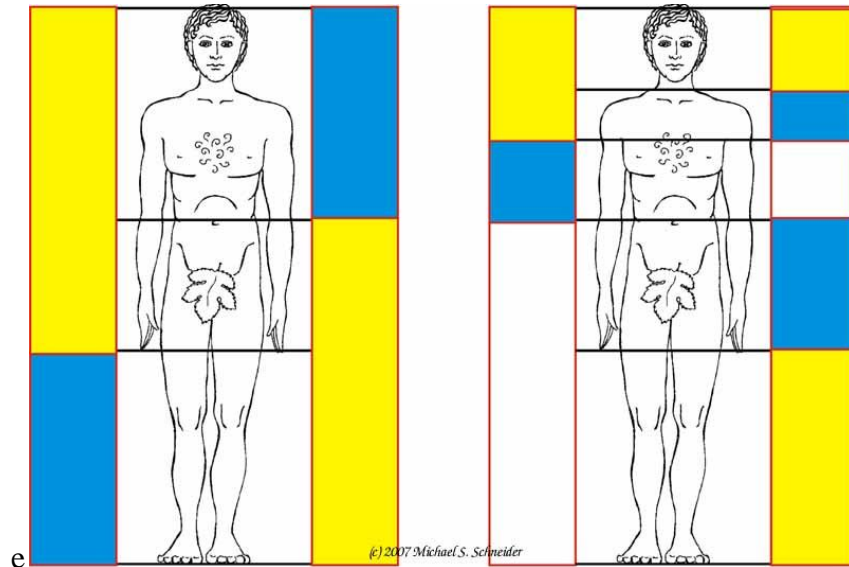
Notation of Phi

The golden ratio on plant…

And… snail

$$60'' \div 37'' \approx 1.62$$

On your body

THE END!