THE BEAUTY OF PHI

If you haven't read Dan Brown's famous novel The Da Vinci Code, buy it. That novel is truly a work of art. Basically, in that novel, it revolves around Professor Langdon. He is a professor in Harvard University and a genius who can solve intriguing riddles. In The Da Vinci Code, the riddles revolved around Leonardo of Pisa, also known as Fibonacci. Since it's Fibonacci, of course I am going to talk about the Fibonacci sequence, which is a quite famous mathematical topic often mentioned in the Hollywood entertainment industry. Now back to the essay, what do you think about the sequence below:

1, 1, 2, 3, 5, 8, 13, 21

Ladies and gentleman, if you have no idea what it represents, then read this carefully. If you look closely, when you add two of the previous side by side numbers, you will get the next number.

For instance,

add 1 and 1, you will get 2,

add 1 and 2, you will get 3,

add 2 and 3, you will get 5,

and thus the pattern goes on.

This is what you call the Fibonacci sequence. The main story behind this discovery was that, Fibonacci came out with this sequence through an idea of breeding rabbits. He wanted to know how many pairs of rabbits are born from one pair in a year.

Fibonacci assumed that

- Every month a pair of rabbits produces another pair, and

- That rabbits begin to bear young, two months after their own birth

Please ignore the wildly improbable biology of breeding and lack of death here.

By adding all of the calculations together, he then managed to obtain the total number of pairs born during the year.

Given that

1 + 1 = 2

1 + 2 = 3

2 + 3 = 5

3 + 5 = 8

5 + 8 = 13

and so on...

After 12 months (one year) there will be 144 rabbits

The formula he used to get to that answer is what's now known as the Fibonacci sequence. What's there to note is that, Fibonacci's approach to this problem shows the importance on making assumptions in any application of mathematics.

Well that is the basic introduction of the Fibonacci sequence and now I will introduce you to the divine proportion phi, or ϕ in Greek rendition. Most people usually call it the *golden ratio* in case you've heard of it before in most problem-solving-math-related movies and series. This is the number that Professor Langdon kept rhapsodising about in the novel. This is the number that links nature's order to the rules of mathematics. Well if it is so, extraordinary claims require extraordinary evidence. Buckle your seatbelts and get ready to have your mind blown.

The golden ratio is a special number that approximately equals to 1.618, and simply said, it is a unique mathematical relationship. Often called the most beautiful number in the universe by most mathematical geniuses, two numbers are in phi if the ratio of the sum of the numbers (a+b) divided by the larger number (a) is equal to the ratio of the larger number divided by the smaller number (a/b). I am going to show you a diagram in case you're still stuck in the confusingly-long mathematical sentence stated.

Before that, do note that

$\phi = \frac{1+\sqrt{5}}{2} \approx$ 1.618033989..., like the better known π, it is an irrational number.

A B

Credit: Inside Design

The idea is given by:

$$\frac{A}{B} = \frac{A+B}{A} = 1.618 = \varphi$$

Okay, but what's the correlation between the golden ratio and the Fibonacci sequence? How does that figure into this? I know it might seem totally unrelated, but check this out. Completely unbeknownst to Fibonacci, the sequence of ratios of successive numbers of the Fibonacci sequence closes in on ϕ. Thanking that big brain of Johannes Kepler for figuring out the connection of those two elements. Pretty smart guy, I'd say?

Remember that the sequence is

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89....

So now if you look closely, the first few ratios are

1/1 = 1,

2/1 = 2,

3/2 = 1.5,

5/3 ≈ 1.666,

and as it goes on,

34/21 ≈ 1.619,

55/34 ≈ 1.617,

and 89/55 ≈ 1.618.

As you can see, the ratio of the eleventh Fibonacci number over the tenth agrees with ϕ up to three decimal places. At first I was amazed at how ϕ is closely associated with the Fibonacci sequence but after I did some more research, the golden ratio completely impressed me to the point where I could make a whole essay about it. I mean after all; the universe is a strange place full of surprises.

There's actually even more strangeness mathematically. If you multiply phi with itself, you will get the same as 1 plus phi.

Φ^2 = 2.618…

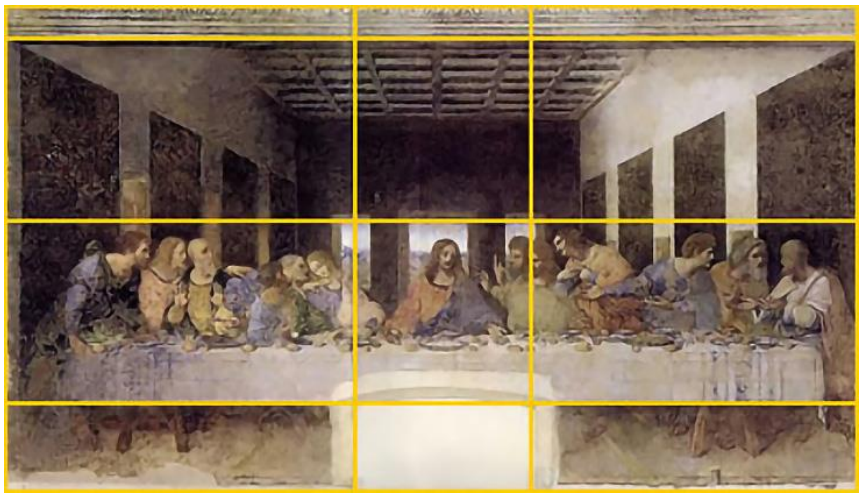
1 + Φ = 2.618…

And if you divide 1 by Φ, that's the same value as Φ minus 1.

$$\frac{1}{\Phi} = \Phi - 1 = 0.618\ldots$$

Ever heard of the phi joke where it goes, “Do you have the golden ratio because you are so *phine*”? Well jokes aside, the golden ratio is often used to describe beauty and perfection. If any science person has ever told you that your face proportions remind them of the golden ratio, well good news and congratulations, you are basically ethereal. In all seriousness, you can find the golden ratio almost everywhere, you name it. Architectural design? The Parthenon, The Great Pyramid of Giza, The Notre Dame Cathedral, and what else? Arts and paintings, of course as we all know Leonardo da Vinci’s The Last Supper and The Vitruvian Man.

This is because when specifically applied to a design, it creates a balanced, and aesthetically pleasing composition. Even some of the greatest mathematical minds of all ages, from Pythagoras and Euclid in ancient Greece, through the medieval Italian mathematician Leonardo of Pisa and the astronomer Johannes Kepler, have spent endless hours over this simple ratio and its properties.



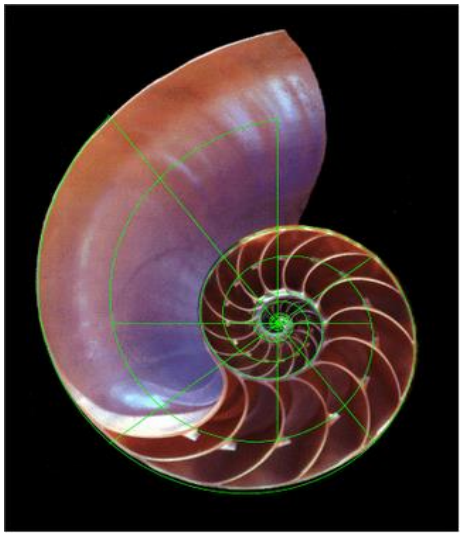
Credit: Dianne Mize

The fun part that piqued my interest about the golden ratio is when I can apply it to my surroundings. Let’s look at some places people claim to see phi. One of the situations where you might not notice the presence of the golden ratio is in our human body. Take a measuring tape and measure the distance between the top of your head to the end of your toes. Now divide that length with the distance between your bellybutton and your toes. Believe it or not, you will get the golden ratio. Not only that, guess the ratio when you try dividing the length from the top of your head to the shoulder by the distance between the top of your head to your chin. I assume this is why people often say we are made perfect, because we have the golden ratio applied on ourselves.

If I were to write an article, to attract the viewers’ eyes, the golden ratio is in fact helpful. It helps to figure out the size font that I should use. Consequently, when applying for a job and a neat and aesthetically pleasing resume is needed, playing around with the golden ratio might help you get the job. Mr Smith William, I hope you don’t mind becoming my example of a perfect template design.

Credit: Slideuplift

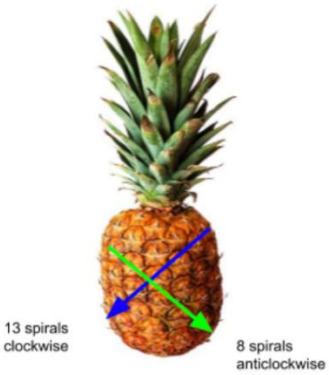
There are actually some claims of seeing phi in nature as fake, as being close to the number is not exactly enough to claim it as having the golden ratio. Exhibit A being a nautilus shell. The claim is if you trace the spiral of the shell, each ring is a golden ratio away from the next smallest ring. In reality, ratios vary quite a bit and it is actually a logarithmic spiral, not exactly the golden ratio. Each turn of the spiral grows by the same proportions but almost is not enough to claim it as precisely being a golden ratio.



Credit: Engage Intel

Fret not, the golden ratio actually does in fact appear in nature. Grab a pineapple from your kitchen and take a close look at it. You can see spirals around the pineapple's body which can be seen in two directions. One being clockwise and the other being anticlockwise. If you count the rows of spirals in each direction, one direction has 13 spirals while the other has 8 spirals. Do the numbers sound

familiar? That's because they are Fibonacci numbers. Do you know what that means? Cue the drum roll please. If we find the Fibonacci sequence, that means we can find the golden ratio. Maybe that's only a lucky creepy eerie coincidence that the pineapple has it. Well actually, fun fact but actually really surprising fact, pine cones also contains the spooky phi magic! Might as well change their name to phinecones and phineapples. Aside from those two, you can find the golden ratio in sunflower seeds, rose petals, cauliflowers and much more.



Credit: Chalk Dust Magazine

It's so fascinating because wherever you go, now that you know what the golden ratio is, you're always going to detect it in that brilliant brains of yours. Although most of the applications are not exactly phi, being nearly but not accurately 1.618 and so on, many people claim it as almost mythological. I mean, you can find it in so many places so, is it really a coincidence? Or is it only just a mere image created by our pattern sensing brain, making us think that we see it everywhere. Imagine what the world would have missed if Fibonacci didn't release Liber Abaci. Before this essay turns into a conspiracy theory essay, might as well end it with my favourite quote from The Da Vinci Code.

'Despite phi's seemingly mystical mathematical origins, the truly mind-boggling aspect of phi was its role as a fundamental building block in nature. Plants, animals and even human beings all possessed dimensional properties that adhered with eerie exactitude to the ratio of phi to one. Phi's ubiquity in nature clearly exceeds coincidence.' (Langdon, 2003)