The Golden Ratio in Art, Architecture, and Music
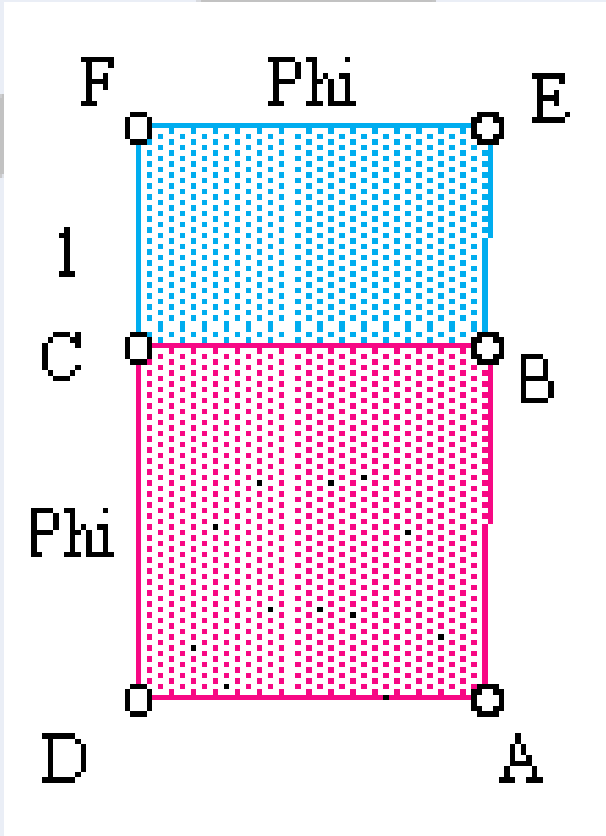
Montgomery College Professor Steelman

The Golden Ratio
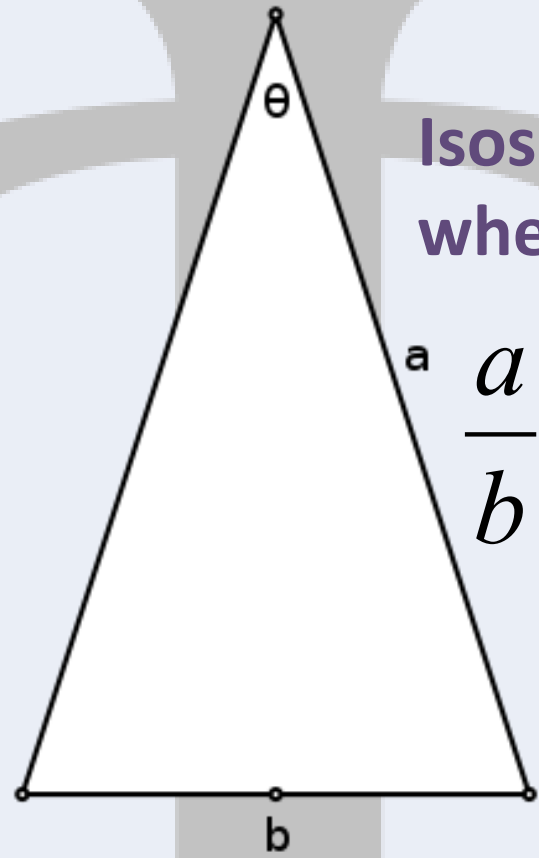## Also known as……

- The Golden Mean
  - Divine Section
- Divine Proportion
  - Golden Cut
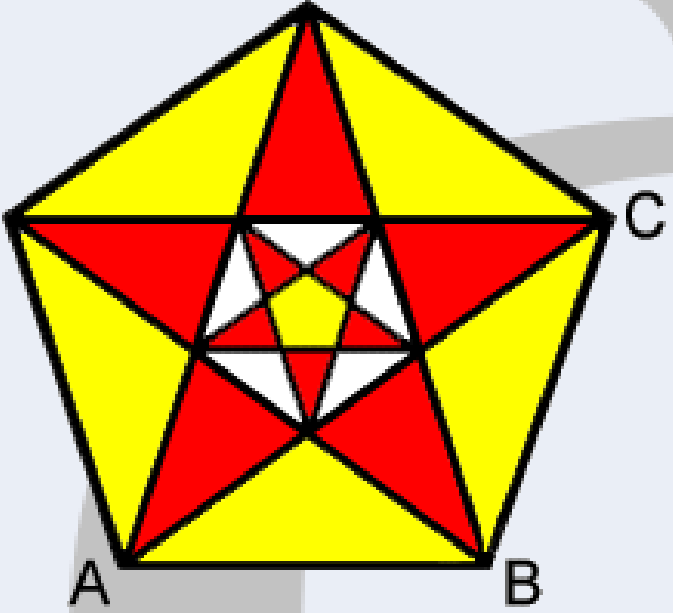- Golden Proportion

$\Phi \approx 1.62$

The Golden Rectangle

θ

a

b

Isosceles triangle where

$$\frac{a}{b} = \Phi \approx 1.62$$

The Golden Triangle

The diagonals of the pentagon form another regular pentagon in the center of the figure with, of course, the potential for additional diagonals to be drawn, thus generating the golden ratio again as well as another regular pentagon further inside the figure. Presumably this could continue indefinitely.
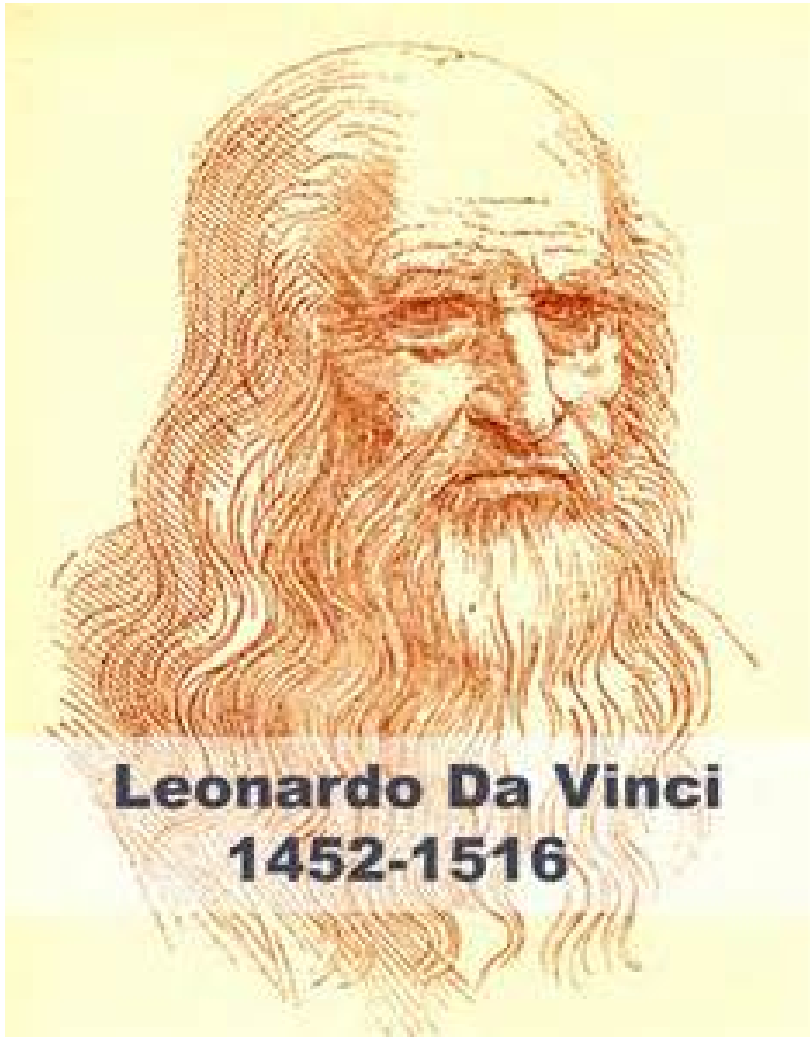
$$\frac{AC}{AB} = \Phi \approx 1.62$$

The Golden Star (Pentagram)

The Great Pyramid of Giza 2560 BC

481.4

612.01

377.9

612.01 / 377.9 = 1.61950...
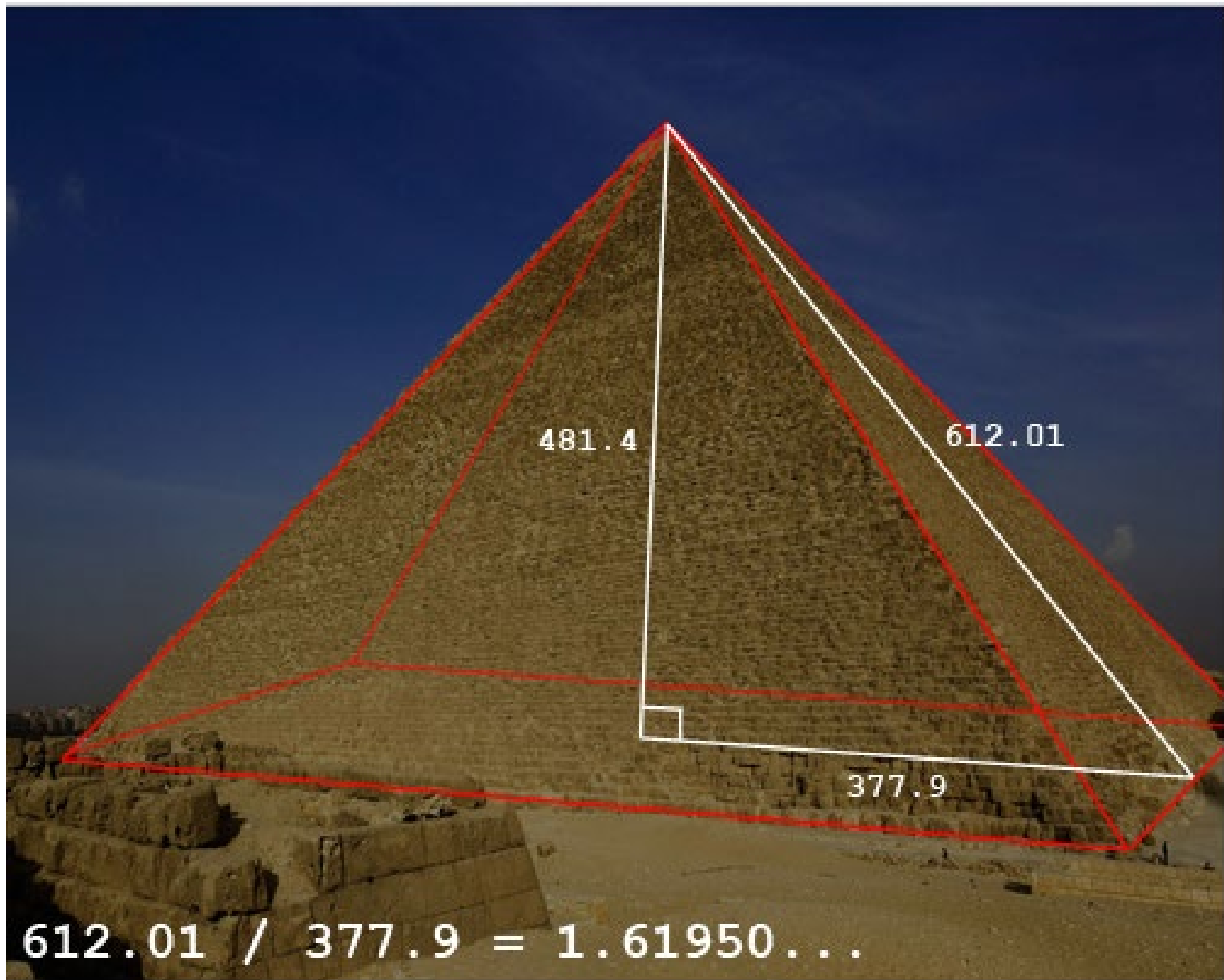
Italian Renaissance polymath: painter, sculptor, architect, musician, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and writer.

Leonardo Da Vinci 1452-1516

Leonardo Da Vinci explored the human body with respect to ratios of the lengths of various body parts.

He called this ratio the "*divine proportion*" and featured it in many of his paintings.
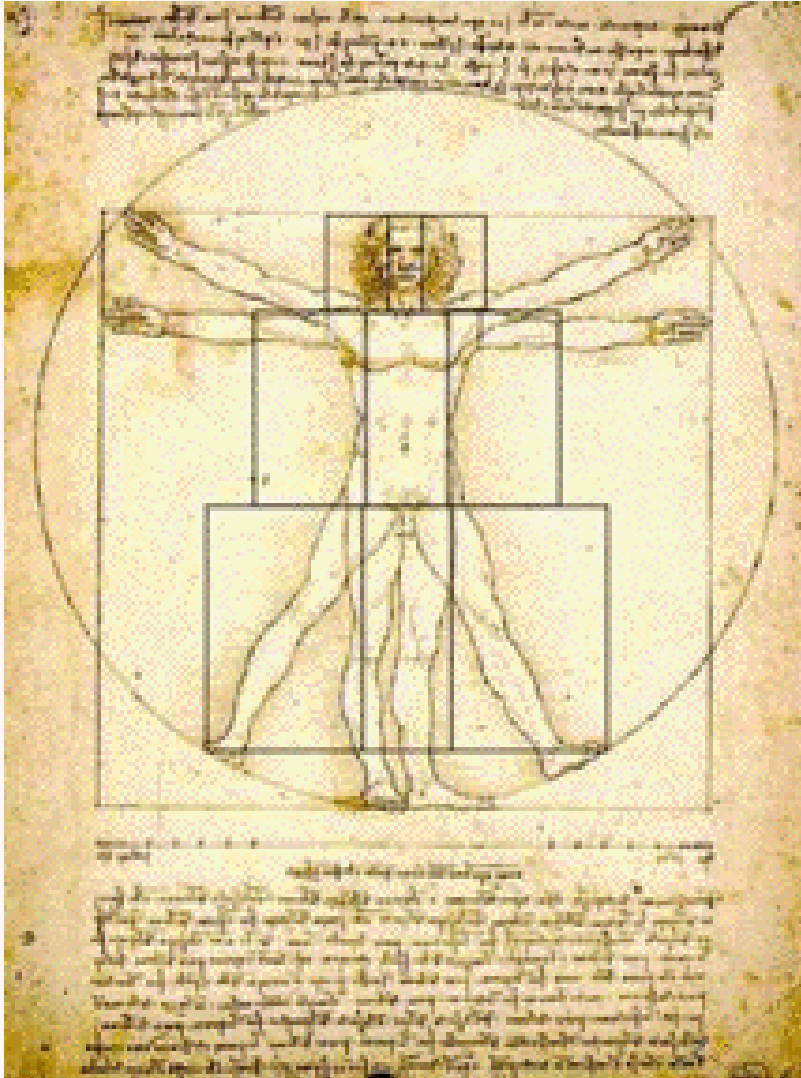
An Old Man by Leonardo Da Vinci
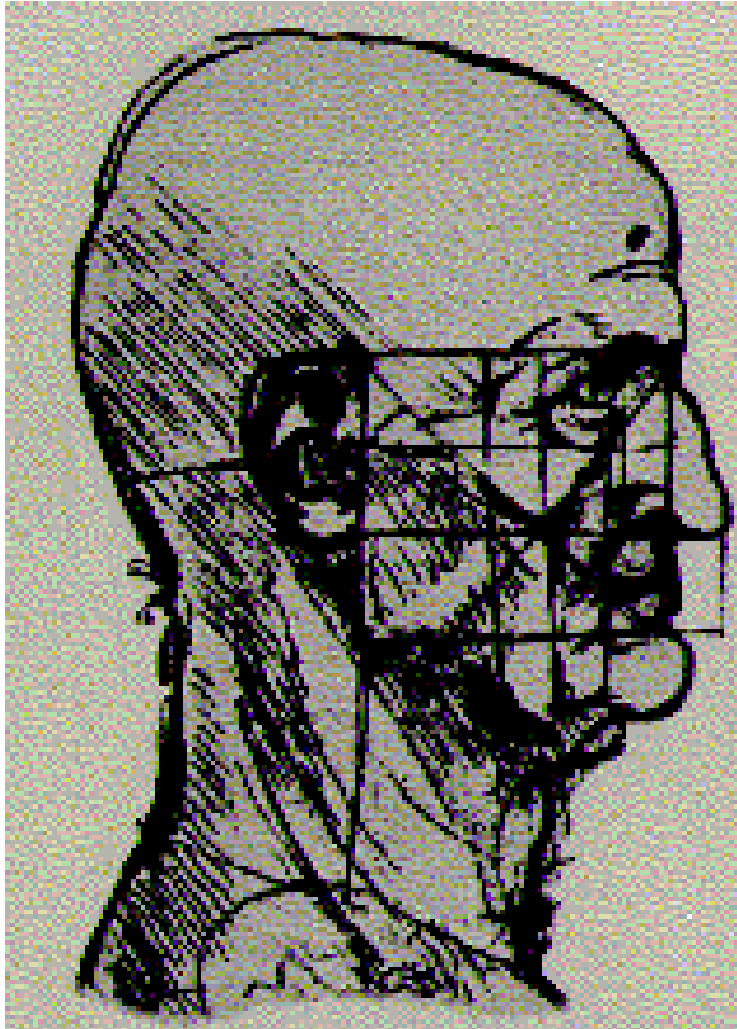
This drawing of an old man can be overlaid with a square subdivided into rectangles, some of which approximate Golden Rectangles.

Circa 1500

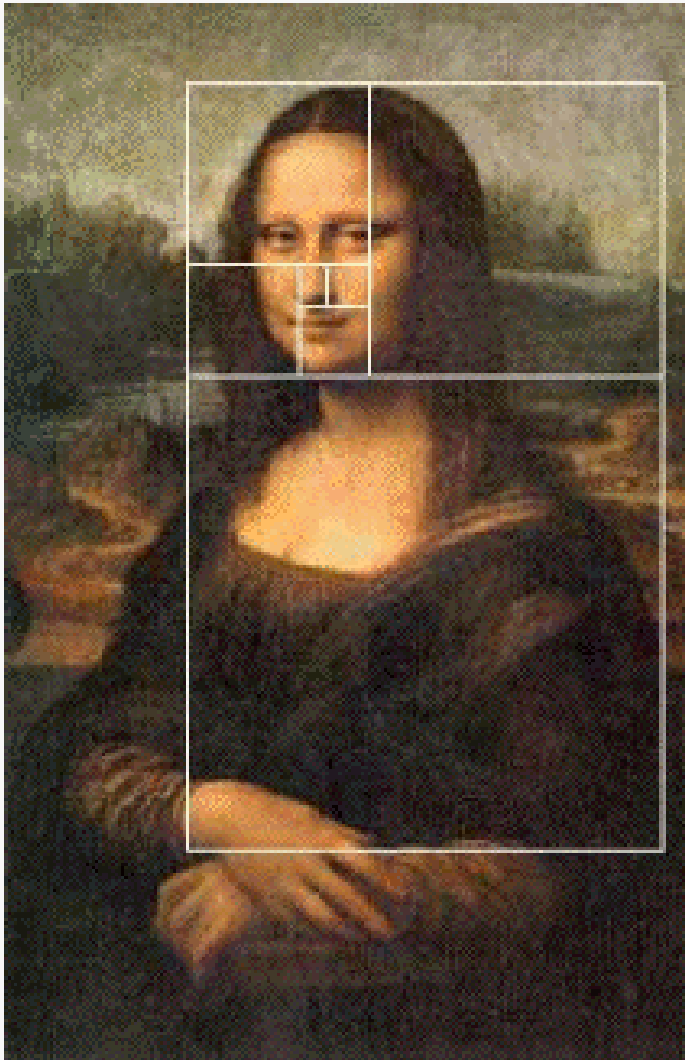# *The Vetruvian Man (The Man in Action)* **by Leonardo Da Vinci**

We can draw many lines of the rectangles into this figure.

There are three distinct sets of Golden Rectangles: Each one set for the head area, the torso, and the legs.

circa 1490

Mona Lisa by Leonardo Da Vinci

Consider a rectangle whose base extends from the woman's right wrist to her left elbow and extend the rectangle vertically until it reaches the very top of her head (Golden Rectangle.)

Consider the squares inside this Golden Rectangle. The edges of these new squares come to all the important focal points of the woman: her chin, her eye, her nose, and the upturned corner of her mysterious mouth.

Circa 1503-1506
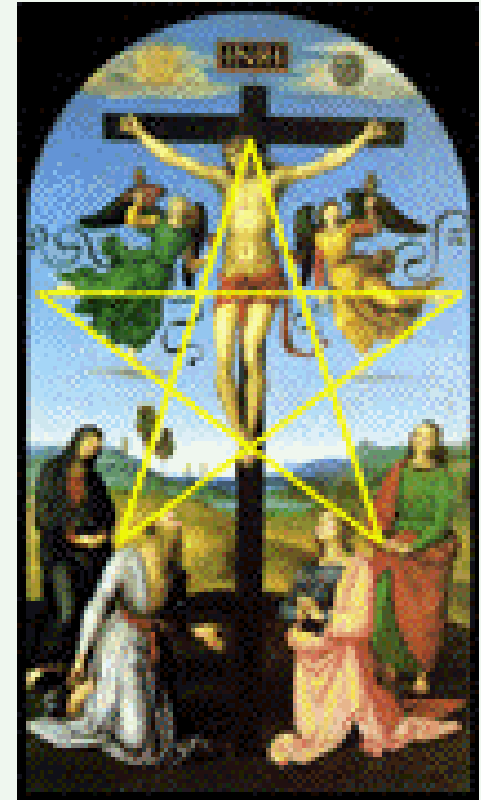
Holy Family by *Michelangelo*
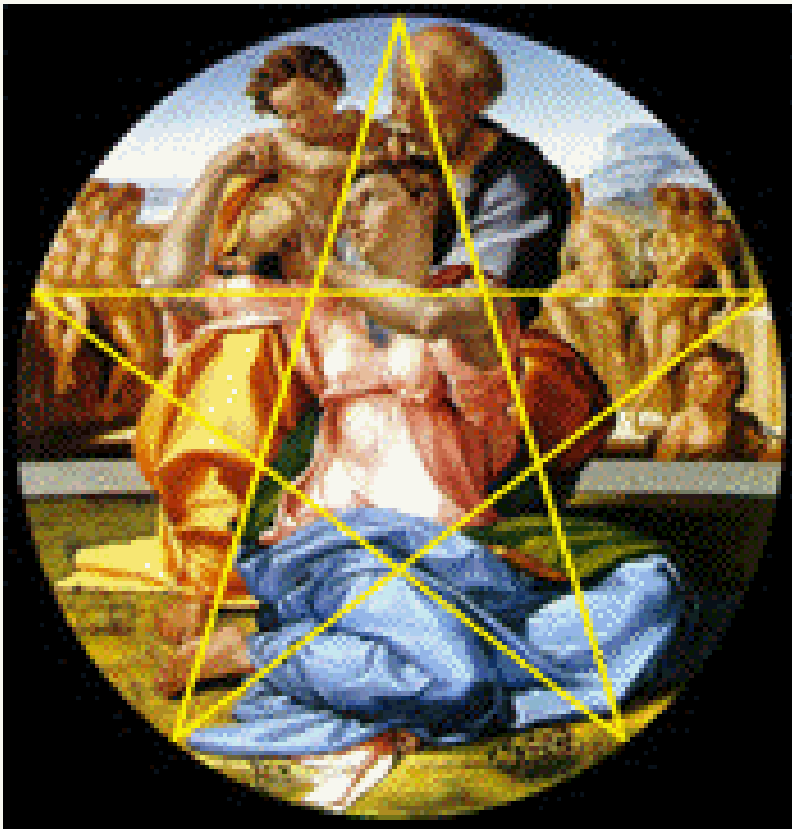
This picture is positioned so the principal figures are in alignment with a Pentagram or Golden Star.

Circa 1507

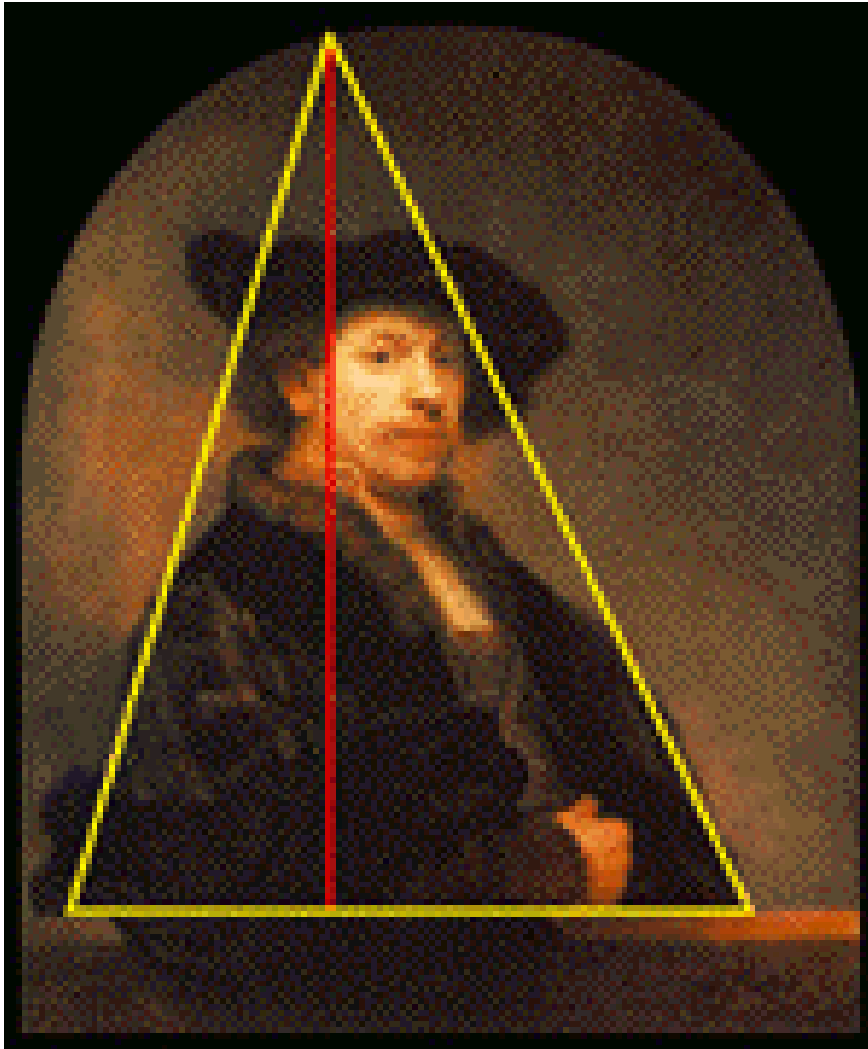# *Crucifixion* by Raphael

In this picture, a golden triangle can be used to locate one of its underlying pentagrams.

Circa 1502

self-portrait by Rembrandt

We can draw three straight lines into this figure. Then, the image of the feature is included into a triangle. Moreover, if a perpendicular line would be dropped from the apex of the triangle to the base, the triangle would cut the base in Golden Section.
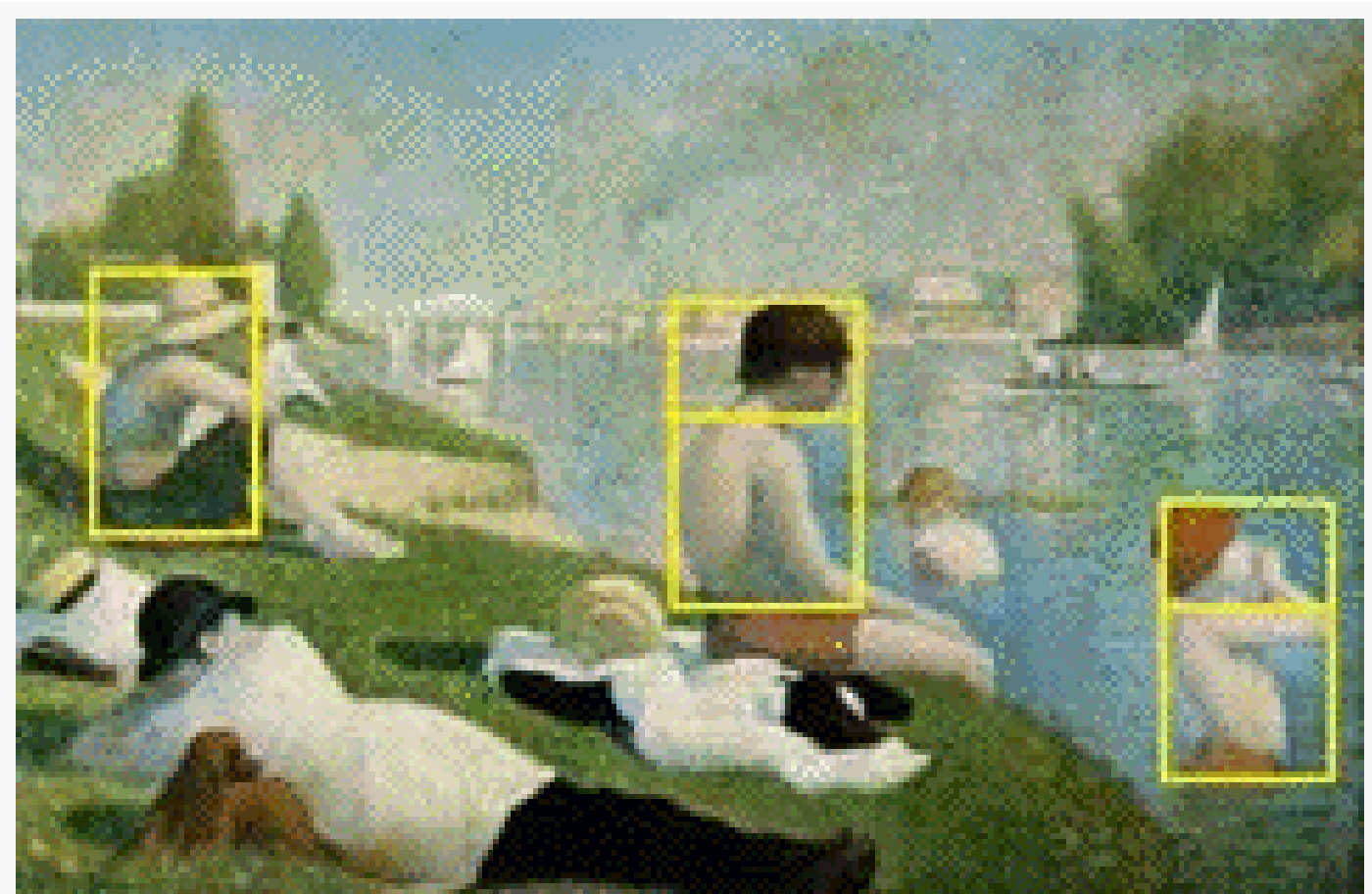
Circa 1620-1630

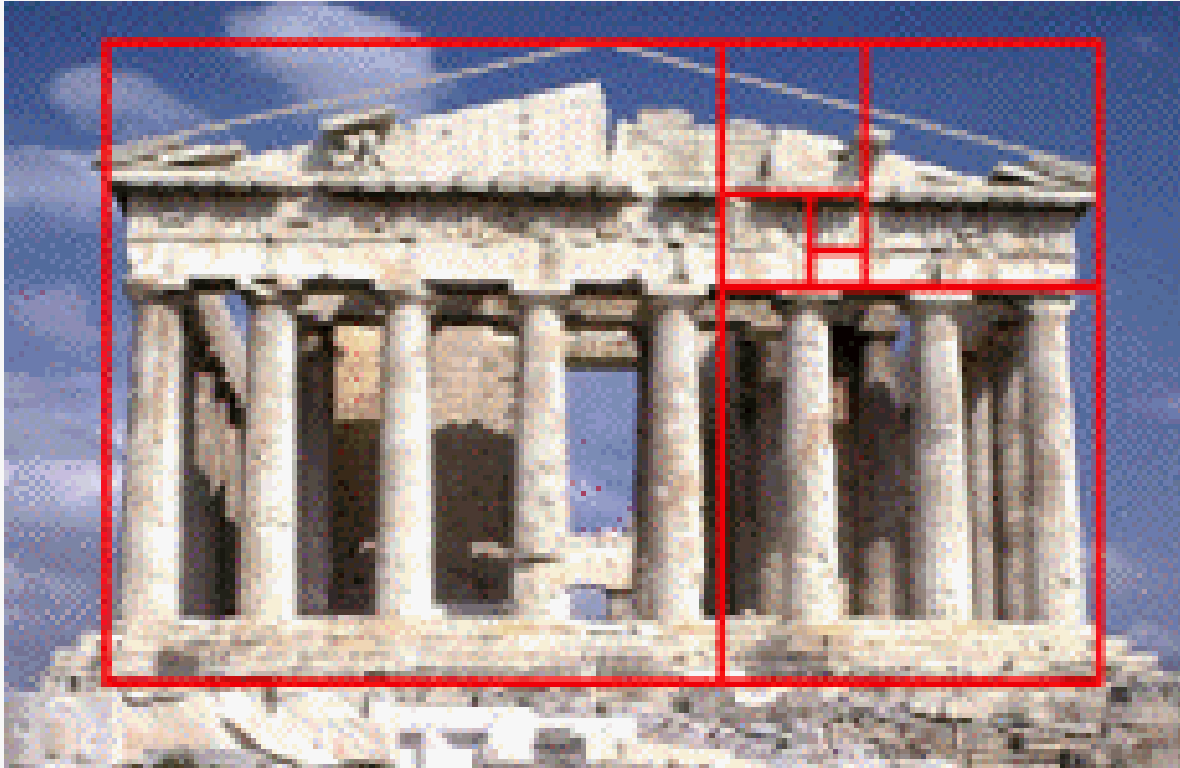# *The Sacrament of the Last Supper* by *Salvador Dali*(1904-1989)

This picture is painted inside a Golden Rectangle. Also, we can find part of an enormous dodecahedron above the table. Since the polyhedron consists of 12 regular Pentagons, it is closely connected to the golden section.

Bathers by *Seurat*

Circa 1884

Parthenon

The Greek sculptor Phidias sculpted many things including the bands of sculpture that run above the columns of the Parthenon

Circa 447BC-438BC

Music and The Golden Ratio

Musical compositions often reflect phi

- Phi relationships are often found in the timing of musical compositions.

- As an example, the climax of songs is often found at roughly the phi point (61.8%) of the song, as opposed to the middle or end of the song. In a 32 bar song, this would occur in the 20th bar.

Musical instrument design is often based on the Golden Ratio

- The whole overtone series is a series of golden ratios. If you divide an octave by a perfect fifth, (13/20), you get the golden ratio.
- If you divide a perfect fifth by an octave, (8/13), you get the golden ratio. If you divide a perfect fourth by a major sixth, (6/10), you get the golden ratio.
- And if you divide a major third by a perfect fifth, (5/8), you get the golden ratio.
- The overtone series is a natural order of notes that is played by horn instruments and found in other instances in music.

Musical instrument design is often based on the Golden Ratio
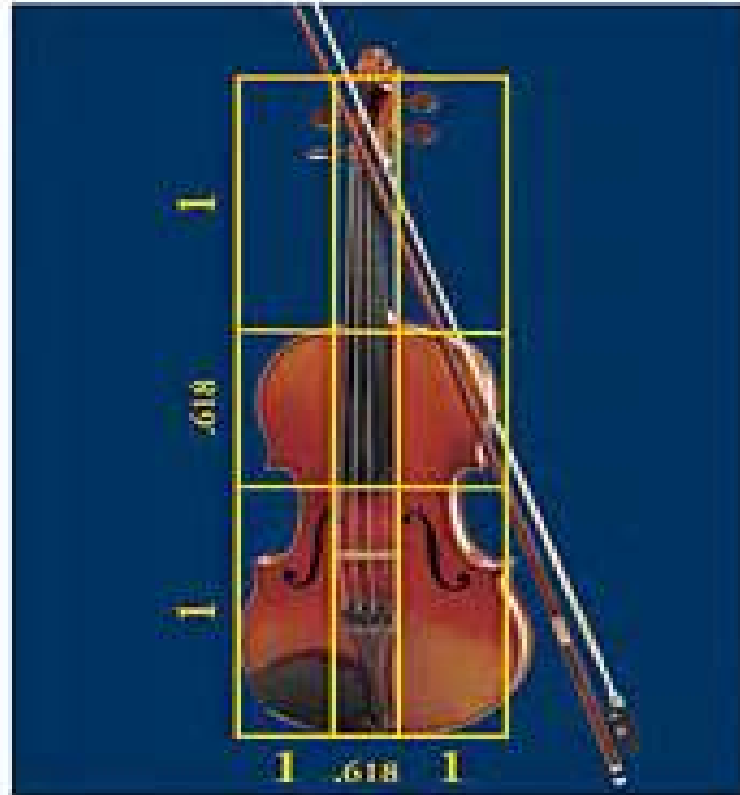
Math and Art
Math and Architecture
Math and Music

- There are many other relationships between math and art, architecture, and music.

- Youtube video of a Geometrical interpretation of Mona Lisa.

- Lots of resources on web.