Fibonacci sequence and golden ratio

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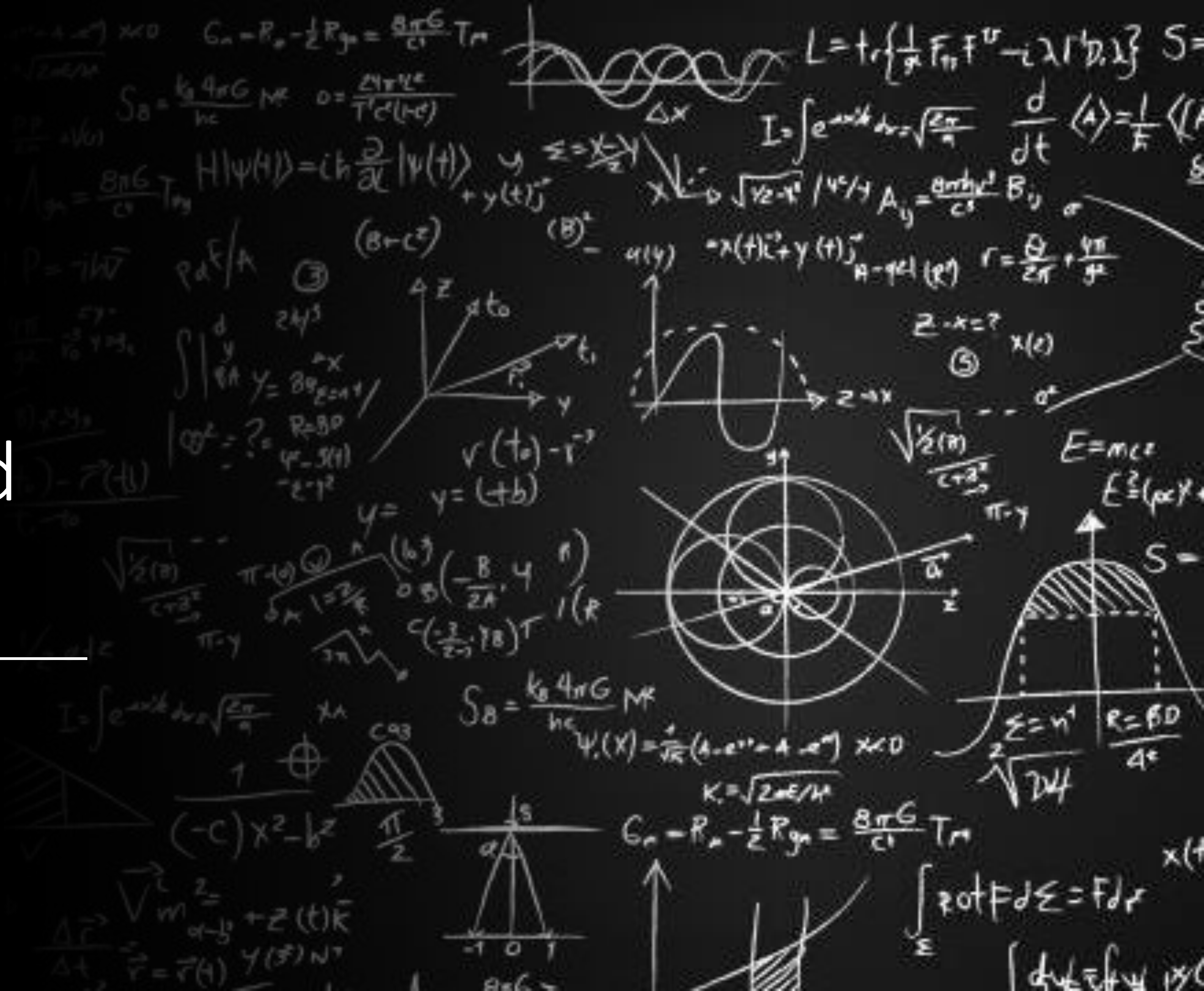
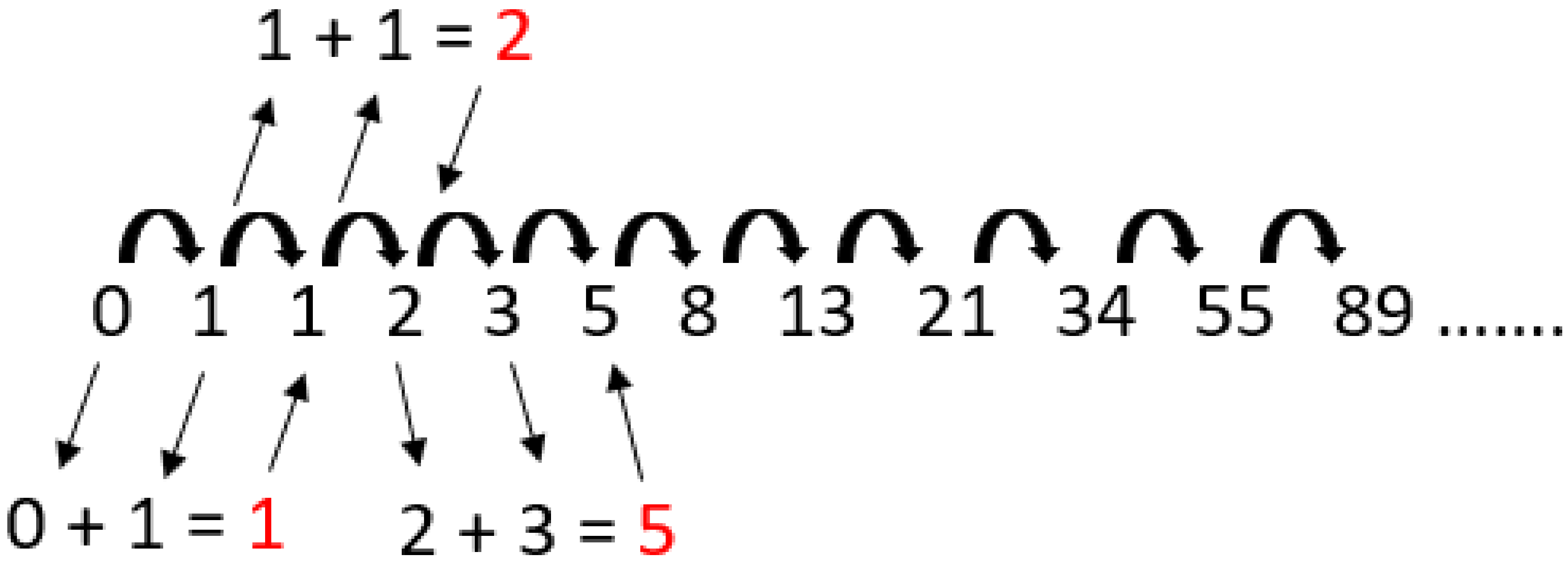


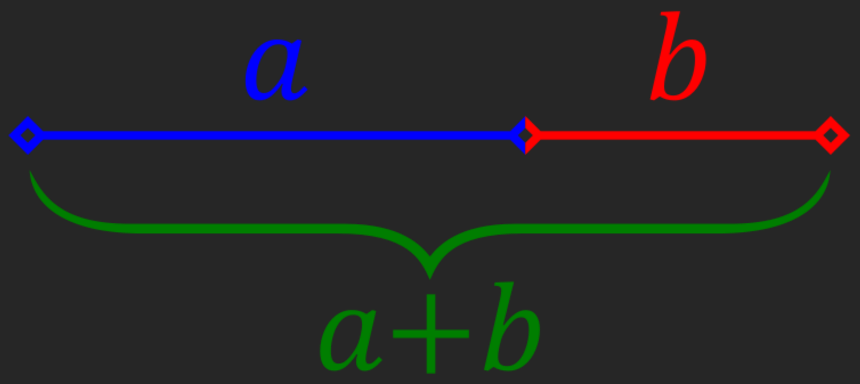


What is Fibonacci sequence?

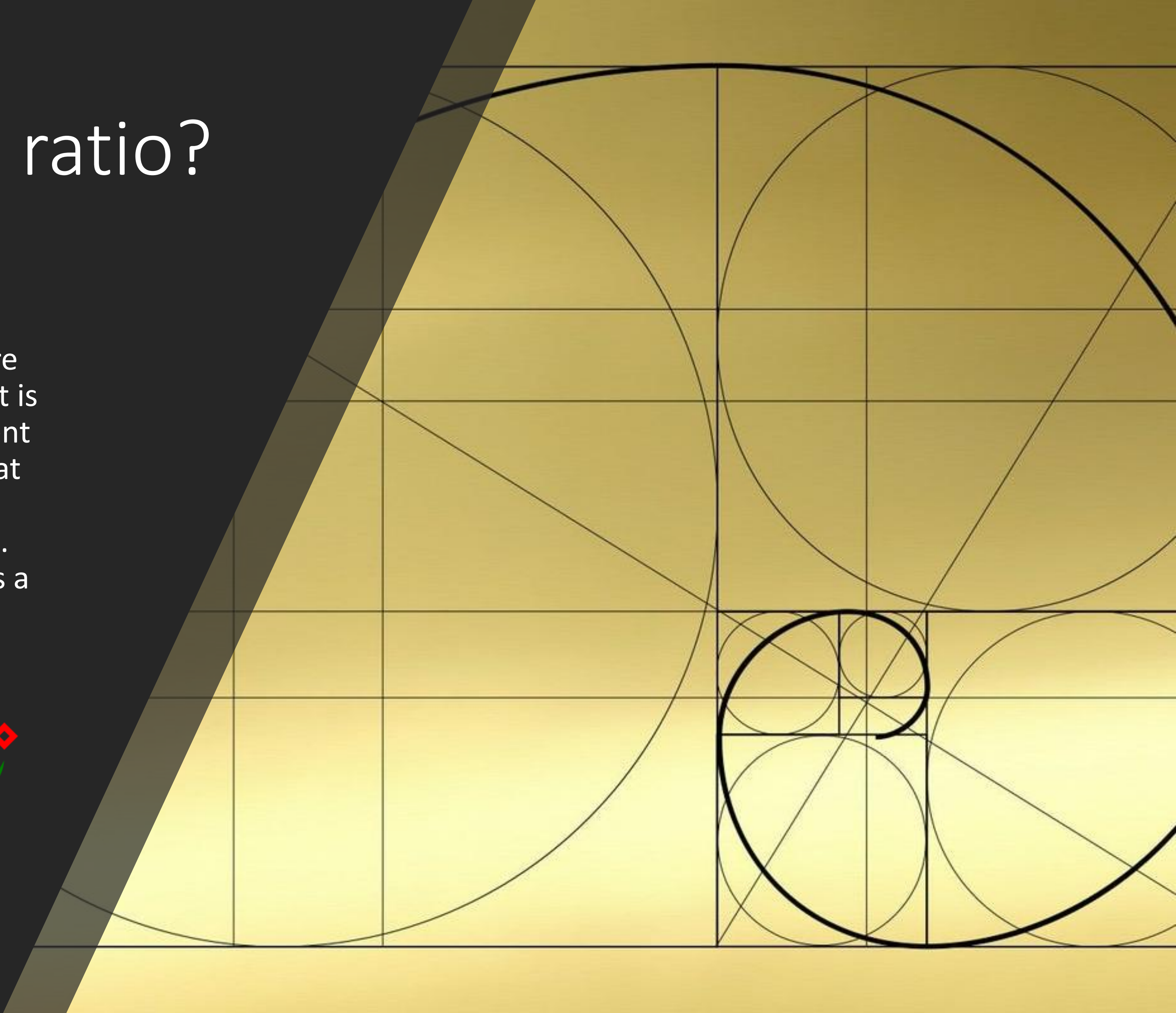
- Fibonacci sequence is a sequence of natural numbers where every next number is a sum of two previous numbers. For example 0,1,1,2,3,5,8,13,21 where 8 appeared because 5+3=8 and 13 appeared because 8+5=13. Often we write beginning of this sequence as 1,1,2 but it really don't matter If we write it that way or as 0,1,1,2.

What is golden ratio?

- Golden ratio is a ratio where we divide a segment in the way where ratio of longer part to shorter part is the same as ratio of whole segment to the longer part. We assume that number of golden ratio is 1.618025751. Symbol for this is φ. Golden ratio is often presented as a spiral like in the picture.



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

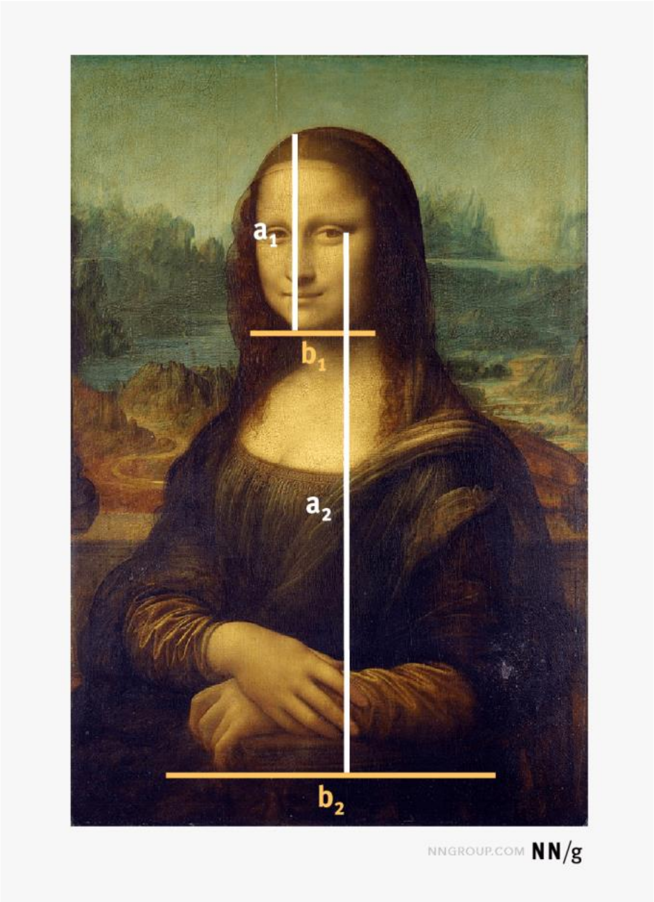


Connection between Fibonacci sequence and golden ratio

- If we divide any number of Fibonacci sequence with the number that is standing before it in result we are going to get a number which is very close to golden ratio. For example If we take 377 and divide it by the previous number which is 233 in result we are going to get 1.618025751 which is exact number of golden ratio. Only exceptions for this rules are the first 6 numbers of Fibonacci sequence which are 1,1,2,3,5,8 after this numbers this rule will apply to every next pair of numbers.

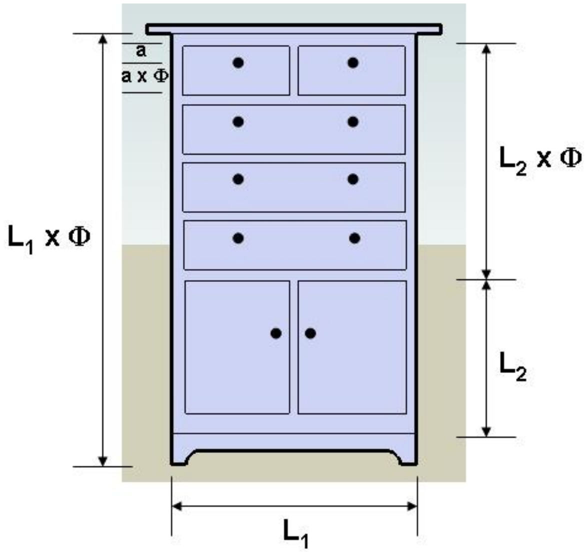
Where can we find a golden ratio?

- In art



In nature

In furnitures



Golden ratio in furnitures

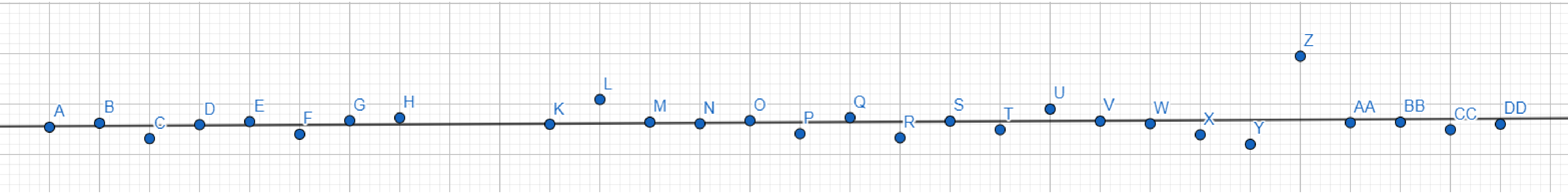
- In furnitures like shelfs, warderobes, cupboards etc.

If we measure width and height of for example shelf and divide one by another we almost always get a number very close to golden ratio.

As a proof I measured 30 pieces of furniture and checked If this is actually true.

Width	Height	Result
60	38,5	1,558442
160	98	1,632653
53	40	1,325
72	45	1,6
59	35,5	1,661972
130	92	1,413043
128	76	1,684211
59	34	1,735294
201	124	1,620968
147	77	1,909091
193	120	1,608333
128	60	2,133333
116	70	1,657143
120	74	1,621622
202	120	1,683333
200	140	1,428571
211	121	1,743802
201	150	1,34
100	60	1,666667
180	120	1,5
132	69	1,913043
140	84	1,666667
141	87	1,62069
77	55	1,4
95	78	1,217949
160	54	2,962963
56	34	1,647059
101	61	1,655738
120	80	1,5
170	105	1,619048
		49,72663
		1,657554

The graph of results compared to golden ratio



Statistical test for mean - first part

So does golden ratio appear in every furniture?

α – significance level I took this ratio as a 5% so as 0,05

- Null hypothesis - $\bar{x}$ = φ
- Critical value – is value above which we reject null hypothesis. For our significance level critical value is 1,64
- Standard deviation - value which tell us how much every number can be different from mean. For instance if we have mean m=2 and the standard deviation Sd=1,5 we can write that m=2 +/- 1,5

Standard deviation

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$$

x_i is a result of dividing width and height for every piece of furniture I measured

$\bar{x}$ is a mean of every result from the table

n is number of furnitures that we took under consideration

Standard deviation calculations

So i caluclate this part of formula $(x_i - \bar{x})^2$ for every result from the table and I summed up every result from this.

Later I divided it by 30 which is the n from formula

And at the end I took a root from the result of dividing and I got a standard deviation.

From this part $\sum (x_i - \bar{x})^2$ I got 2,6197, then I divided it by 30 and got 0,08732 and root from it is 0,2955 so our standard deviation is 0,2955.

Statistical test for mean - second part

- X is a mean of every result in the table
- M is a perfect value that we seek
- S is standard deviation
- N is number of values we consider

$$u = \frac{\bar{x} - m_0}{S(x)} \cdot \sqrt{n}$$

U={(1,65-1,61)/0,2955}*√30

{(1,65-1,61)/0,2955}*√30=0,741

U=0,741

U<Cv

0,741<1,64

Statistical test for mean - third part (conclusions)

- After calculating everything in result we get that:
- Factor U is smaller than critical value so there is no enough evidence to reject null hypothesis so we can think that the mean ratio that we got is the golden ratio

The end

- Thank you for you attention I hope that my presentation intrested you and that you liked it
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