Math Project 2021

(Golden ratio)

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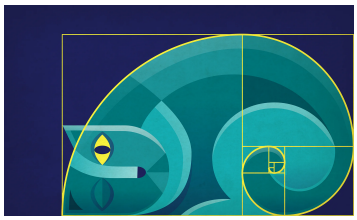


Credits: https://99designs.com.sg/blog/tips/the-golden-ratio/

What is our aim for the project?

- The different methods of generating the golden ratio
- We aim to find out how to use the golden ratio in our daily lives
- And also to find out how the Golden ratio helps to make the world around us more beautiful

What are our research questions?

1. How can we explore and compare the various methods of generating the Golden Ratio?

2. Ancient architectures used Golden Ratio in their construction. We will investigate the application of Golden Ratio in modern buildings.

3. Investigate and find out the various models of car that uses Golden Ratio in its design to enhance its look and safety aspect.

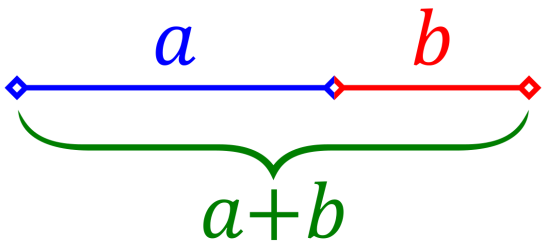
Introduction to the golden ratio
What is the golden ratio?

- The golden ratio is a number, also known as phi, is an irrational number that is approximately 1.61803398875

- It is commonly used in ancient artwork and buildings. Some, but not a lot of buildings still follow the golden ratio now, but it is commonly found in nature.

- Usually, the golden ratio is known to be the number that makes things look pleasing to the eye, although nobody is really sure whether the golden ratio is actually the most pleasing number.

- The golden ratio is:



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

Credits:https://en.wikipedia.org/wiki/Golden_ratio

As seen in the picture, longer part a divided by shorter part b is equal to the sum of a+b divided by a, which both equal the golden ratio.

- The golden ratio is mainly used in design. Famous artworks like the Mona Lisa and famous buildings like The Parthenon follow the golden ratio.

Literature review

“A guide to the golden ratio for designers” by Emily Esposito.

Summary

- The golden ratio can be used in typography and defining hierarchy, cropping and resizing images … etc.
- The golden ratio can be easily calculated by using tools like the golden ratio calculator or the golden ratio ruler.
- The golden ratios are used a lot in typography!

Relevance to the topic

- This proves that the golden ratio is widely used, in many things around us.

“How Architects Take Advantage of The Golden Ratio” by Tara Mastroeni
https://www.mymove.com/home-inspiration/decoration-design-ideas/how-architects-take-advantage-of-the-golden-ratio

Summary

- This ratio – 1:1.61– occurs over and over again in nature. It is found in everything from the shape of our universe, the structure of clouds, and even the proportions of the human body.
- While there is some controversy over the exact origins, many people believe that use of the ratio dates all the way back to the Great Pyramids in Egypt.

- One of the simplest ways to impart a sense of balance to a structure is to base it off the principles of the golden rectangle which uses the golden ratio.

Relevance to the topic

- The golden ratio is used in many things around us and is very useful in making architecture look more pleasing to the eye.
    - Architects use golden ratio to determine building design, layout, floor plan and give building the balance and height.
- It allows for creation of different shapes apart from golden rectangle, like golden triangle and logarithmic spiral.

"The story of Phi, the world's most astonishing number" by Mario Livio.

Summary

- The golden ratio is an irrational number, like pi.
- Many things follow the golden ratio, including
    - Petal arrangements on flowers
    - Spiral shells of mollusks
    - Mona Lisa and The Parthenon

Relevance to the topic

- The golden ratio exists in many things in nature, as well as some famous buildings and drawings.

<u>What are the methods of generating the golden ratio?</u>

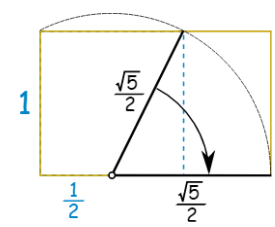
1. You can divide 1 by your value, then add 1 to the answer. Then repeat this steps, and the number will get closer and closer to the golden ratio.
    a. PROS: Easy to use, as it is sort of a pattern, a repeat.
    b. CONS: Does not directly give golden ratio, needs a lot of repeats to get golden ratio

2. The square root of 5 is approximately 2.236068, so the Golden Ratio is approximately 0.5 + 2.236068/2 = 1.618034.

    a. PROS: Very easy way to get golden ratio on a calculator should we forget the value of golden ratio, accurately.

    b. CONS: Have to memorise the formula of 0.5+square root 5/2 but as long as memorised should not be a problem

3. The third way is by geometry, drawing. First, draw a square of size 1, then place a dot half way along one side, then draw a line from that point to an opposite corner. Then turn that line so it runs along the square's side, then extend the square to a rectangle with the golden ratio! This triangle is known as the golden rectangle.



    a. PROS: Can do without a calculator, just needs to measure

    b. CONS: Takes longer to draw, human error.

4. Lastly the golden ratio can also be generated with the Fibonacci sequence, thus it being a method to generate the golden ratio.

    a. PROS: Easy to remember, repetitive, easy to use, fun :D.

    b. CONS: Does not directly give golden ratio, needs a lot of repeats to get very close to golden ratio

Thus, we feel that the 4th method is the best method to calculate the Golden ratio because it is the most enjoyable to use.

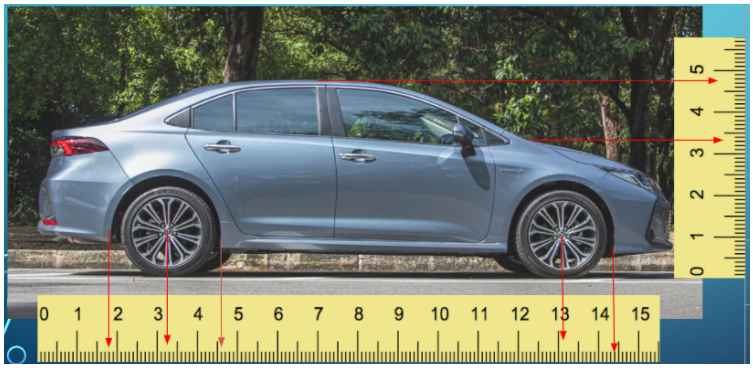
As seen here, we used a python code to show how the fibonacci number can create the golden ratio. The ratio using the fibonacci number divided by the one before, with the numbers getting closer and closer to the golden ratio.

```
Let's assume the value is 5. All answers will be rounded by the system.
1/PreviousAnswer + 1 = 1.2
1/PreviousAnswer + 1 = 1.83333
1/PreviousAnswer + 1 = 1.54545
1/PreviousAnswer + 1 = 1.64706
1/PreviousAnswer + 1 = 1.60714
1/PreviousAnswer + 1 = 1.62222
1/PreviousAnswer + 1 = 1.61644
1/PreviousAnswer + 1 = 1.61864
1/PreviousAnswer + 1 = 1.6178
1/PreviousAnswer + 1 = 1.61812
1/PreviousAnswer + 1 = 1.618
1/PreviousAnswer + 1 = 1.61805
1/PreviousAnswer + 1 = 1.61803
1/PreviousAnswer + 1 = 1.61804
1/PreviousAnswer + 1 = 1.61803
```

As seen here, 1/previous value + 1 will get closer and closer to the golden ratio, as shown in this c++ code.

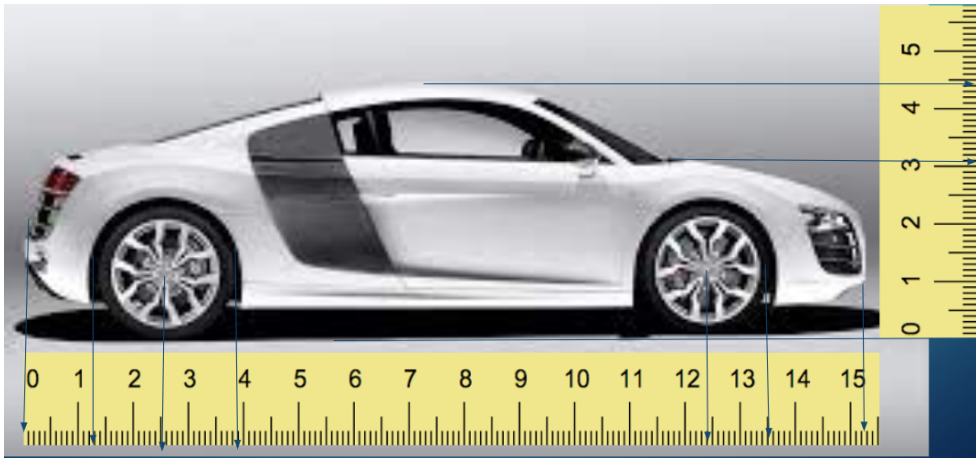
Thus the BMW 650i coupe follows the golden ratio to a large extend

	2012 BMW 650i coupe	Ratio
Rear wheel arch diameter	2.5	1.6
Rear overhang	1.5	
Height of car	4	1.3
Height of highest part of bonnet	3	
Wheelbase	8.6	2.0
Total length of both front and rear overhang	4.2	
Average		1.6



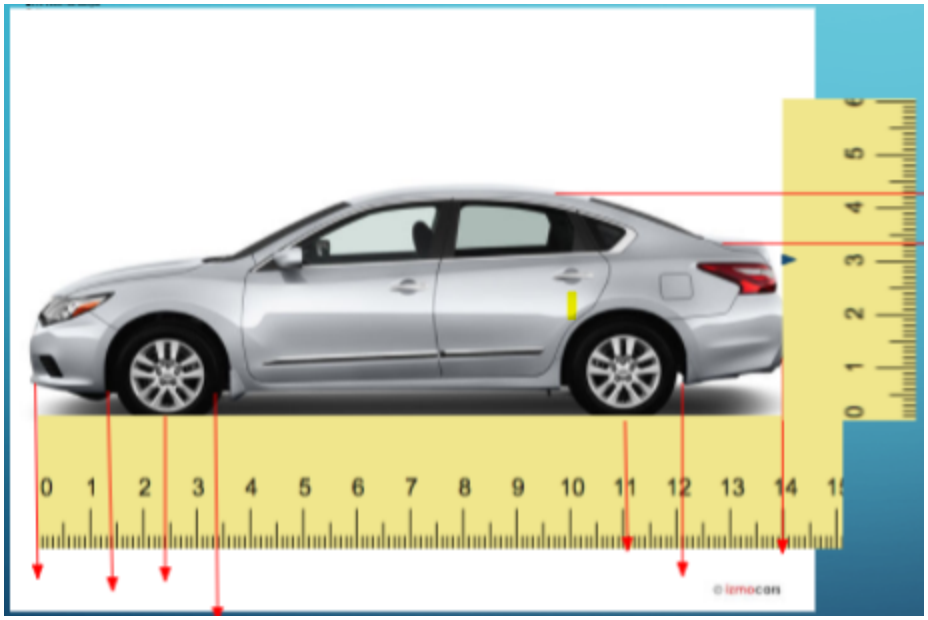
	2020 Toyota Corolla Altis	**Ratio**
Rear wheel arch diameter	2.8	1.6
Rear overhang	1.8	
Height of car	4.8	1.5
Height of highest part of bonnet	3.3	
Wheelbase	9.9	3.1
Total length of both front and rear overhang	3.2	
Average		2.1

Thus, the 2020 toyota corolla altis is partially in the golden ratio.



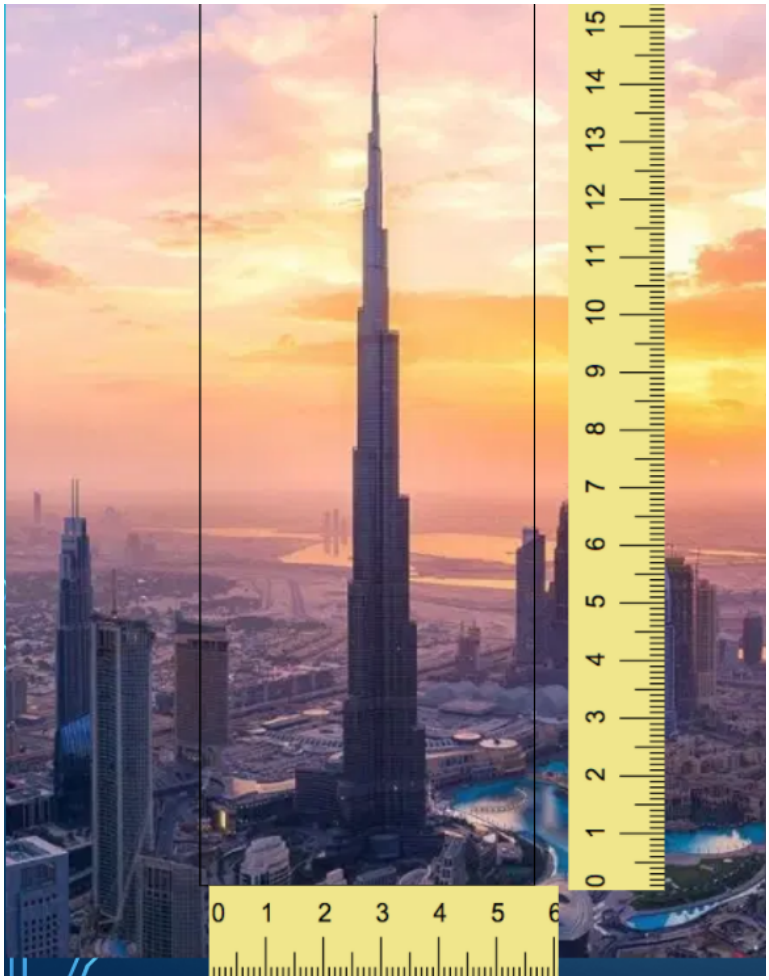
Thus, the car is partially in the golden ratio.

		Ratio
Rear wheel arch diameter	2.6	2.1
Rear overhang	1.2	
Height of car	4.4	1.4
Height of highest part of bonnet	3.1	
Wheelbase	9.9	3.2
Total length of both front and rear overhang	3.1	
Average		2.2



	2018 Nissan Ultima	**Ratio**
Rear wheel arch diameter	2.0	1.4
Rear overhang	1.4	
Height of car	4.2	1.3
Height of highest part of bonnet	3.3	
Wheelbase	8.7	2.6
Total length of both front and rear overhang	3.3	
Average		1.8

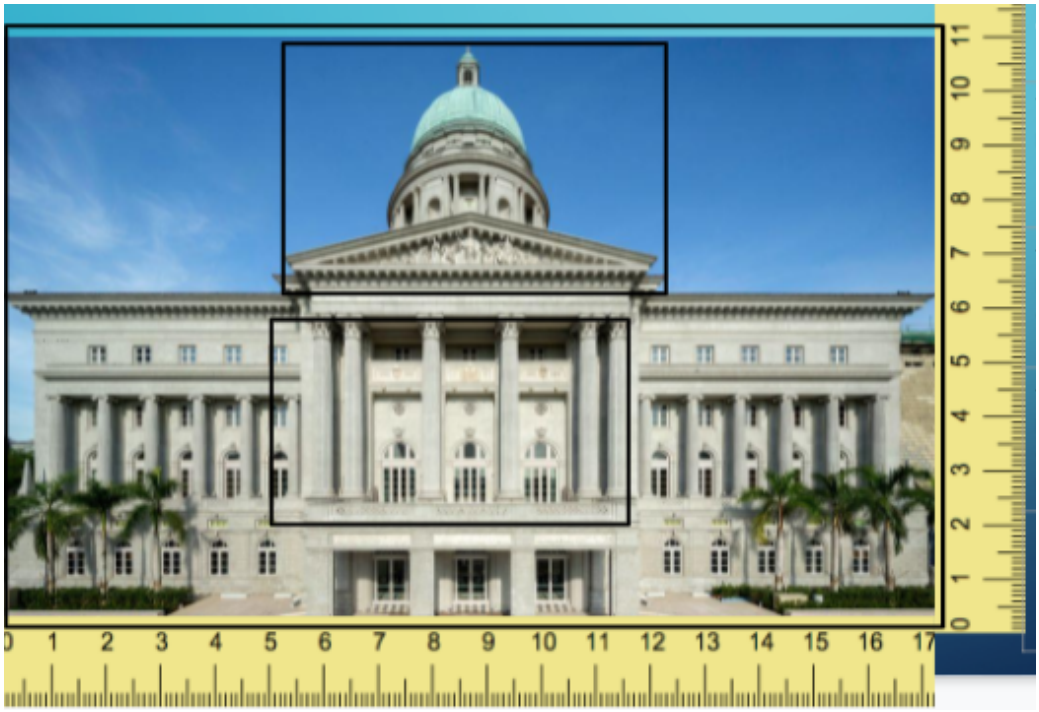
Therefore, this car is largely in the golden ratio.



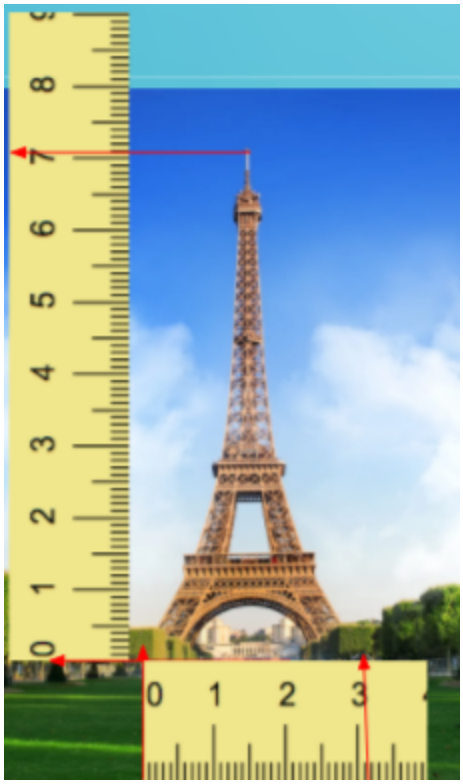
The breadth of this building is 5.5, and the length is 15.3

Ratio : 2.7

It was not really constructed in the golden ratio



	breadth	length	ratio
The biggest rectangle	11	17	1.5
the rectangle on the top	4.6	7	1.5
the rectangle on the middle	3.7	7.6	2
average	1.6		



Length = 3.1
Ratio = 2.3

The Eiffel tower does not really follow the golden ratio.

Breadth is 2.5
Length is 8.5
Ratio is 3.4
Thus this building is not in the golden ratio