SANTA FE
ALLIANCE FOR
SCIENCE

This video was created by volunteers from the
Santa Fe Alliance for Science, a 501(c)(3) organization.

Our Mission

We inspire the inner scientist in Santa Fe students by creating STEM learning and discovery opportunities through our network of volunteer scientists, engineers, and other STEM professionals.

Learn more: www.sfafs.org

2020

SANTA FE ALLIANCE FOR SCIENCE

Fibonacci and his numbers

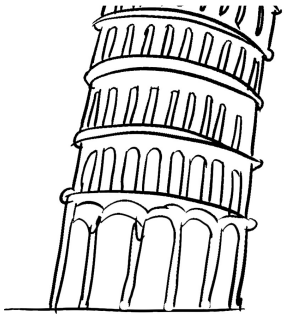
Hubert van Hecke
January 2021

1170-1250

Leonardo of Pisa

Fibonacci

Son of Bonacci



1172-1372

Leaning tower of Pisa

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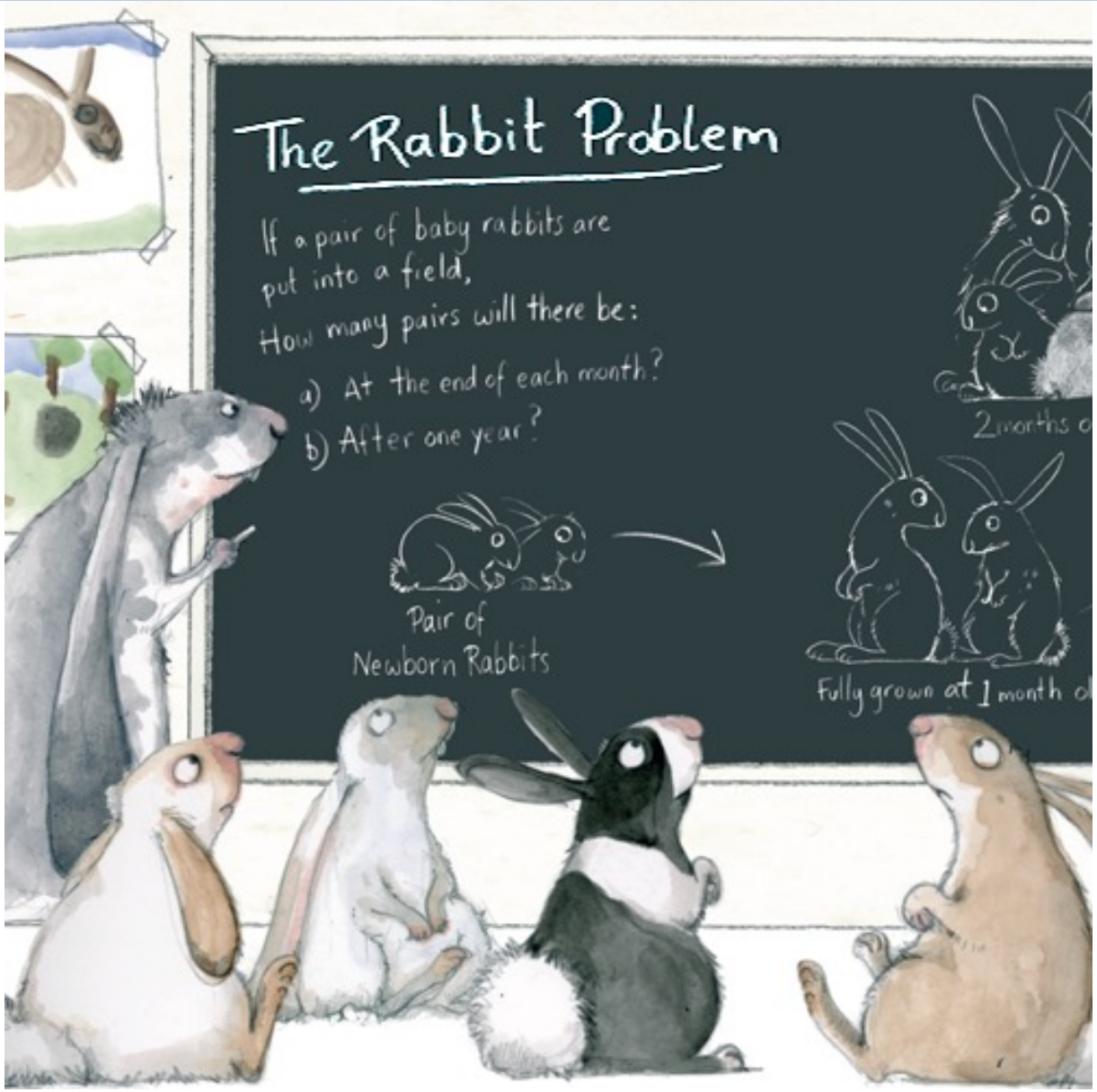
If I put a pair of baby rabbits in a field,
How many rabbits will there be in a year?

Rules:

- It takes one month to grow into an adult rabbit
- An adult pair will produce a pair of baby rabbits every month



Month

# of Pairs

Mature

Immature

1  1

Month

# of Pairs


Mature


Immature

1  1

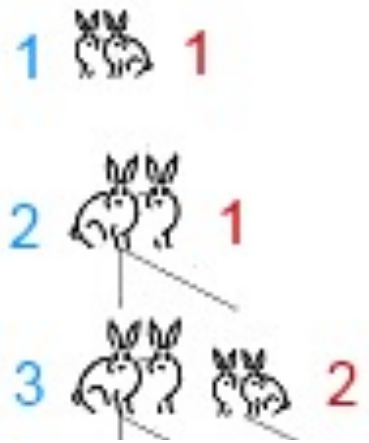
2  1

Month

# of Pairs

Mature

Immature

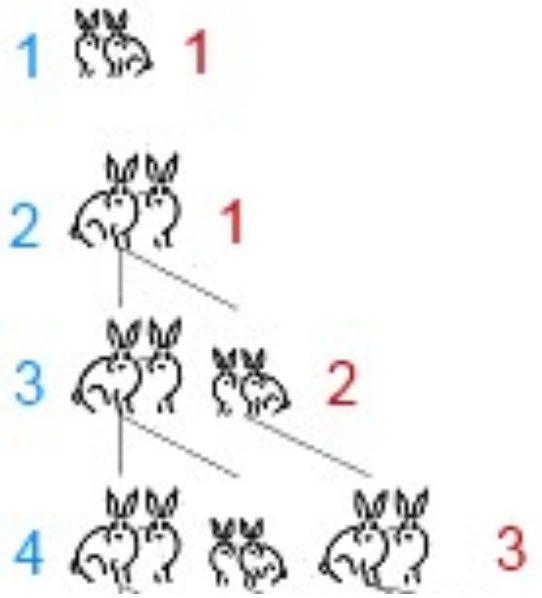


Month

# of Pairs

Mature

Immature

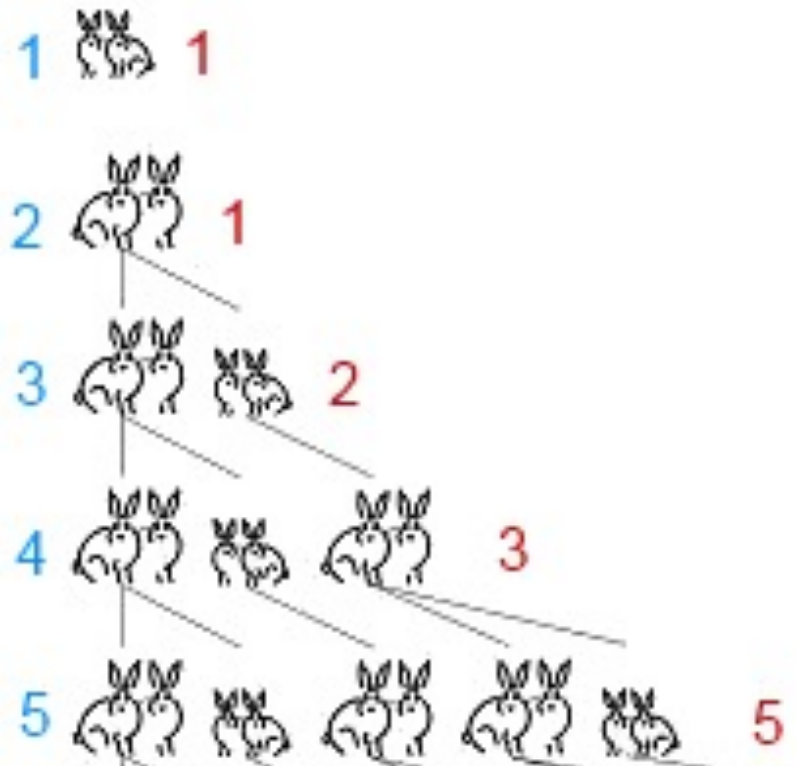


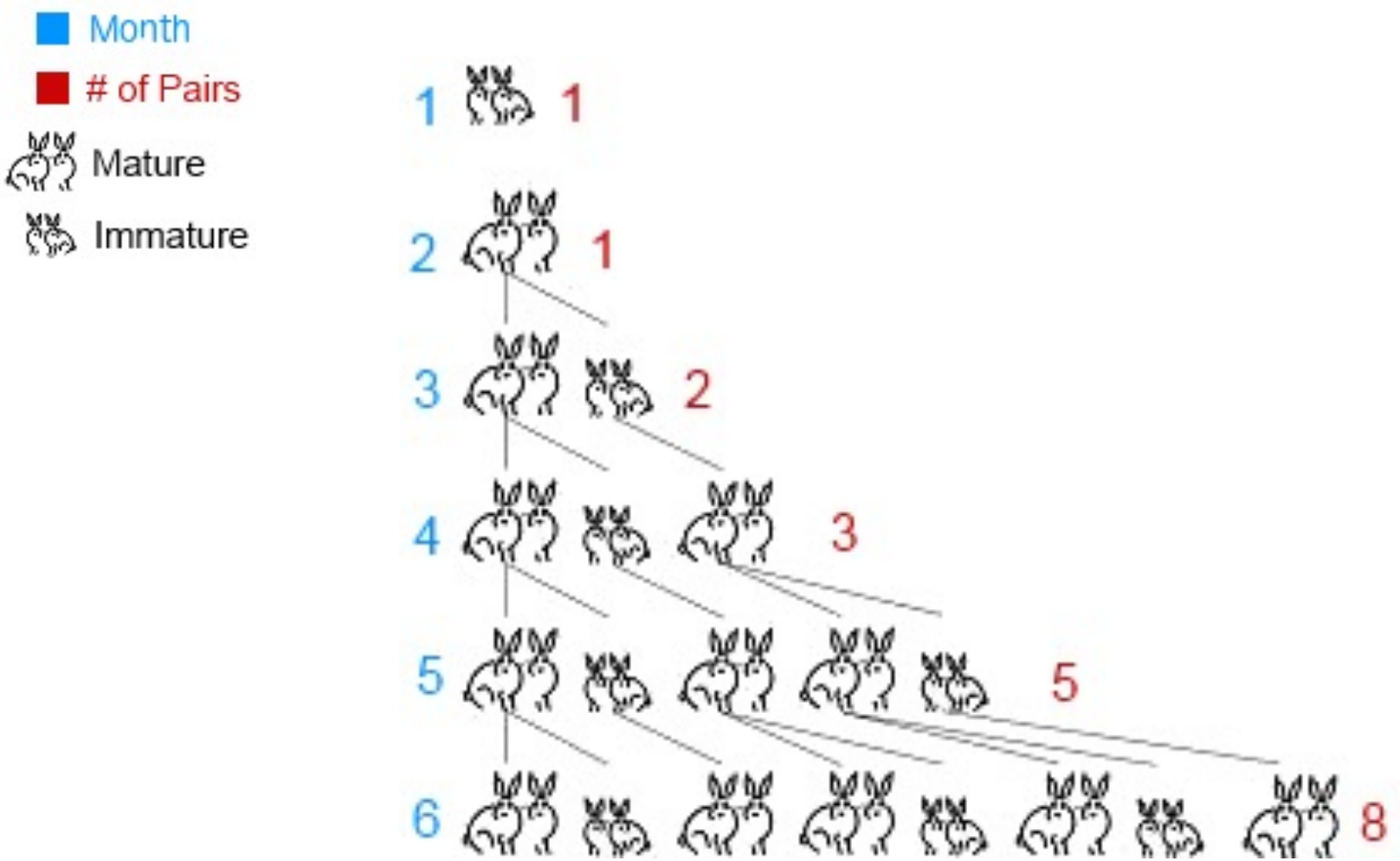
Month

# of Pairs

Mature

Immature




Month
# of Pairs
Mature
Immature
1
1
2
1
3
2
4
3
5
5
6
8

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Fibonacci number series

1 1 2 3 5 8 13 21 34 ??

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Fibonacci number series

1 1 2 3 5 8 13 21 34 ??

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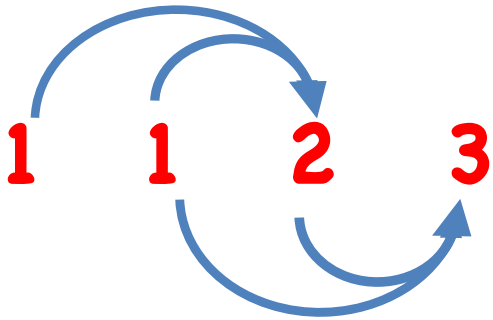
Fibonacci number series



1 1 2 3 5 8 13 21 34 ??

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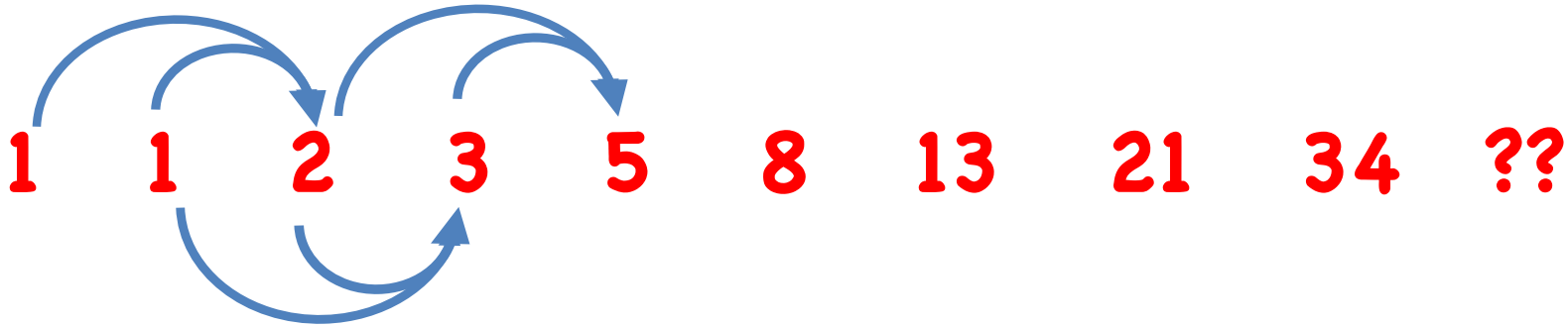
Fibonacci number series



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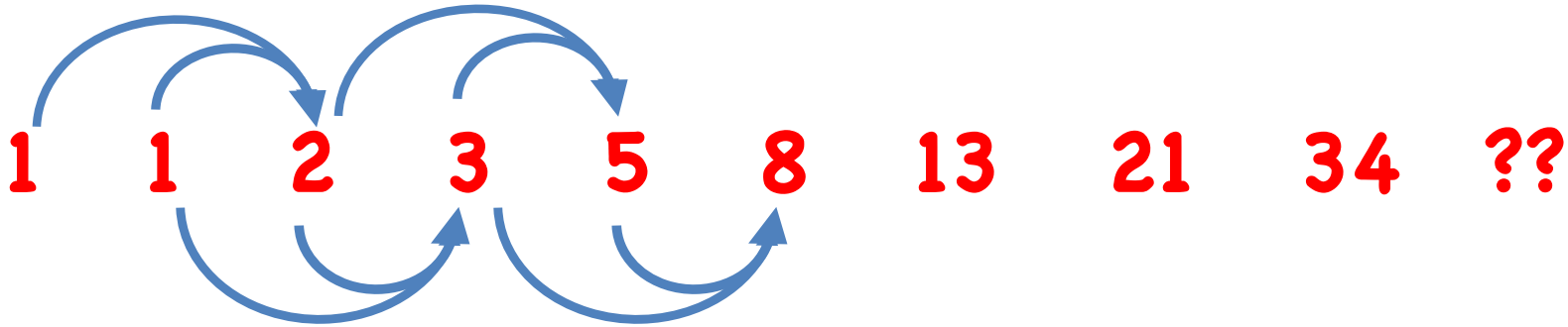
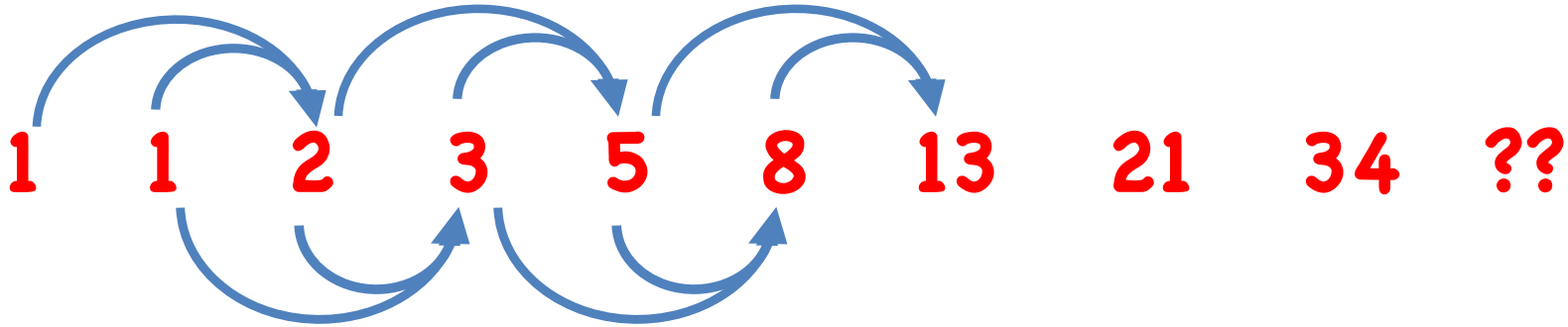
Fibonacci number series



SANTA FE ALLIANCE FOR SCIENCE

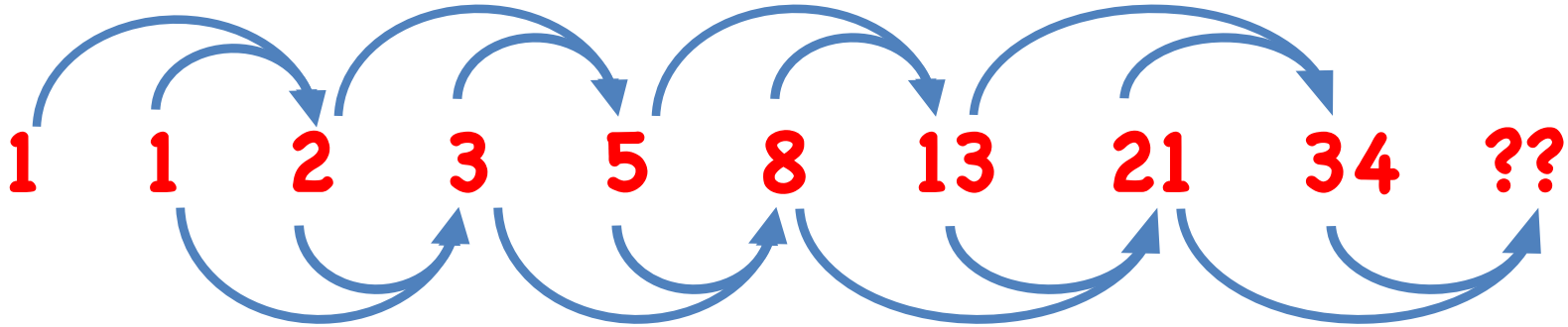
Fibonacci number series



Every number is the sum of the previous two numbers

SANTA FE ALLIANCE FOR SCIENCE

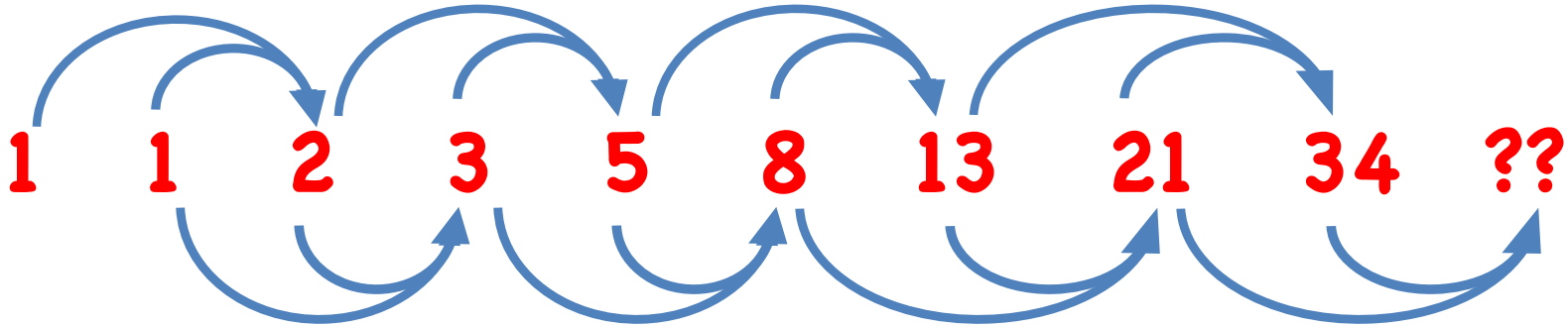
Fibonacci number series



Every number is the sum of the previous two numbers

SANTA FE ALLIANCE FOR SCIENCE

Fibonacci number series



21
34
---- +
55

Every number is the sum of the previous two numbers

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Fibonacci number series

Every number is the sum of the previous two numbers

1 1 2 3 5 8 13 21 34 _ _ _ _

1 January 1190

1 July

1 January 1191

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Fibonacci number series

Every number is the sum of the previous two numbers

1 1 2 3 5 8 13 21 34 55 _ _ _

1 January 1190

1 July

1 January 1191

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Fibonacci number series

Every number is the sum of the previous two numbers

1 1 2 3 5 8 13 21 34 55 89 _ _

1 January 1190

1 July

1 January 1191

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Fibonacci number series

Every number is the sum of the previous two numbers

1 1 2 3 5 8 13 21 34 55 89 144 _

1 January 1190

1 July

1 January 1191

SANTA FE ALLIANCE FOR SCIENCE

Fibonacci number series

Every number is the sum of the previous two numbers

1 1 2 3 5 8 13 21 34 55 89 144 233

1 January 1190

1 July

1 January 1191

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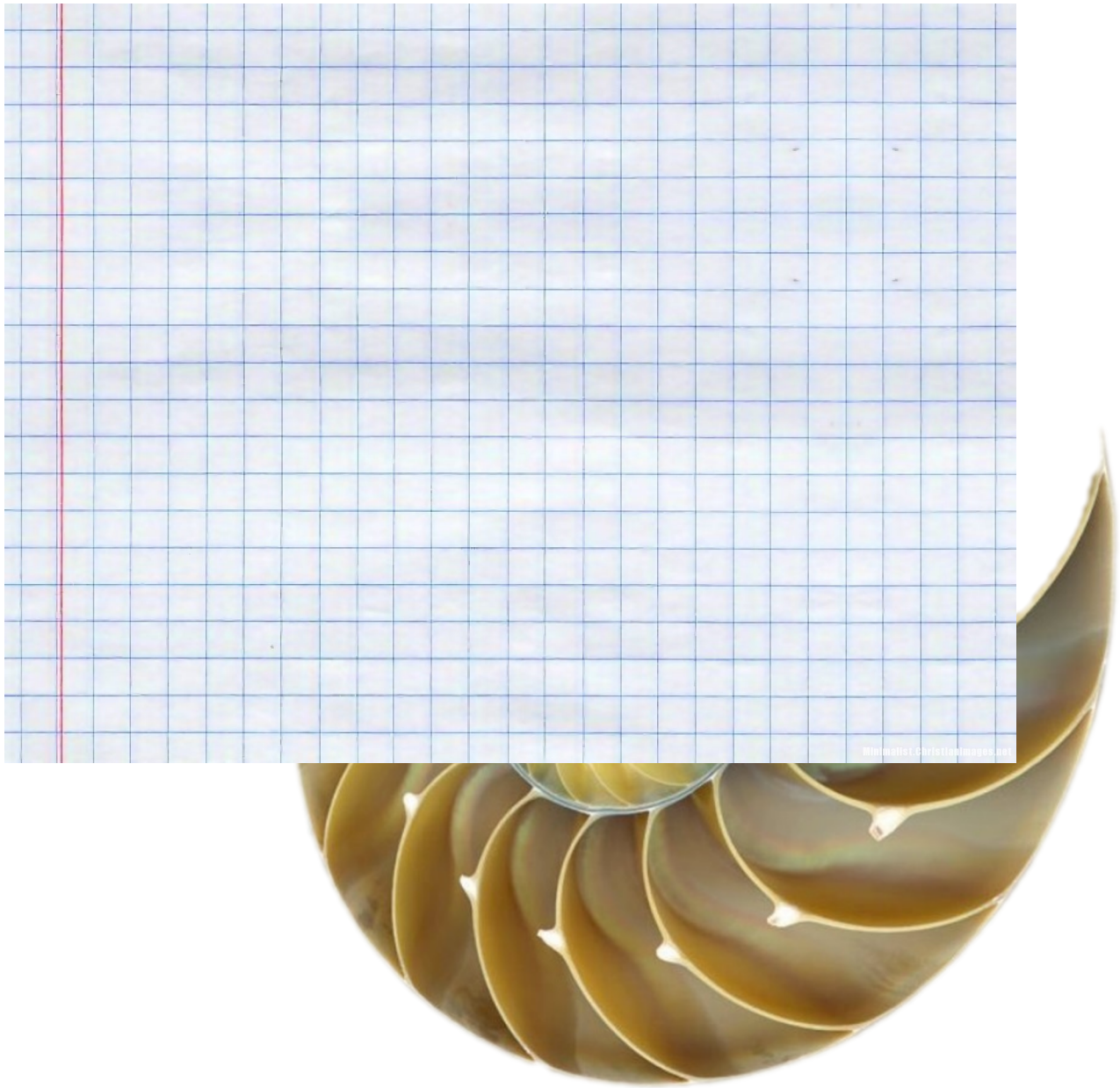
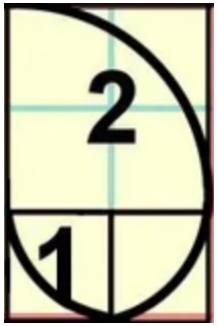
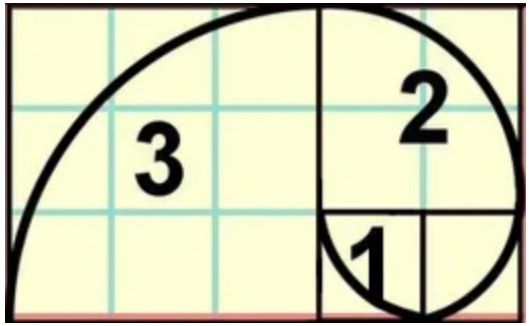
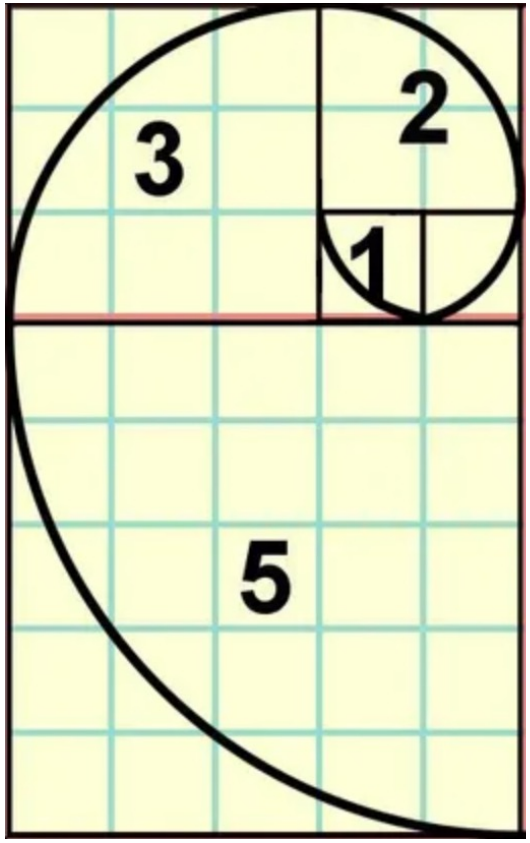
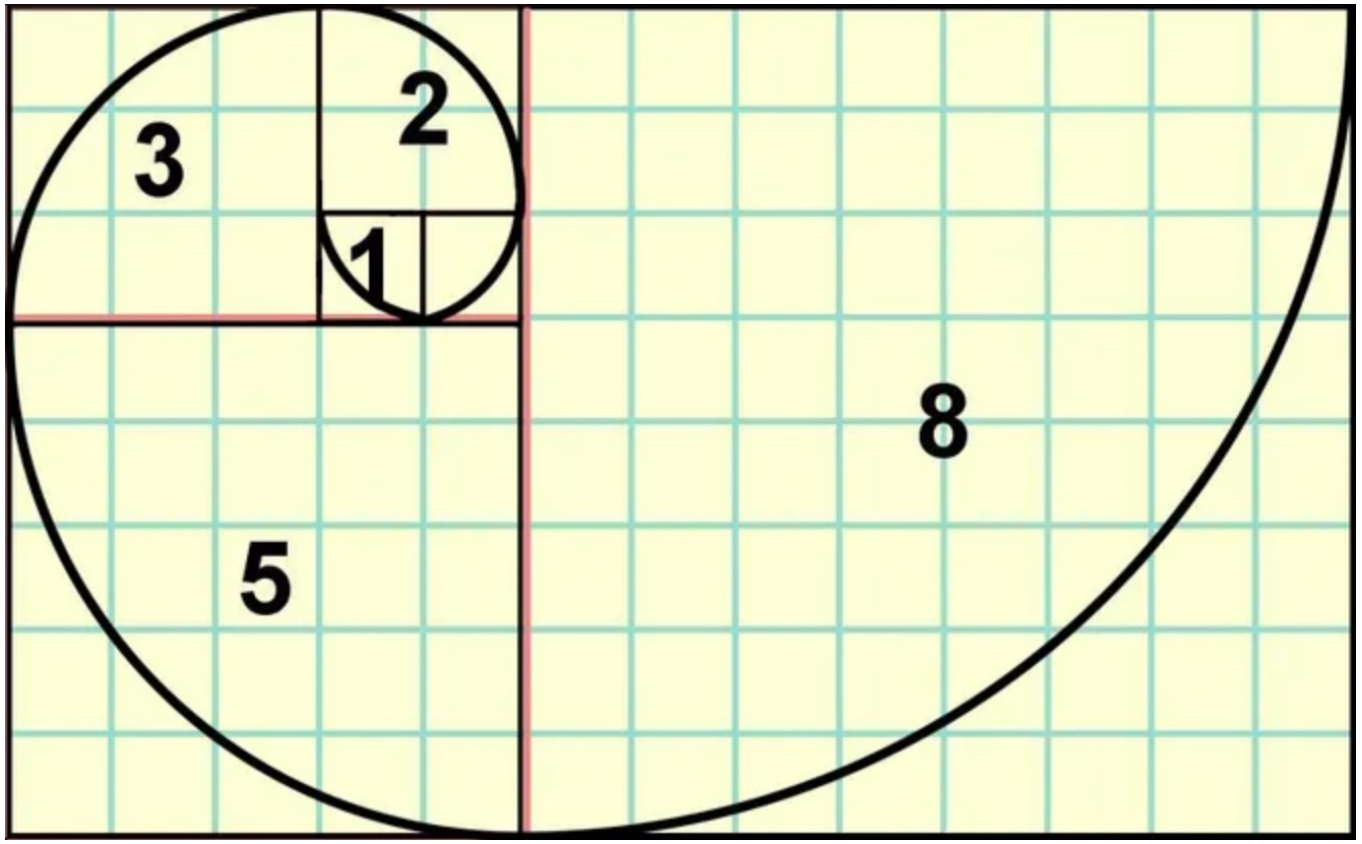


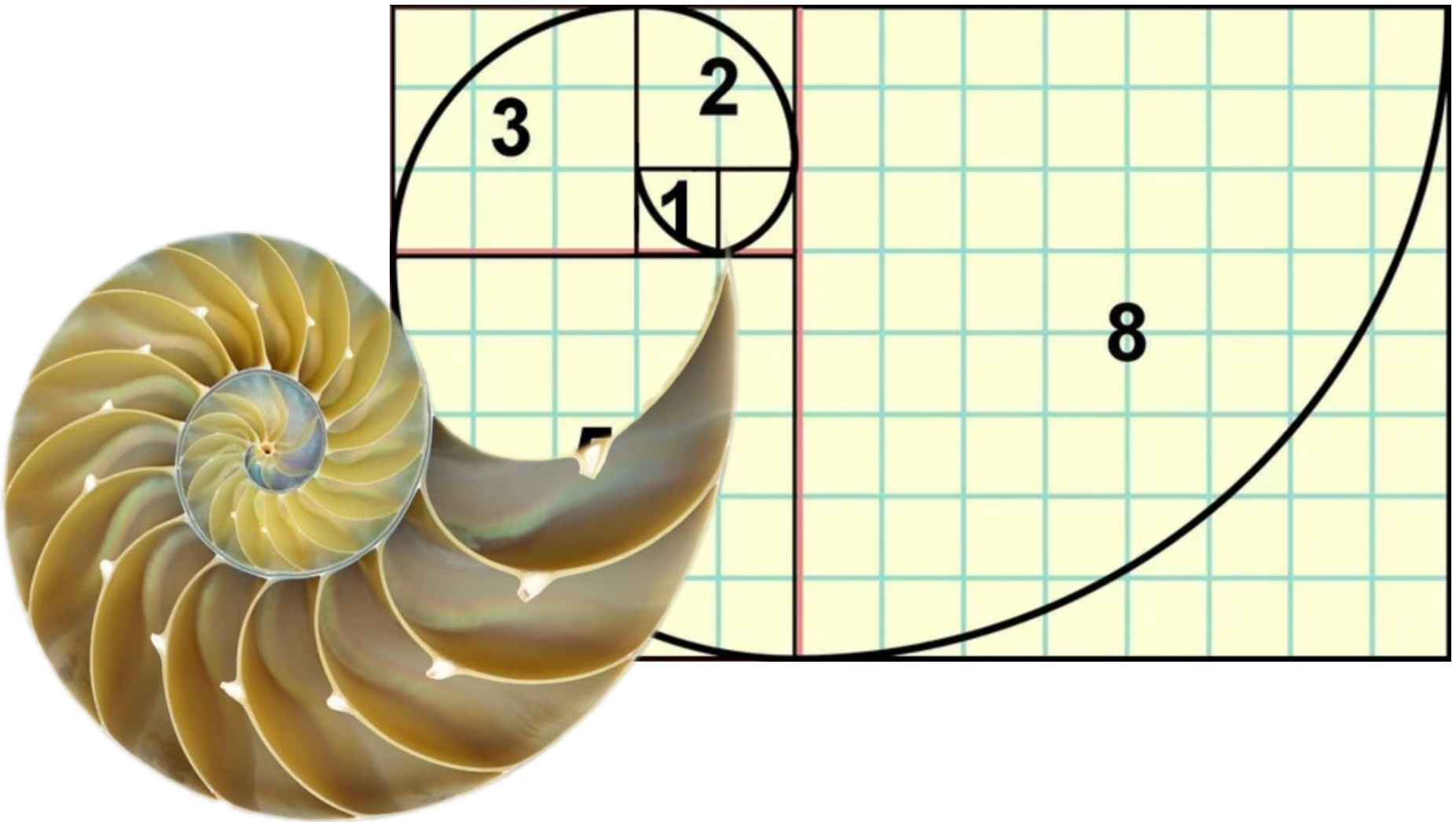

1


2
1


3
2
1


3
2
1
5


3
2
1
8
5


3
2
1
8

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Let's find Fibonacci numbers in Nature

First: the grocery store

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

Fibonacci numbers in Nature

pineapple

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

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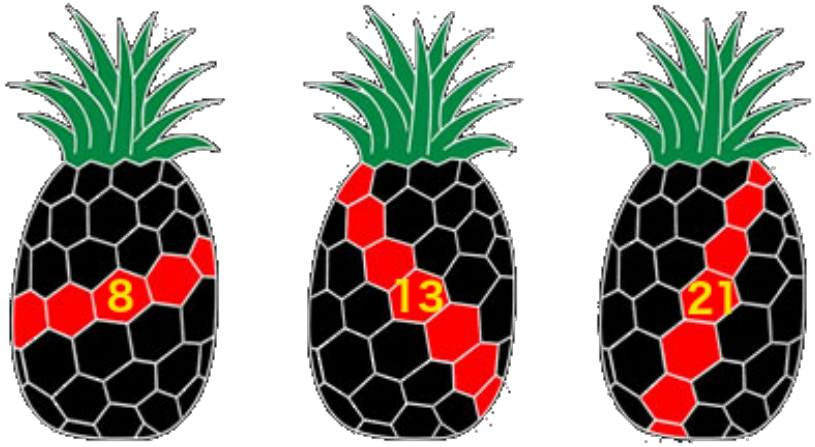
Pineapple

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



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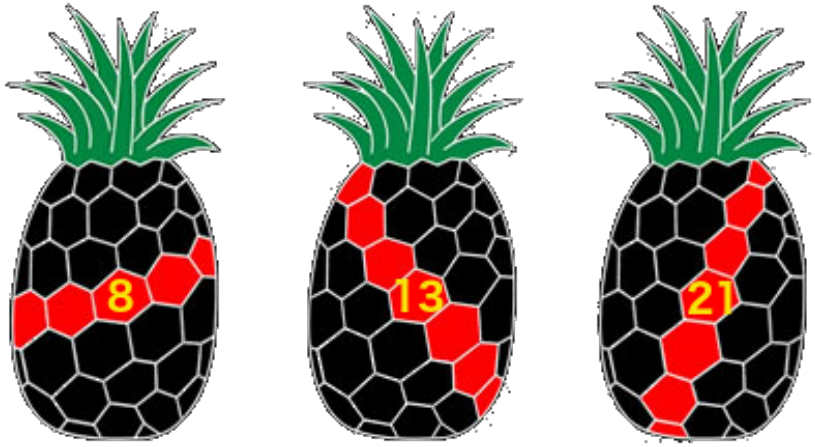
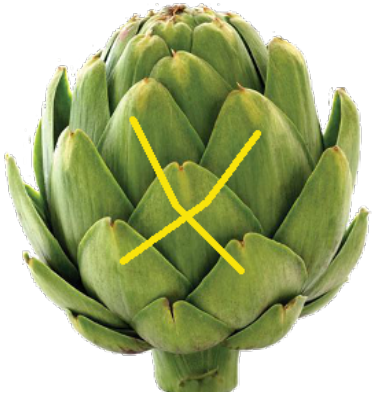
Pineapple

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



Artichoke

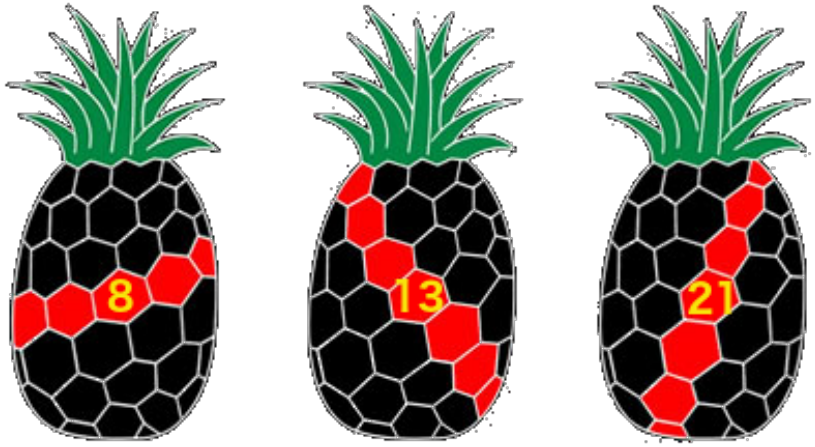
1 1 2 3 5 8 13 21 34 55 . . .



SANTA FE ALLIANCE FOR SCIENCE

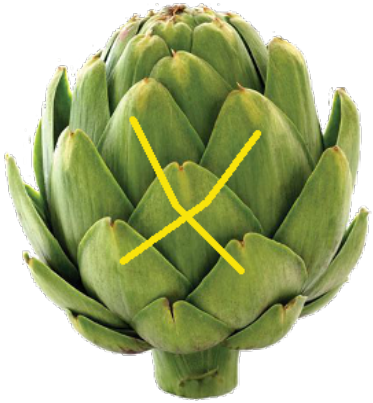
Pineapple

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



Artichoke

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



Asparagus

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

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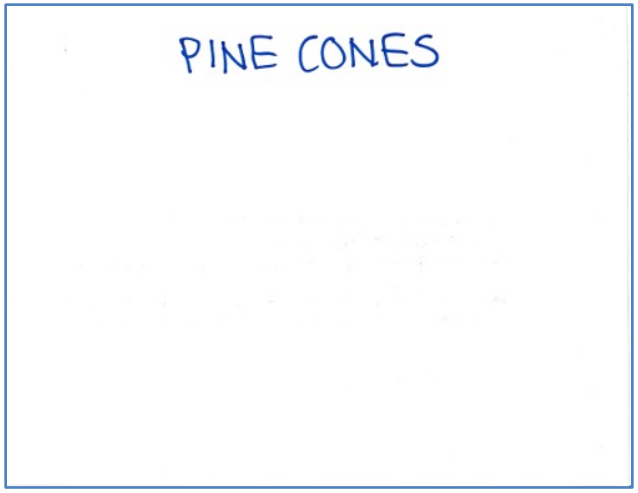
Fibonacci numbers in Nature

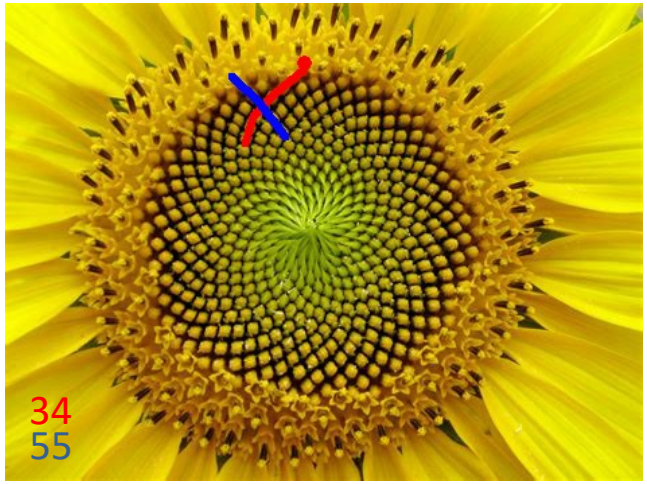
pinecones

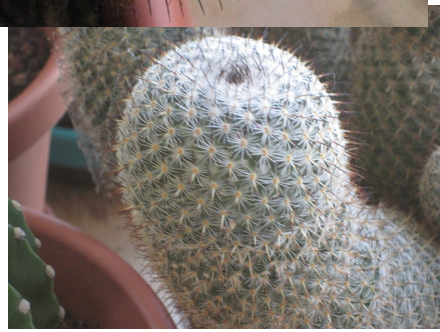
1 1 2 3 5 8 13 21 34 55 . . .

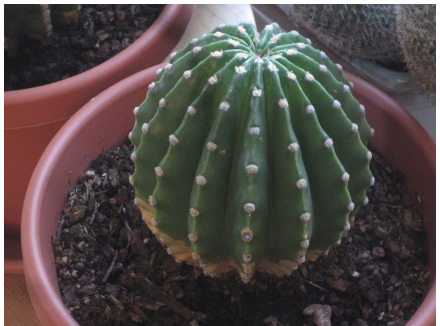
(switch to overhead camera)




8
13


34
55





Part2:
Ratios
Golden Ratio

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

SANTA FE ALLIANCE FOR SCIENCE

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

1/1 = 1

SANTA FE ALLIANCE FOR SCIENCE

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

1/1 = 1
2/1 = 2

SANTA FE ALLIANCE FOR SCIENCE

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

```
1/1   = 1
2/1   = 2
3/2   = 1.5
```

SANTA FE ALLIANCE FOR SCIENCE

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

```
1/1   = 1
2/1   = 2
3/2   = 1.5
5/3   = 1.667
```

SANTA FE ALLIANCE FOR SCIENCE

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

Let's take the ratio between *adjacent* pairs of Fibonacci numbers

next to each other

```
1/1   = 1
2/1   = 2
3/2   = 1.5
5/3   = 1.667
8/5   = 1.600
13/8  = 1.625
21/13 = 1.615
34/21 = 1.619
      etc…
```

… so what do you think is the next number?

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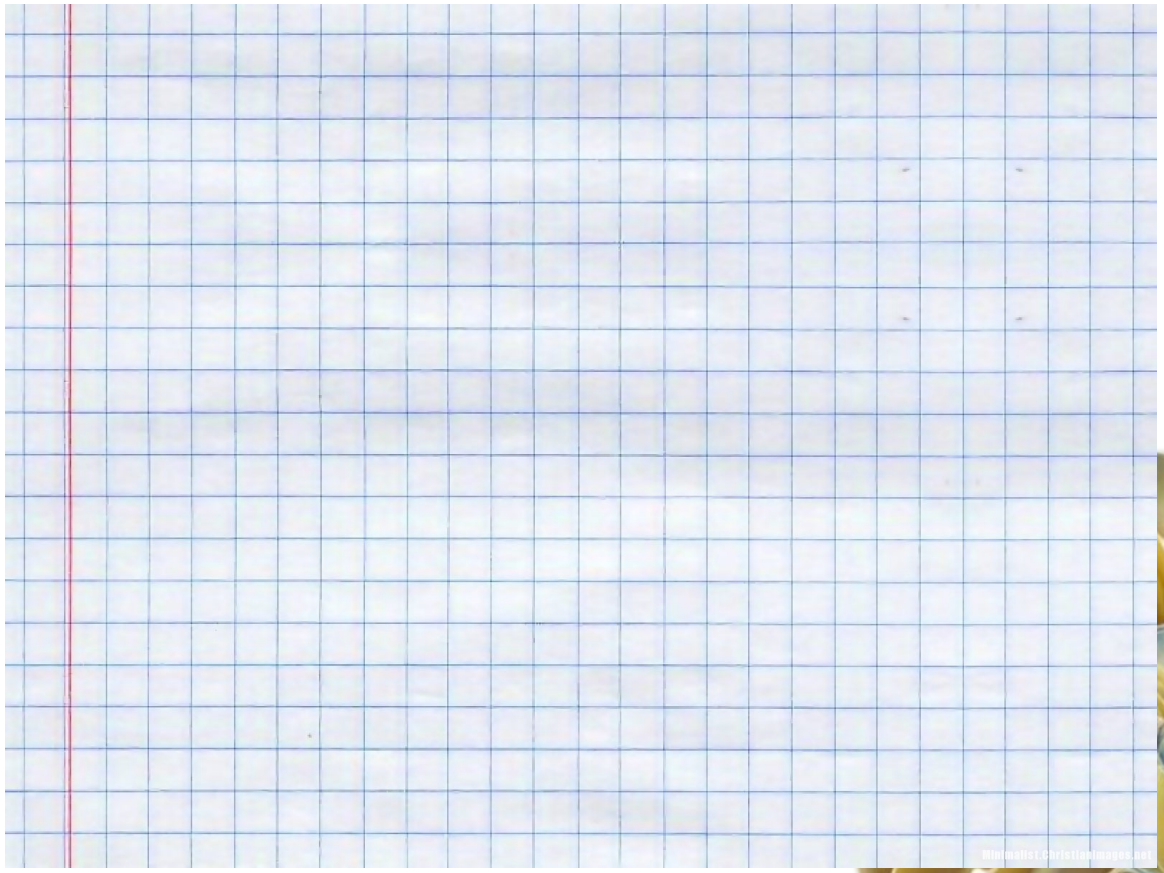
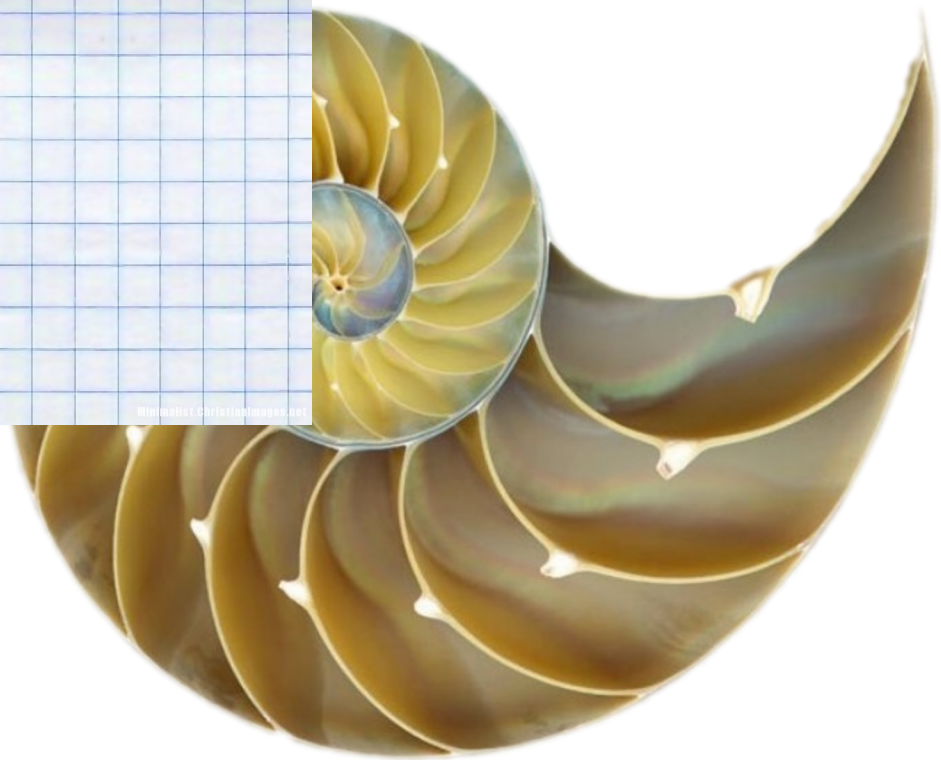
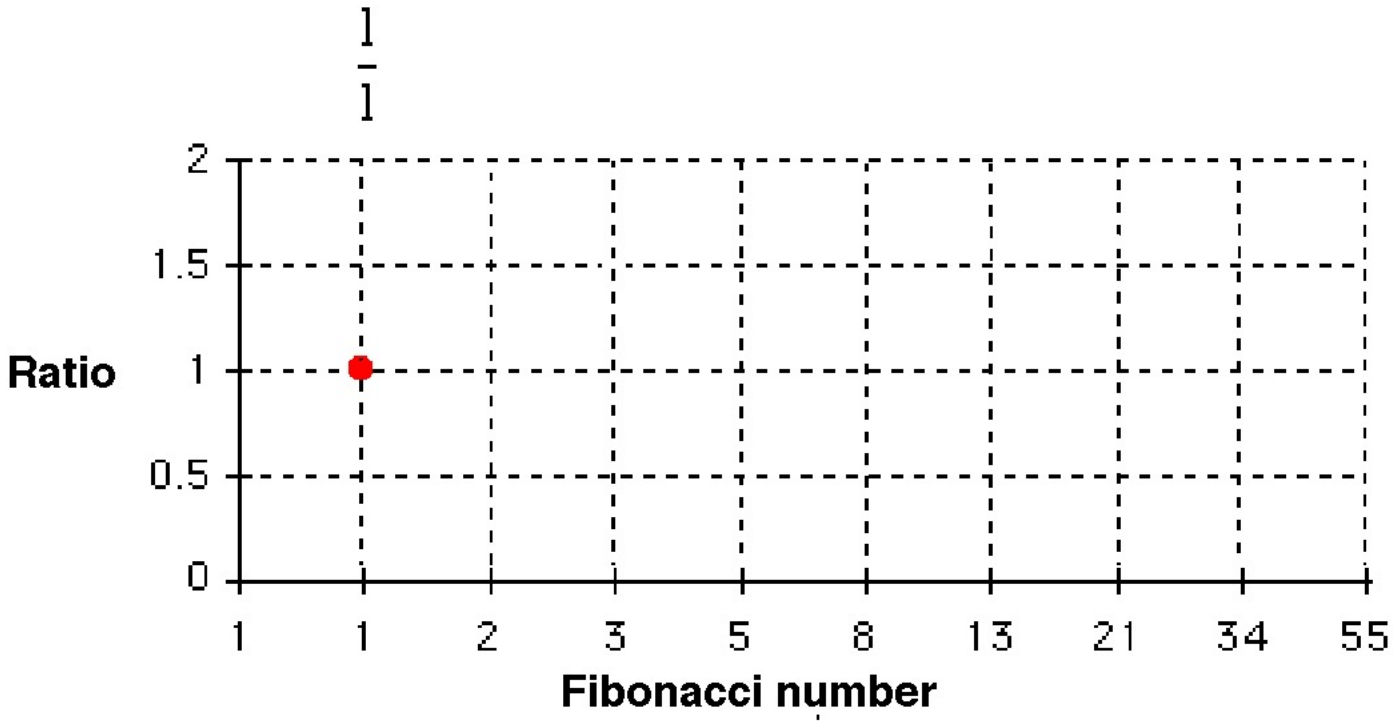
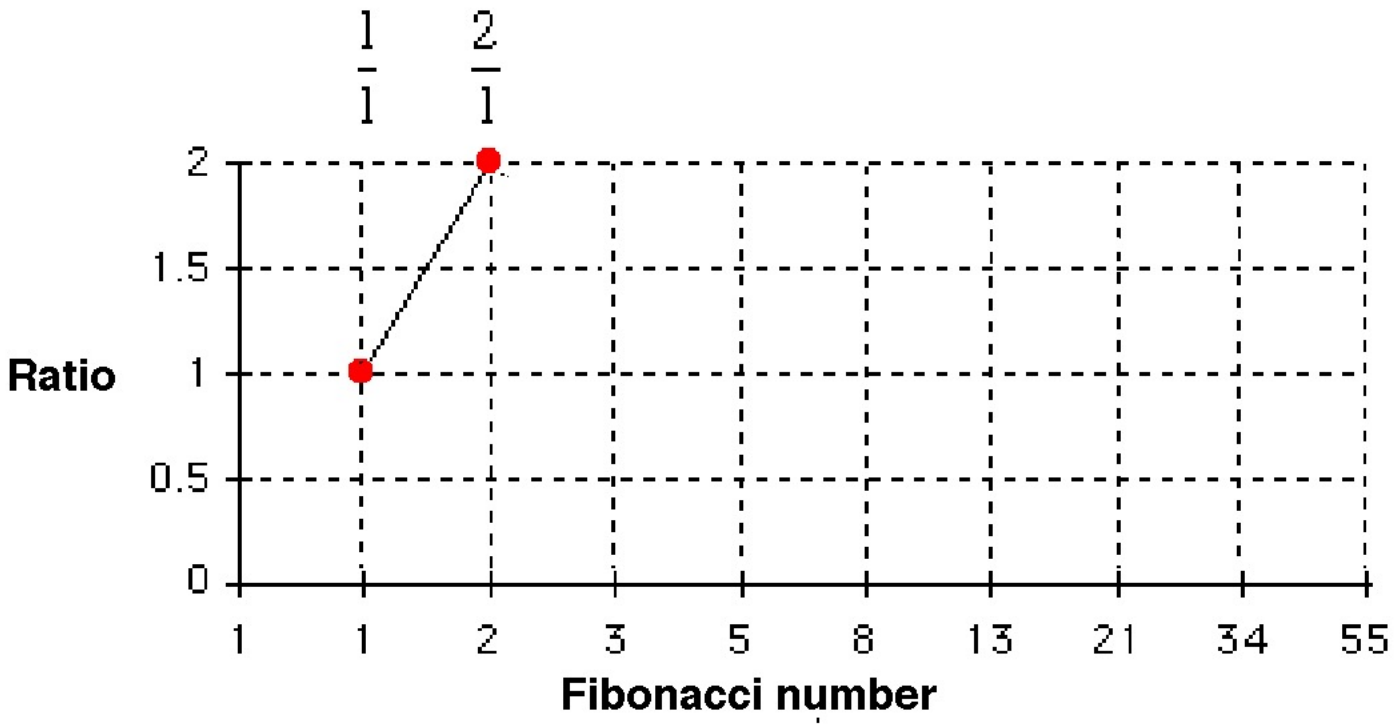
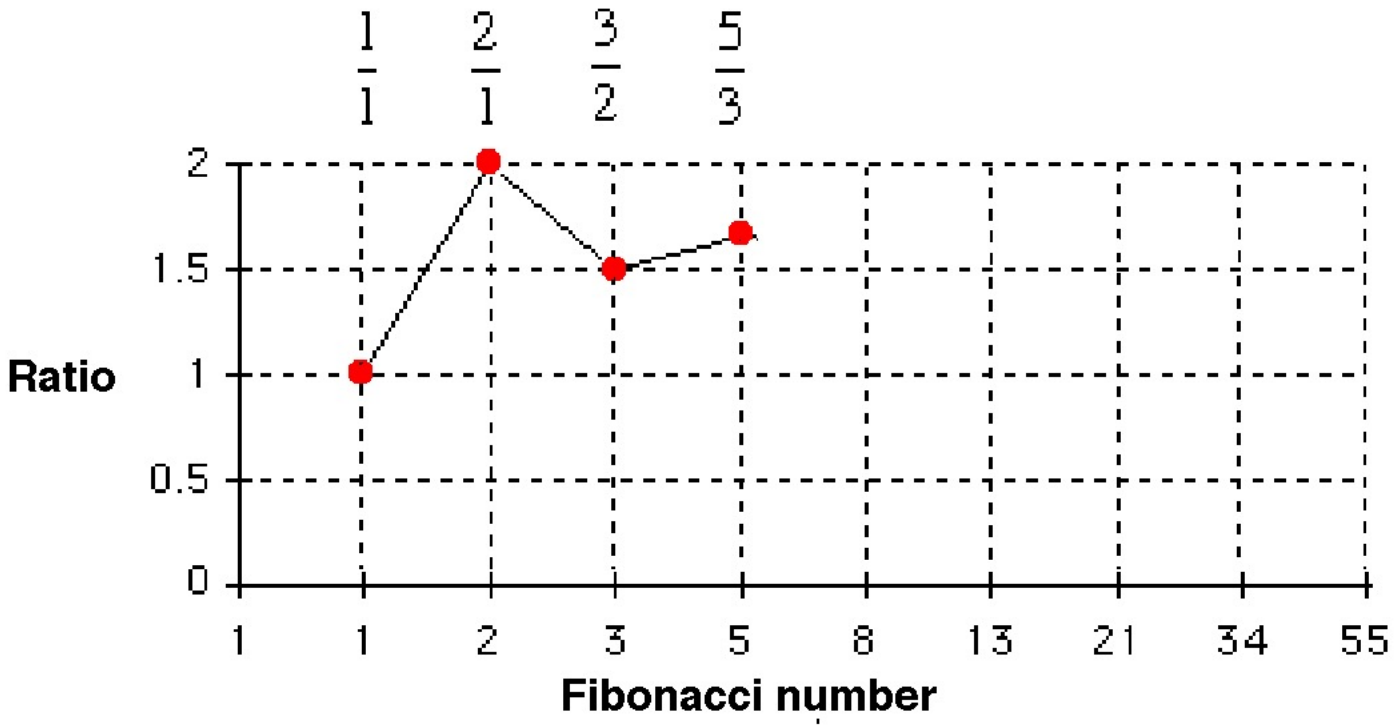
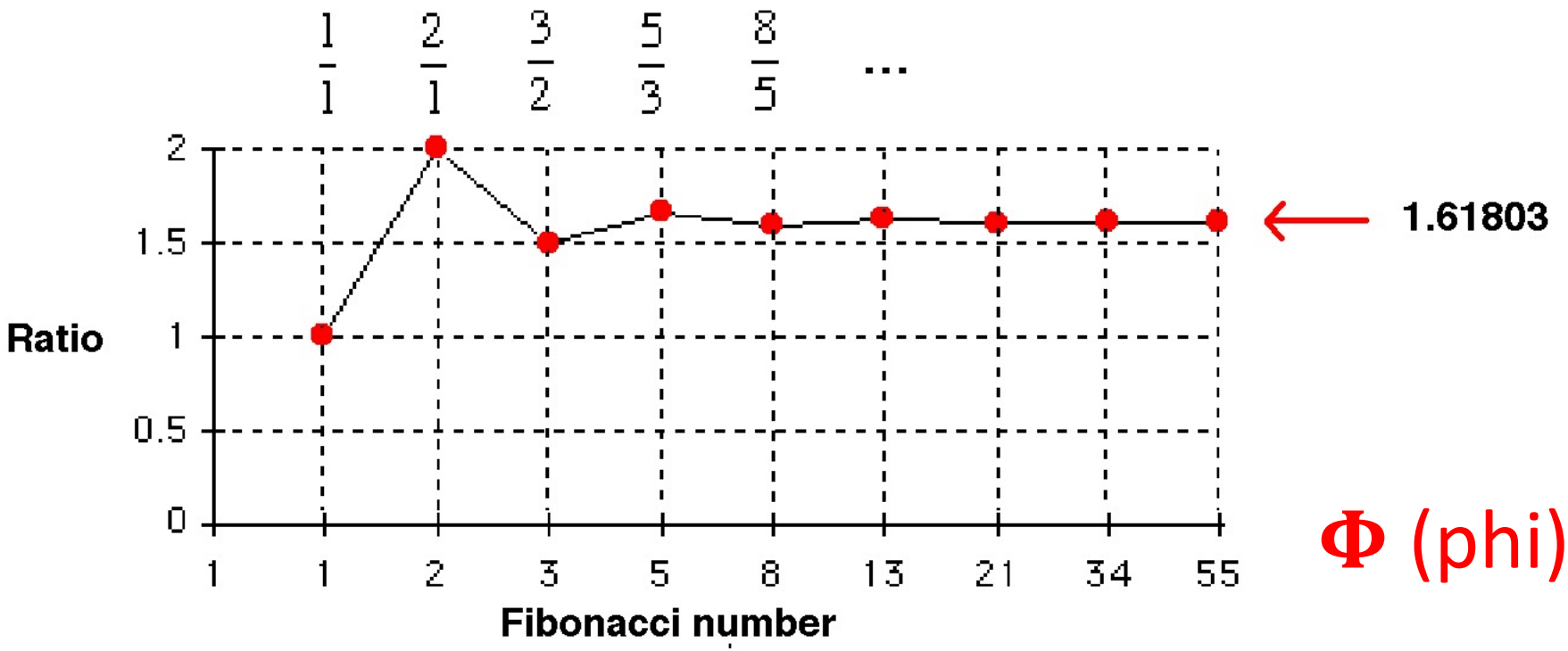




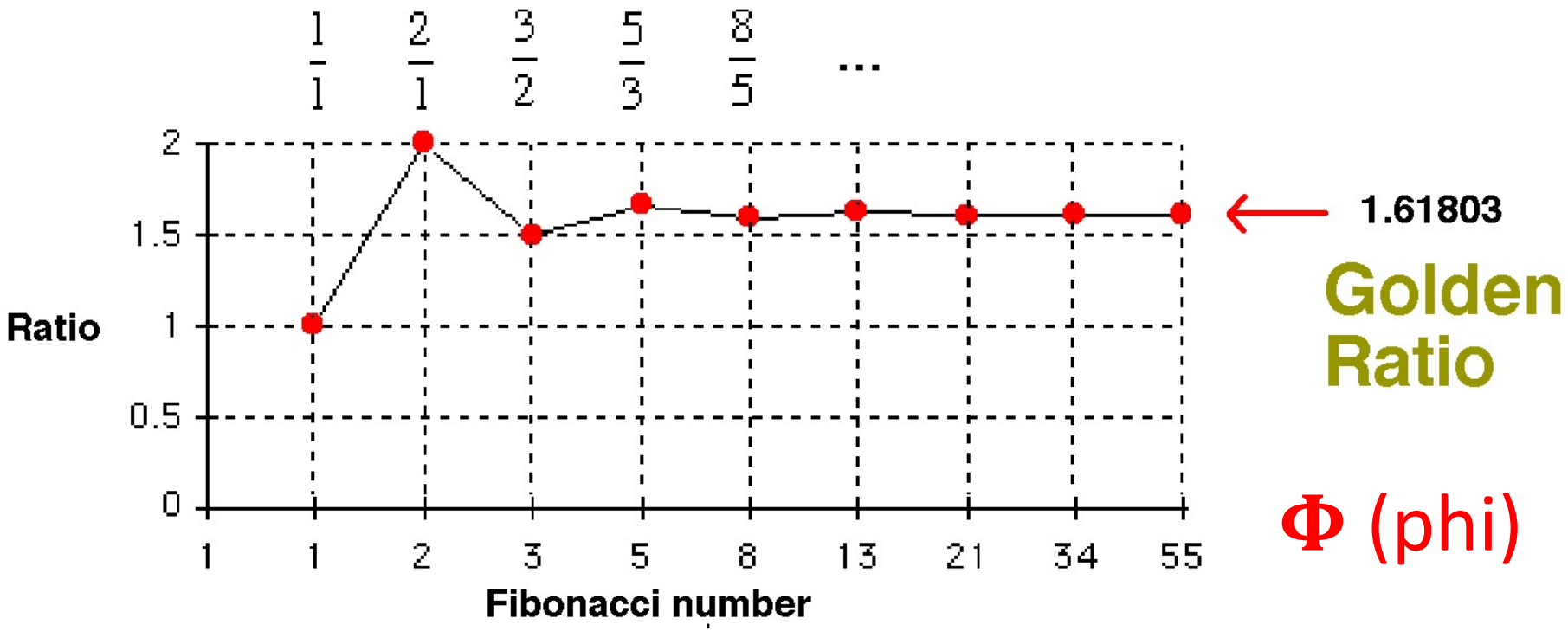

1/1
2
1.5
1
0.5
0
Ratio
1
1
2
3
5
8
13
21
34
55
Fibonacci number


1/1
2/1
2
1.5
1
0.5
0
Ratio
1
1
2
3
5
8
13
21
34
55
Fibonacci number


1/1
2/1
3/2
5/3
2
1.5
1
0.5
0
Ratio
1
1
2
3
5
8
13
21
34
55
Fibonacci number


1/1
2/1
3/2
5/3
8/5
...
2
1.5
1
0.5
0
Ratio
1
1
2
3
5
8
13
21
34
55
Fibonacci number
1.61803

Φ (phi)



So why is this ratio interesting?

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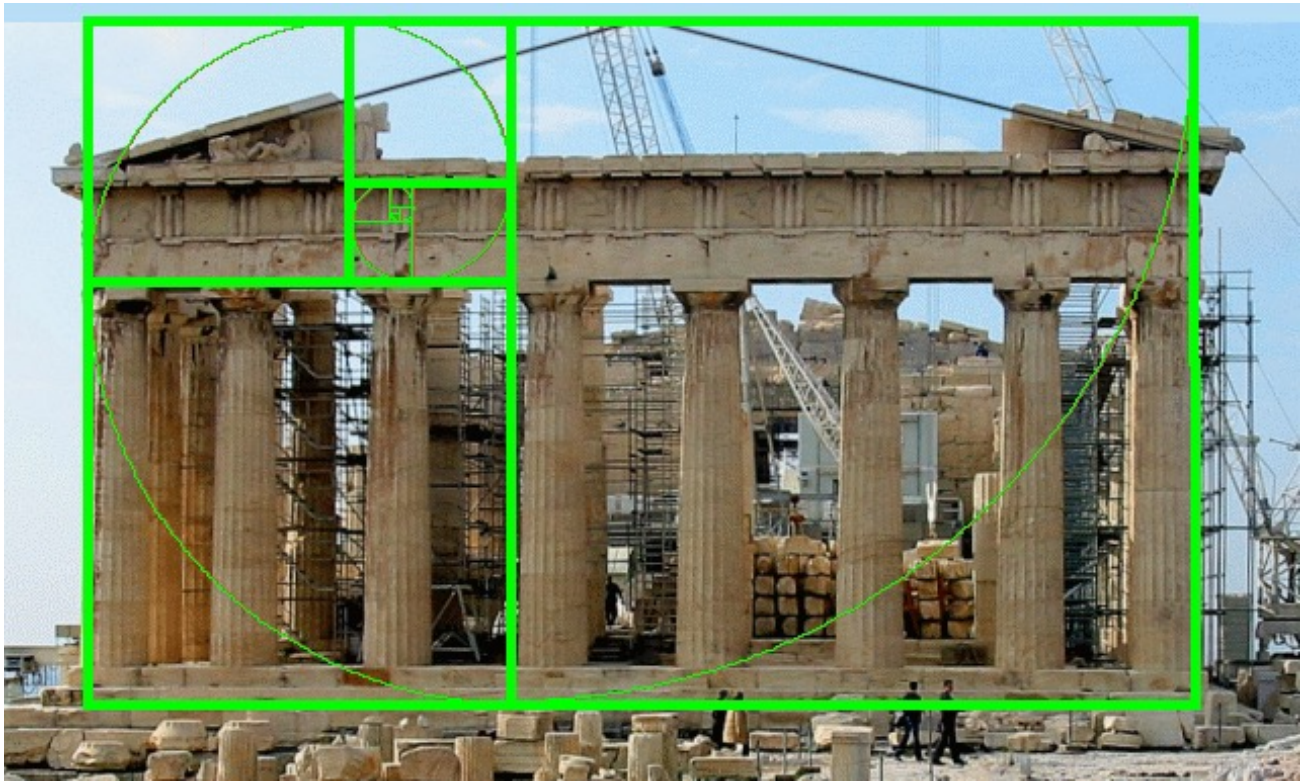
2000 years ago, The Greeks and the Romans

used this ratio to design some of their buildings.

They believed that this ratio led to the most pleasing shapes



The width of this temple
divided by
the height of this temple

is equal to the Golden Ratio, 1.618

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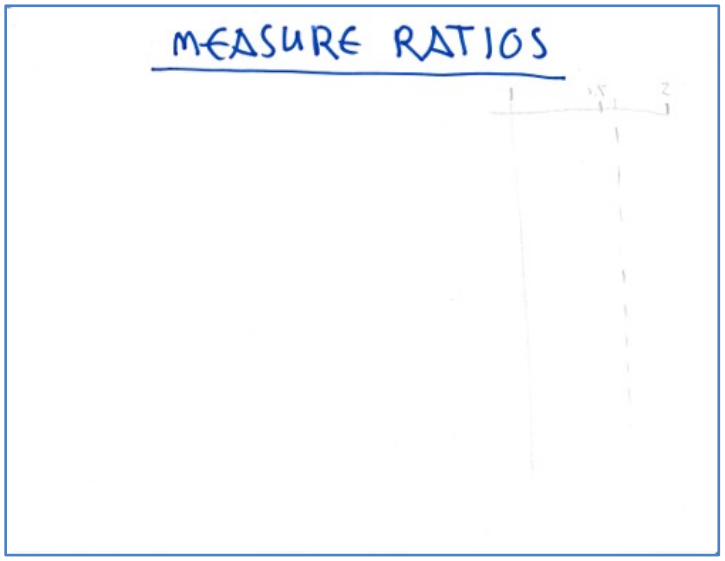
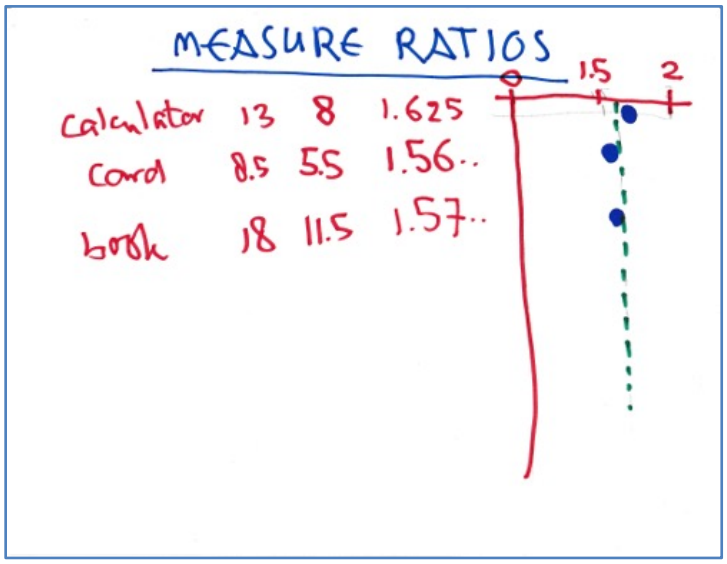
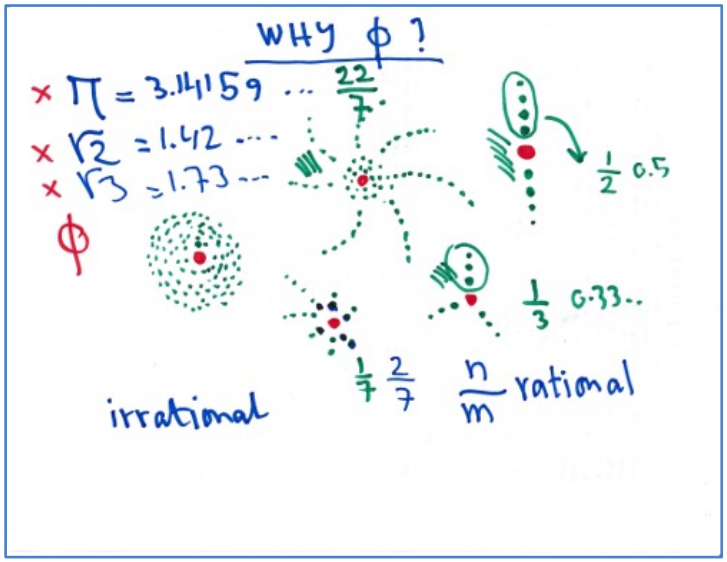
ACTIVITY!

Get out a ruler, a meter stick or a tape measure

(switch to overhead camera)







Part 3:
Number systems

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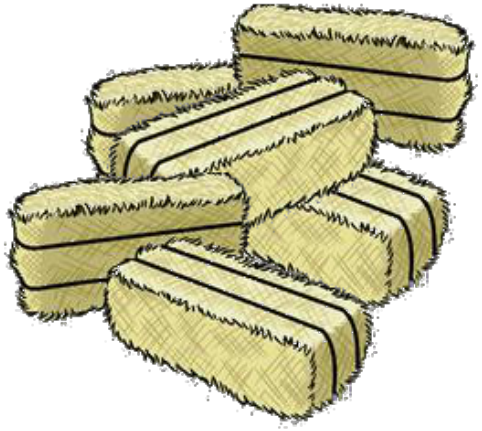
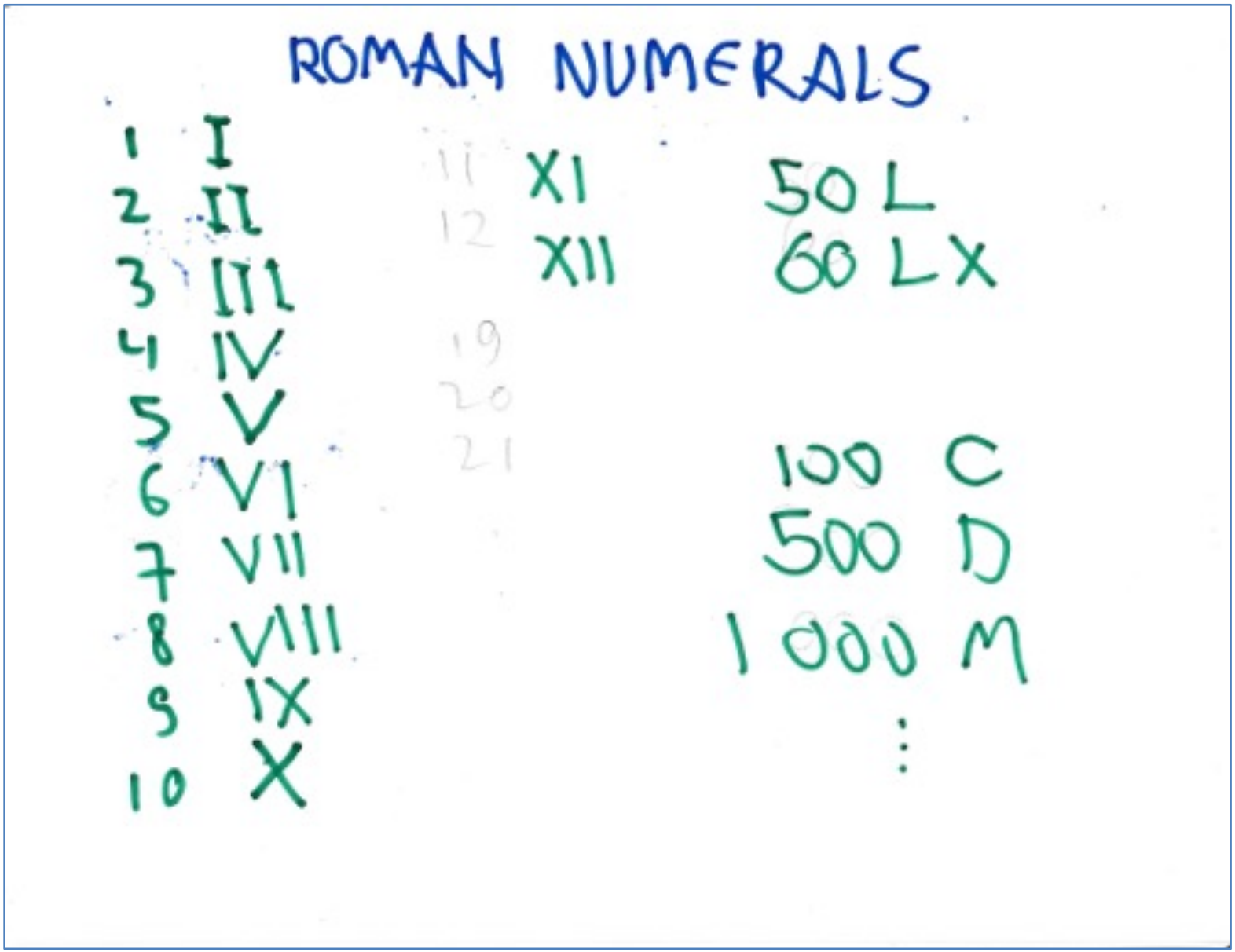
bottles of olive oil

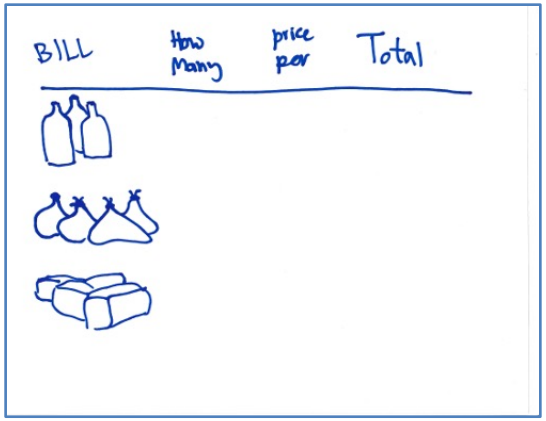
sacks of grain

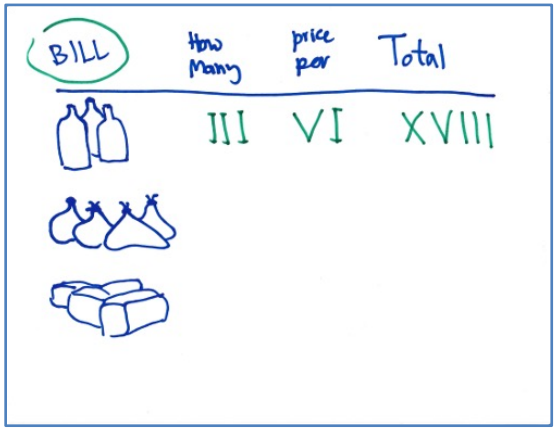
bales of hay

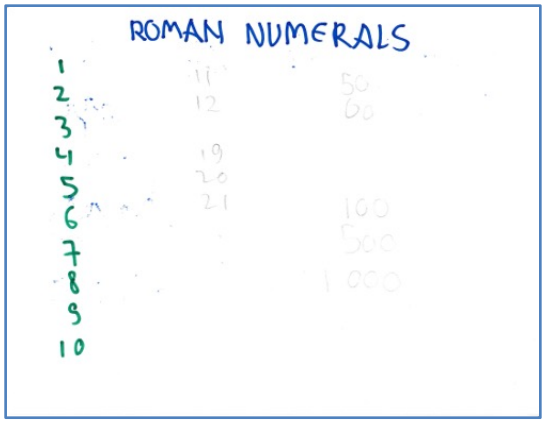


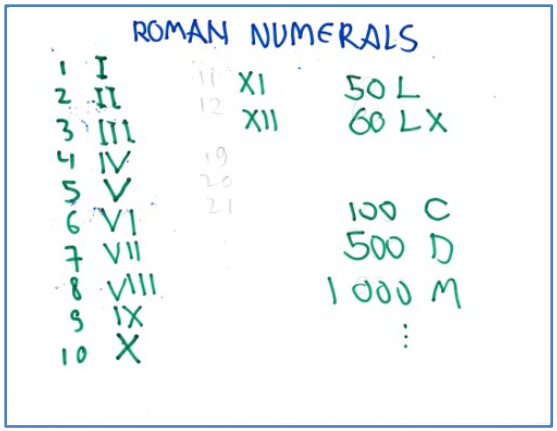

ROMAN NUMERALS
1 I
2 II
3 III
4 IV
5 V
6 VI
7 VII
8 VIII
9 IX
10 X
11 XI
12 XII
50 L
60 LX
100 C
500 D
1000 M

(switch to overhead camera)









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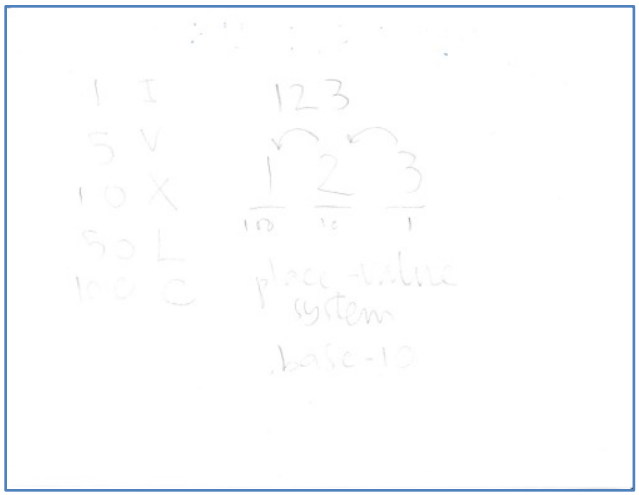
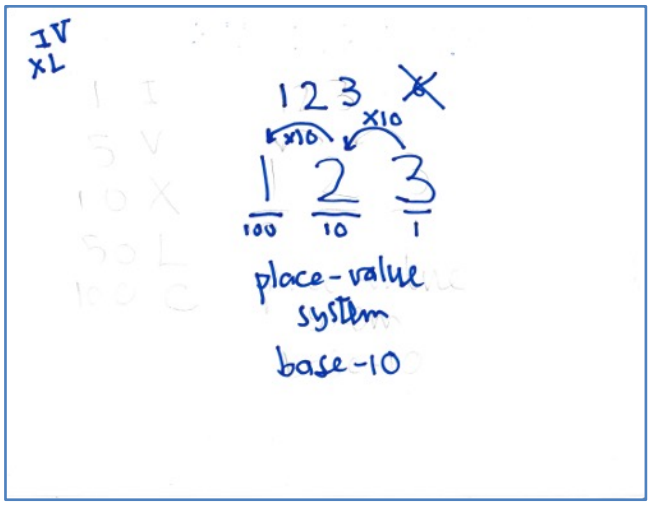
SANTA FE ALLIANCE FOR SCIENCE

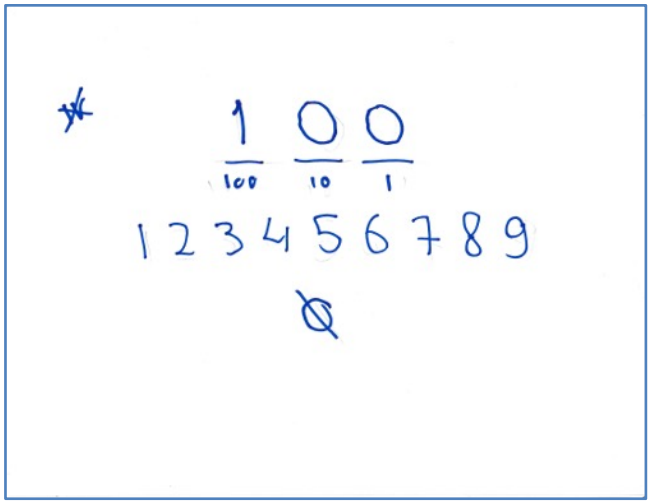
ALGIERS

SANTA FE ALLIANCE FOR SCIENCE

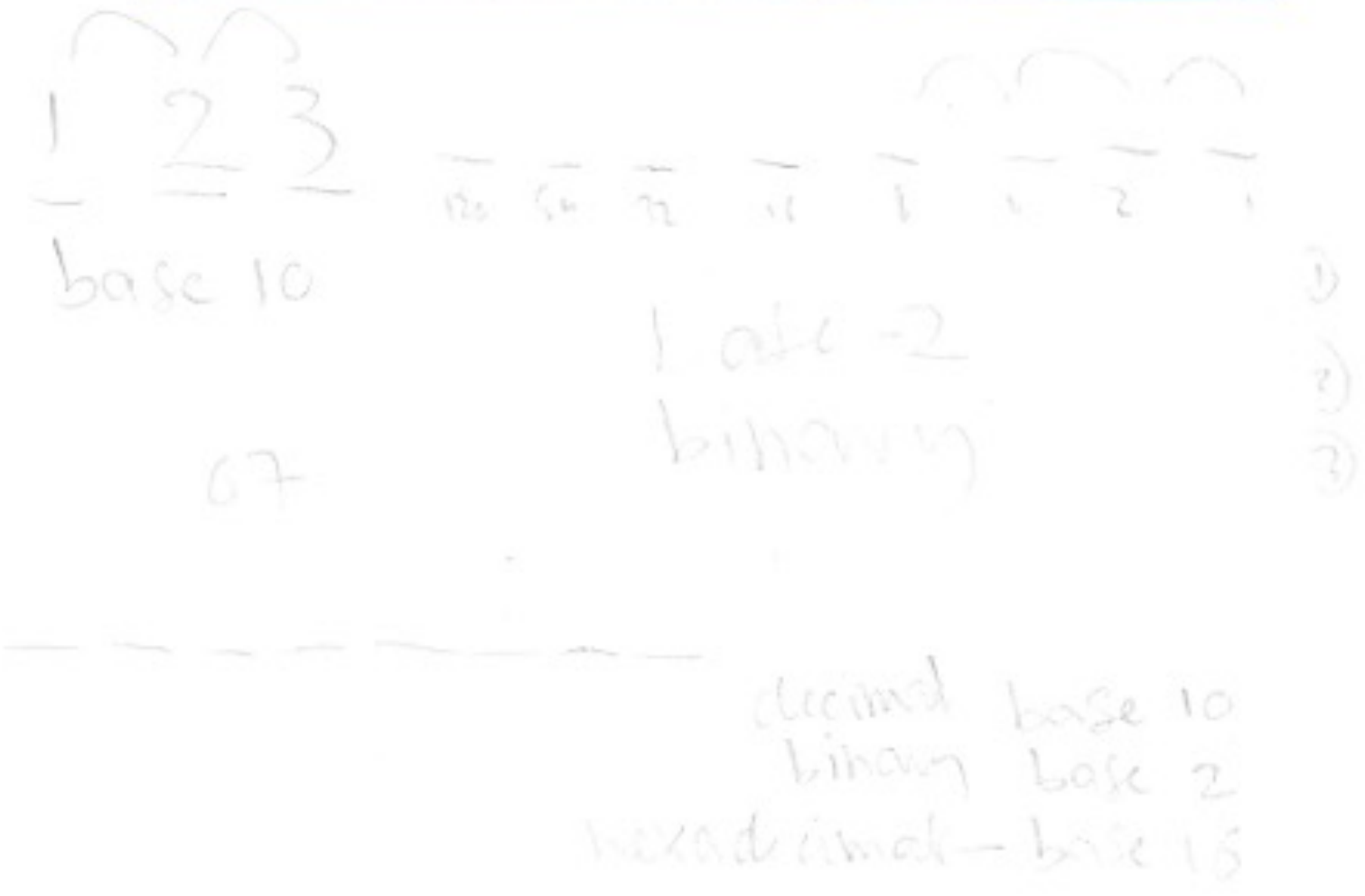
(switch to overhead camera)







OTHER NUMBER SYSTEMS




MONEY!
$ 1.27
THE UNITED STATES OF AMERICA
ONE DOLLAR

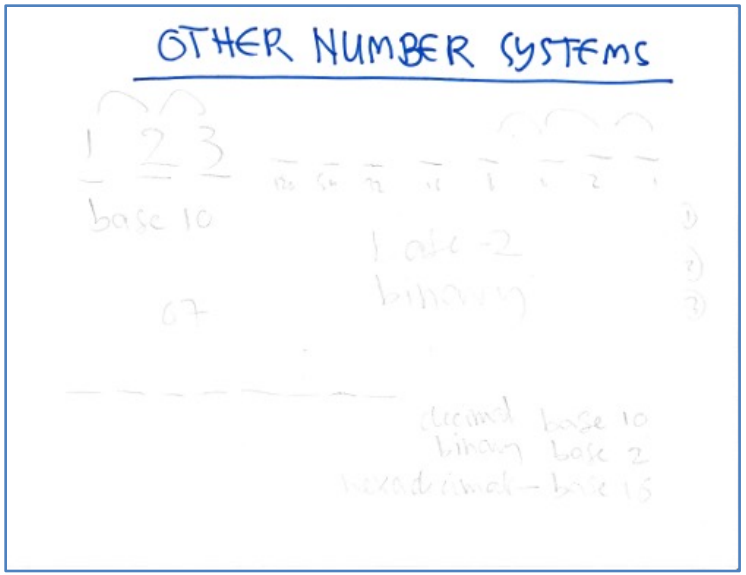

MONEY!
$ 1.27
THE UNITED STATES OF AMERICA
ONE DOLLAR
C X X

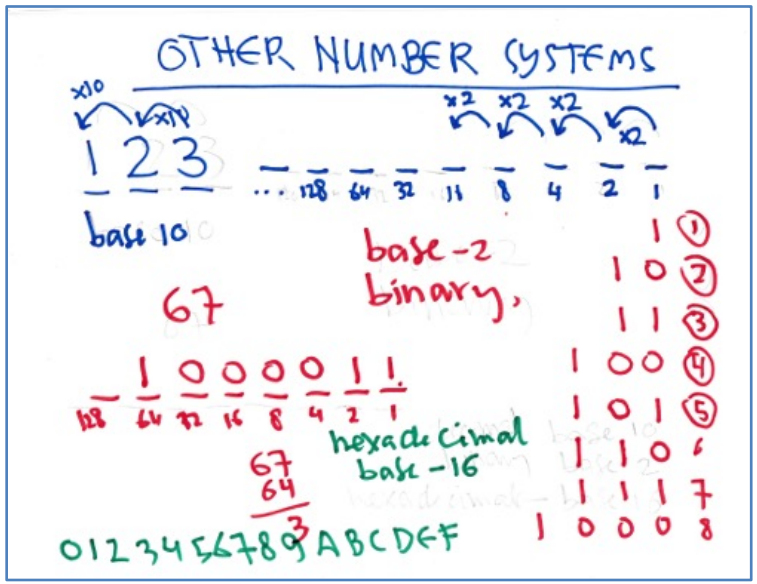
MONEY!

$1.27

CXXVII

(switch to overhead camera)





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Where can you find Roman numerals?

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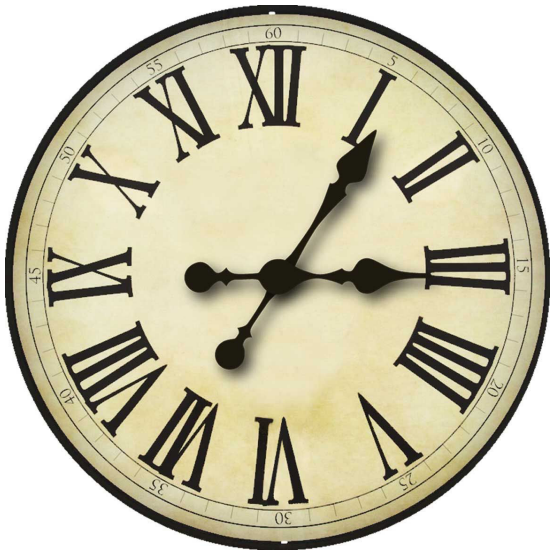
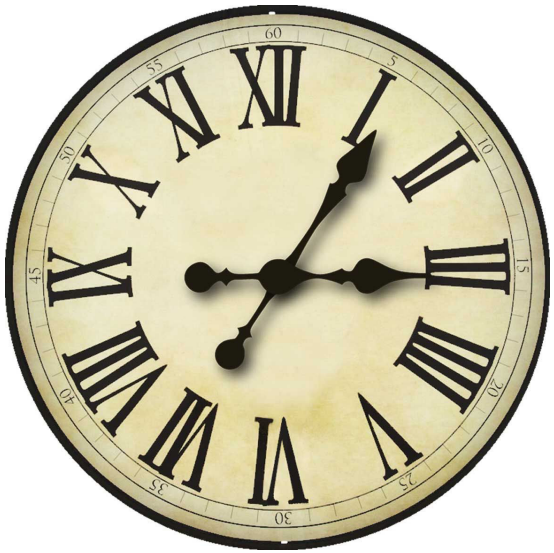
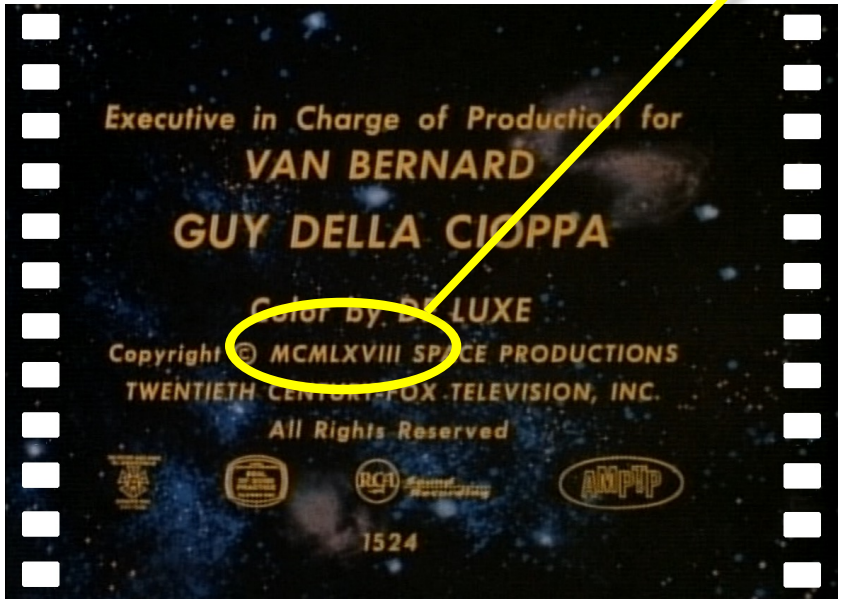
Where can you find Roman numerals?



SANTA FE ALLIANCE FOR SCIENCE

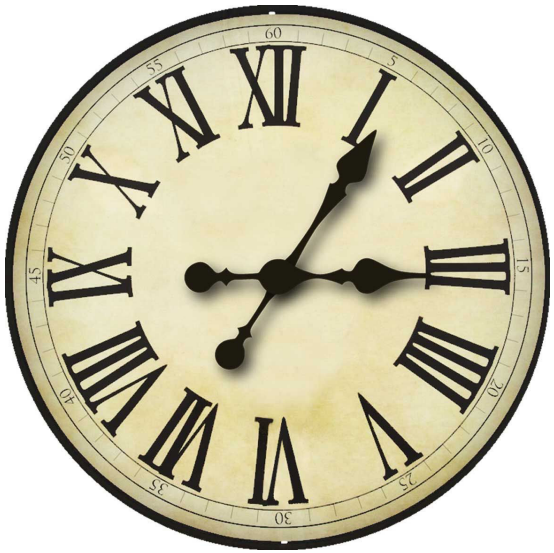
Where can you find Roman numerals?





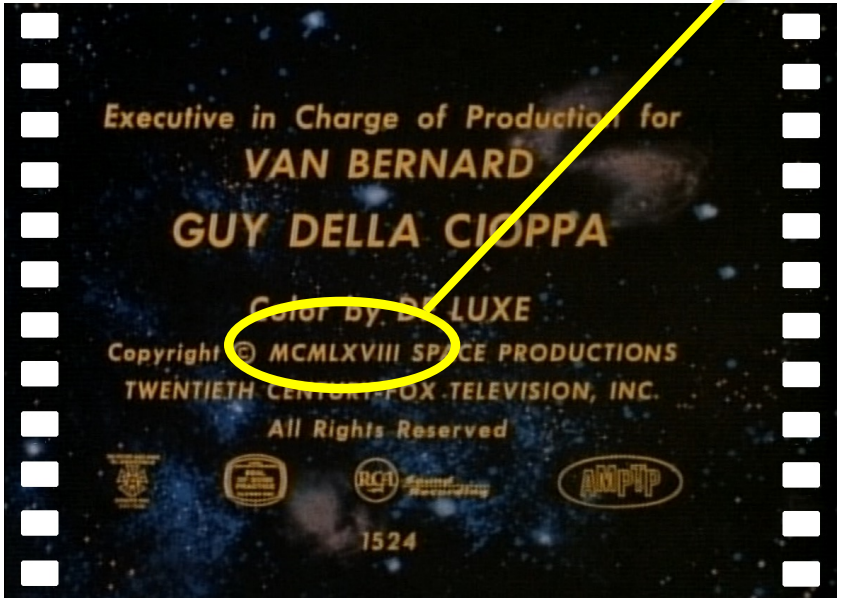
SANTA FE ALLIANCE FOR SCIENCE

Where can you find Roman numerals?



1000
1000
-100
50
10
5
3

1968

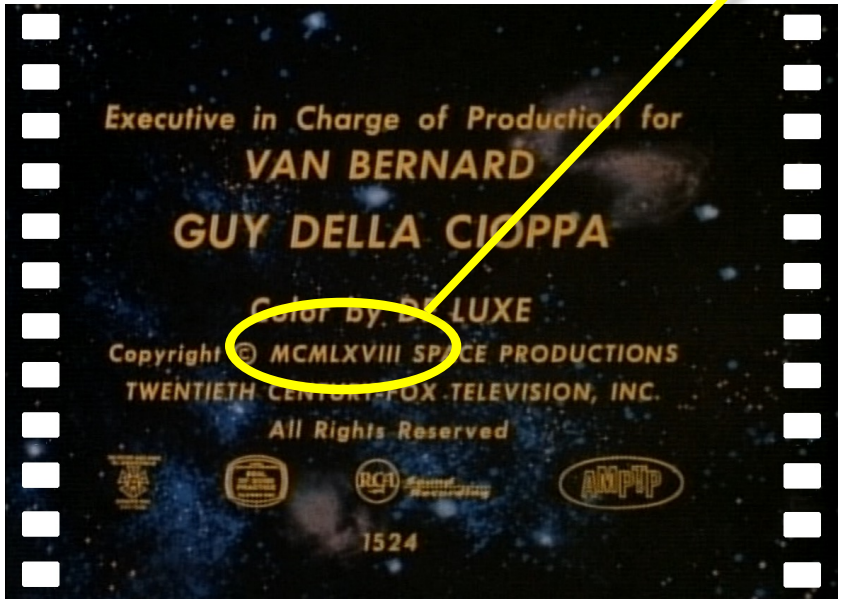


SANTA FE ALLIANCE FOR SCIENCE

Where can you find Roman numerals?

1000
1000
-100
50
10
5
3

1968



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MCMLXVIII	Roman
1968	Arabic
11110110000	Binary

Φ (phi) = 1.61803…

1 1 2 3 5 8 13 21 34 55 …