The Mystery of Golden Ratio in Art Architecture, Painting and Nature.

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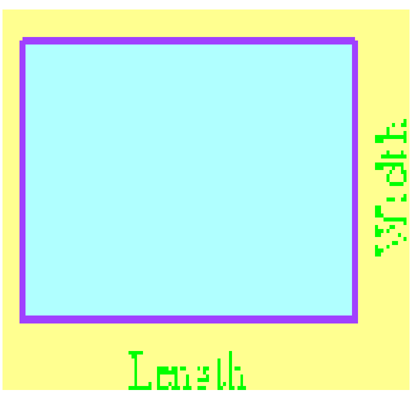
The Golden Rectangle is a unique and significant shape not only in mathematics but also it is evident in Nature, Painting Art, Architecture, Music and especially in Photography. The special property of the Golden Rectangle is that the ratio of the length to the width equals to approximately 1.618, which is known as the Golden Ratio. So, definition of Golden Ratio is



$$\text{Golden Ratio} = \frac{Length}{Width} \approx 1.6$$

Golden Ratio: In mathematics and the arts, two quantities are in the **golden ratio** if the ratio of the sum of the quantities to the larger one equals the ratio of the larger one to the smaller. The golden ratio is an irrational mathematical constant, approximately 1.6180339887. Other names frequently used for the golden ratio are the **golden section.** and **golden mean**. Other terms encountered include **extreme and mean ratio**, **medial section**, **divine proportion**, **divine section**, **golden proportion**, **golden cut**, **golden number**, and **mean of Phidias**. The golden ratio is often denoted by the Greek letter **phi**, usually lower case (**φ**).

Expressed algebraically:

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

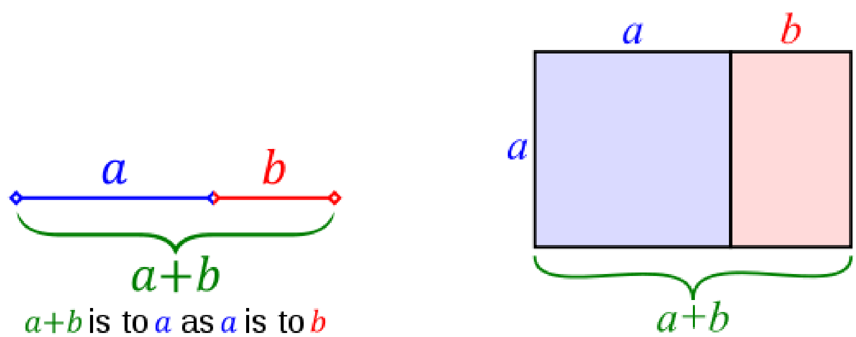
This equation has as its unique positive solution the algebraic irrational number

$$\varphi = \frac{1+\sqrt{5}}{2} \approx 1.6180339887\ldots$$

At least since the Renaissance, many artists and architects have proportioned their works to approximate the golden ratio—especially in the form of the golden rectangle, in which the ratio of the longer side to the shorter is the golden ratio—believing this proportion to be aesthetically pleasing. Mathematicians have studied the golden ratio because of its unique and interesting properties.

Calculation:

Two quantities *a* and *b* are said to be in the *golden ratio φ* if: $\frac{a+b}{a} = \frac{a}{b} = \varphi$.



Line segments in the golden ratio

This equation unambiguously defines φ.

The right equation shows that $a = b\varphi$, which can be substituted in the left part, giving

$$\frac{b\varphi + b}{b\varphi} = \frac{b\varphi}{b}.$$ implies $$\frac{\varphi+1}{\varphi} = \varphi.$$ or $$\varphi^2 - \varphi - 1 = 0.$$

The only positive solution to this quadratic equation is

$$\varphi = \frac{1+\sqrt{5}}{2} \approx 1.6180339887\ldots$$

Several form of Golden Raio:

The formula $\varphi = 1 + 1/\varphi$ can be expanded recursively to obtain a continued fraction for the golden ratio

$$\varphi = [1;1,1,1,\dots] = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \ddots}}}$$

The equation $\varphi^2 = 1 + \varphi$ likewise produces the continued square root, or infinite surd, form:

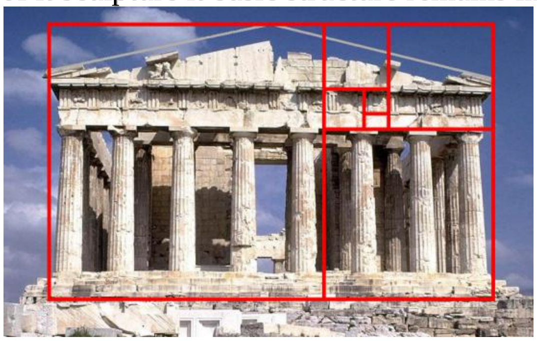
$$\varphi = \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \cdots}}}}.$$

The convergents of these continued fractions (1/1, 2/1, 3/2, 5/3, 8/5, 13/8, .21/13, 34/21...) are ratios of successive Fibonacci numbers.

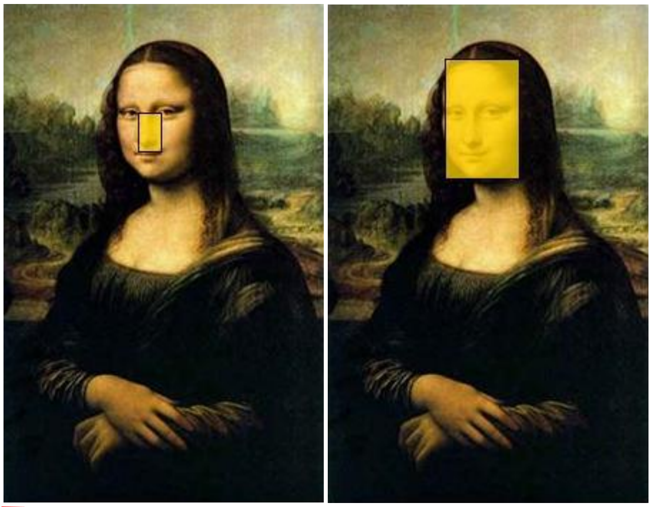
Application Part:
Golden Rectangle in Architecture :

Mesopotamians and Greeks were aware of the beauty of the Golden Rectangle and used it to create many different buildings. One of the most famous and beautiful buildings, built in ancient Greece on the Acropolis, is called the Parthenon.

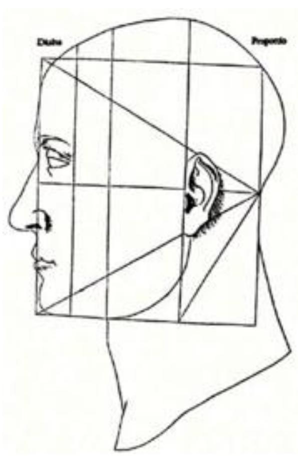
Chief temple Athena on the acropolis at Athen build 447 432 BC by Ictinus and Callicrates under Pericles it is considered the culmination of the Doric order though the white marble temple has suffered damaged over the centuries including the loss of most of it sculpture it basic structure remains intact.

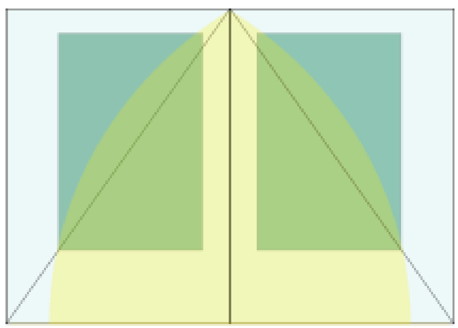


Golden Rectangle in Art



- Figure: Mona Lisa's face can be neatly enclosed by a golden rectangle.
- Figure : so can her Roman nose; you can also fit smaller horizontal rectangles to her eyes and mouth.





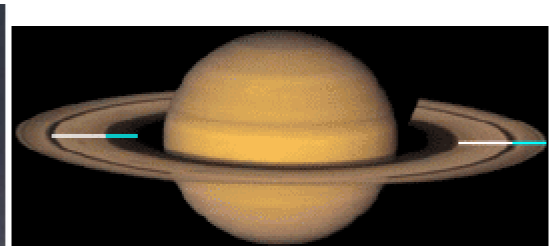
Painting **Book Design**

Golden Ratio in Nature:

Adolf Zeising, whose main interests were mathematics and philosophy, found the golden ratio expressed in the arrangement of branches along the stems of plants and of veins in leaves. He extended his research to the skeletons of animals and the branchings of their veins and nerves, to the proportions of chemical compounds and the geometry of crystals, even to the use of proportion in artistic endeavors. In these phenomena he saw the golden ratio operating as a universal law. Zeising wrote in 1854:

The Golden Ratio is a universal law in which is contained the ground-principle of all formative striving for beauty and completeness in the realms of both nature and art, and which permeates, as a paramount spiritual ideal, all structures, forms and proportions, *whether cosmic or individual, organic or inorganic, acoustic or optical; which finds its fullest realization, however, in the human form.*

Examples:



Conclusion:

In this article, I discuss the application of golden ratio in Art, Architecture, Painting and Nature. This ratio is also sued in Music, Photography and etc.

References

- Phidias (490–430 BC) made the Parthenon statues that seem to embody the golden ratio.
- Plato (427–347 BC), in his *Timaeus*, describes five possible regular solids (the Platonic solids, the tetrahedron, cube, octahedron, dodecahedron and icosahedron), some of which are related to the golden ratio.