# SECRETS OF MATH

## From basic calculations to complex theorems


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&
MATH LAB


presents


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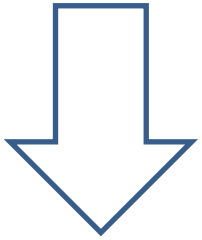
- MEASUREMENT OF THE UNIVERSE
- WHERE CAN WE FIND MATH?
  - 1. PLANTS
  - 2. SHELLS
  - 3. LOOK AROUND
- INTERESTING THINGS ABOUT MATHEMATICS

Please raise your hand if you cannot hear me



**THIS PHRASE IS A PARADOX**

# LOGICAL PARADOX

## WHAT I AM SAYING RIGHT NOW IS A LIE.

## 1. THE STATEMENT BELOW IS FALSE.

## 2. THE STATEMENT ABOVE IS TRUE.

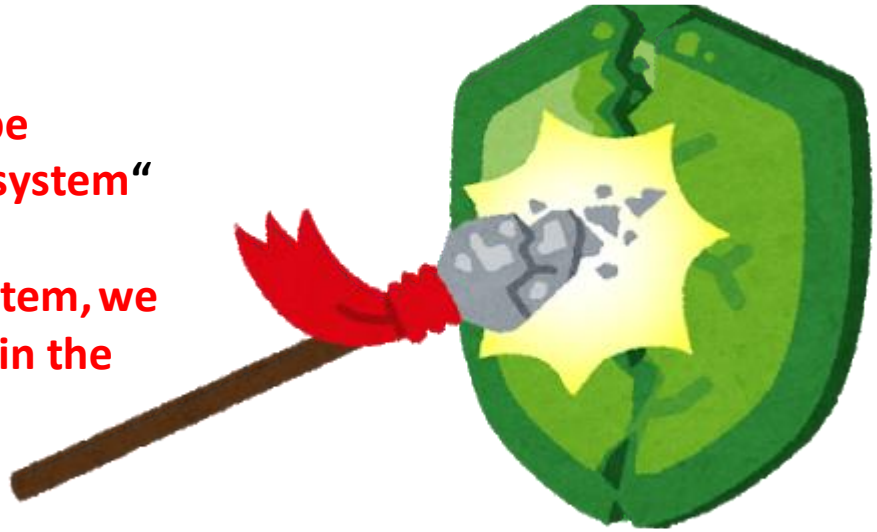
### Gödel's incompleteness theorem

**First imperfection principle**

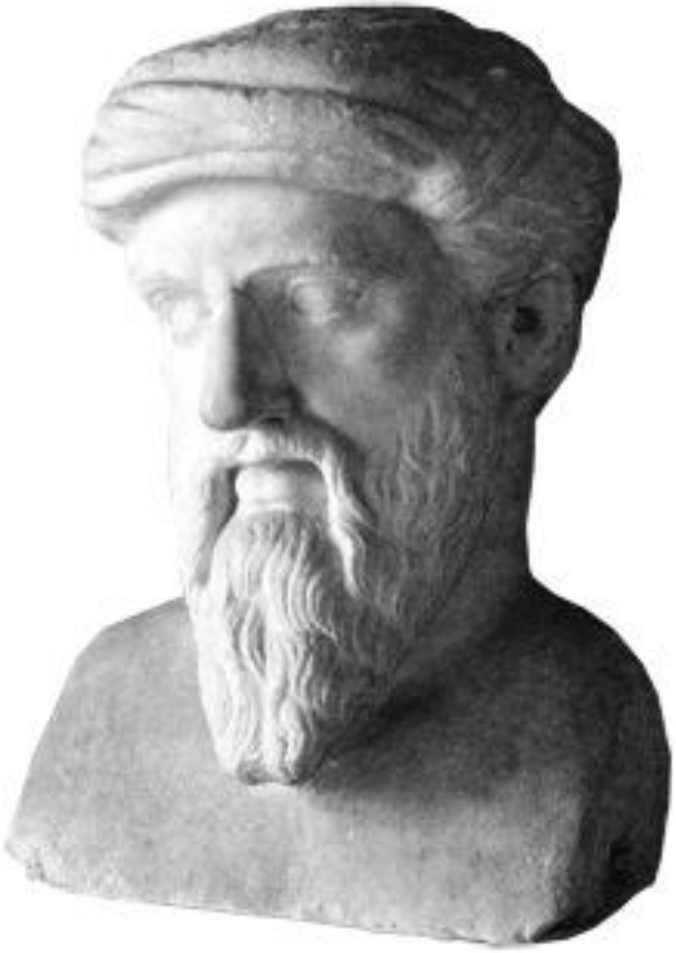
**"There is always a proof proposition that cannot be affirmed or denied in a contradiction-free theory system"**

**Second imperfection principle**

**"Even if there is no contradiction in the theory system, we cannot prove that the theory system is consistent in the theory system itself"**



A paradox is a statement that, despite apparently sound reasoning from true premises, leads to an apparently-self-contradictory or logically unacceptable conclusion.
Some paradoxes have revealed errors in definitions assumed to be rigorous, and have caused axioms of mathematics and logic to be re-examined.



# WHO IS THIS?

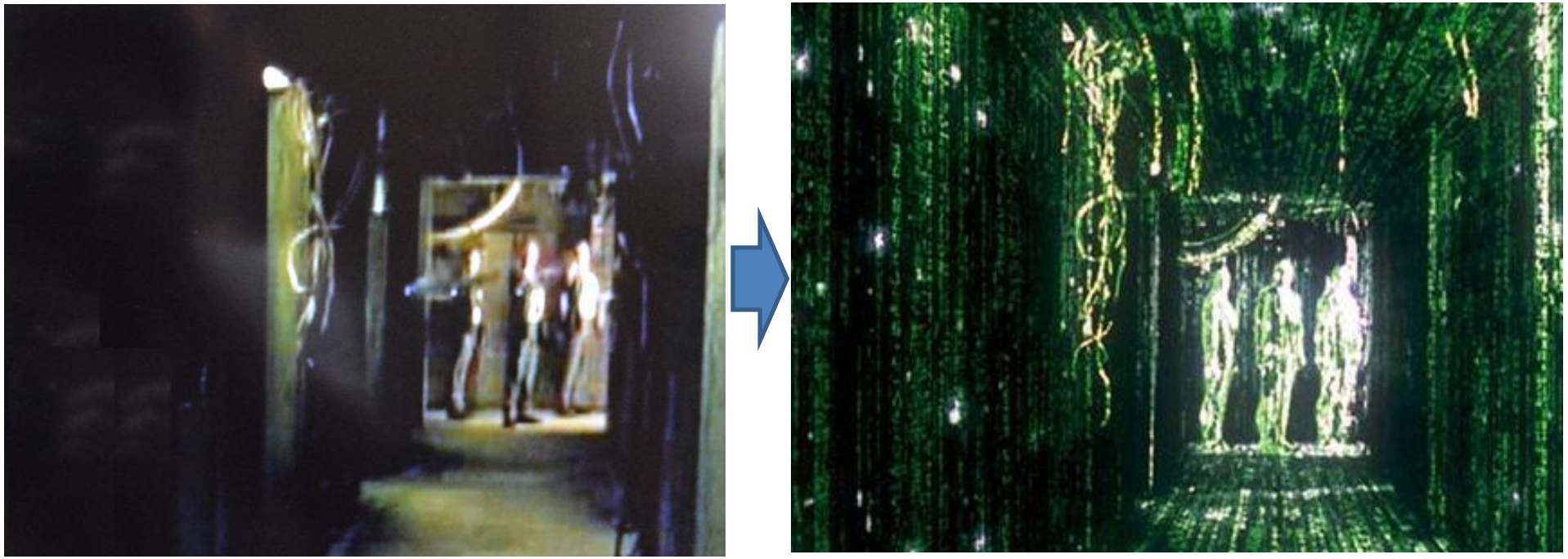
This is PYTHAGORAS.

Ancient Greek Mathematician.
B.C. 582 – B.C. 496

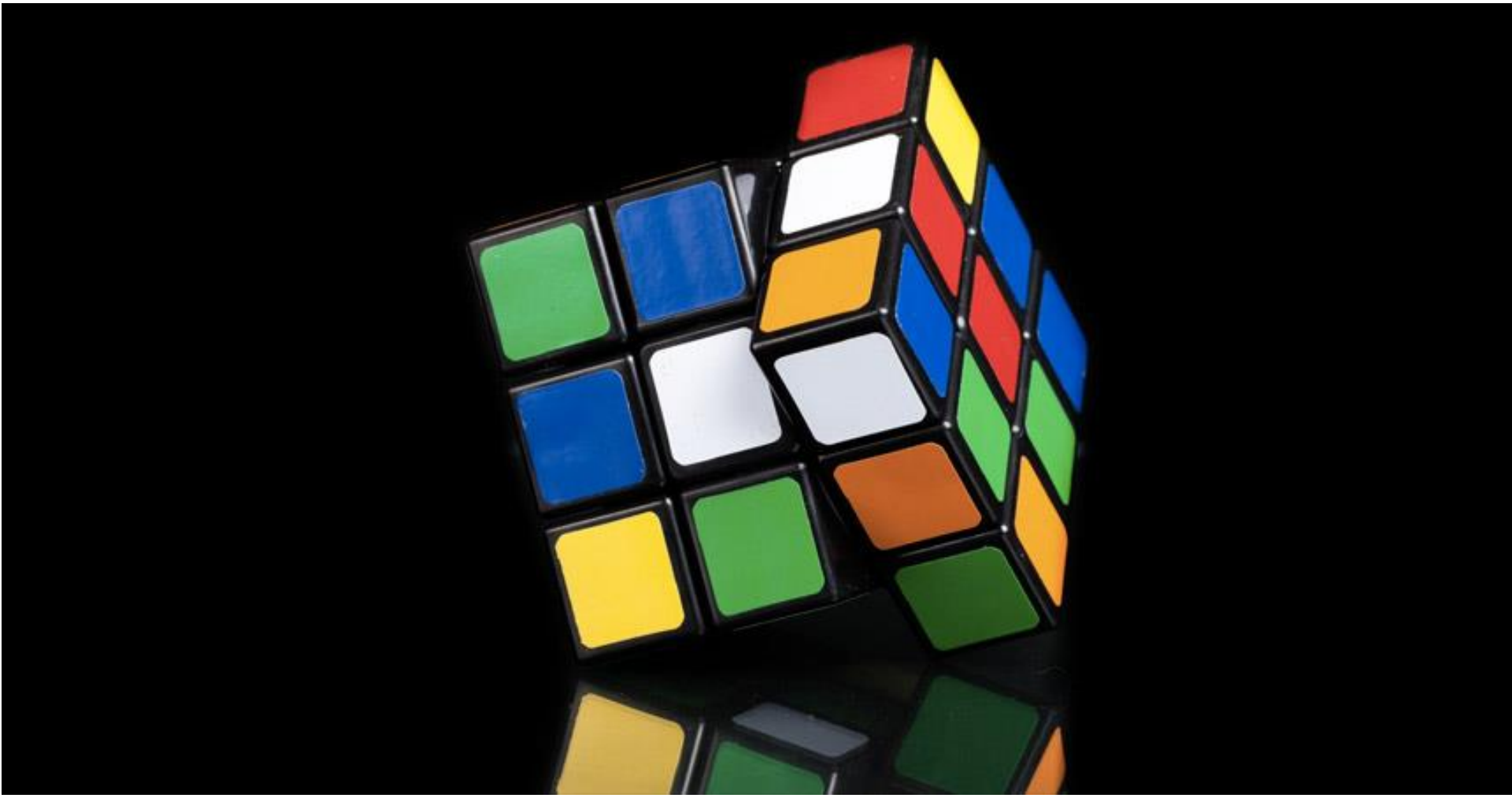
$$a^2 + b^2 = c^2$$

Pythagoras once said,
"NUMBERS RULE THE UNIVERSE".
Every phenomenon and objects can be converted into languages called,

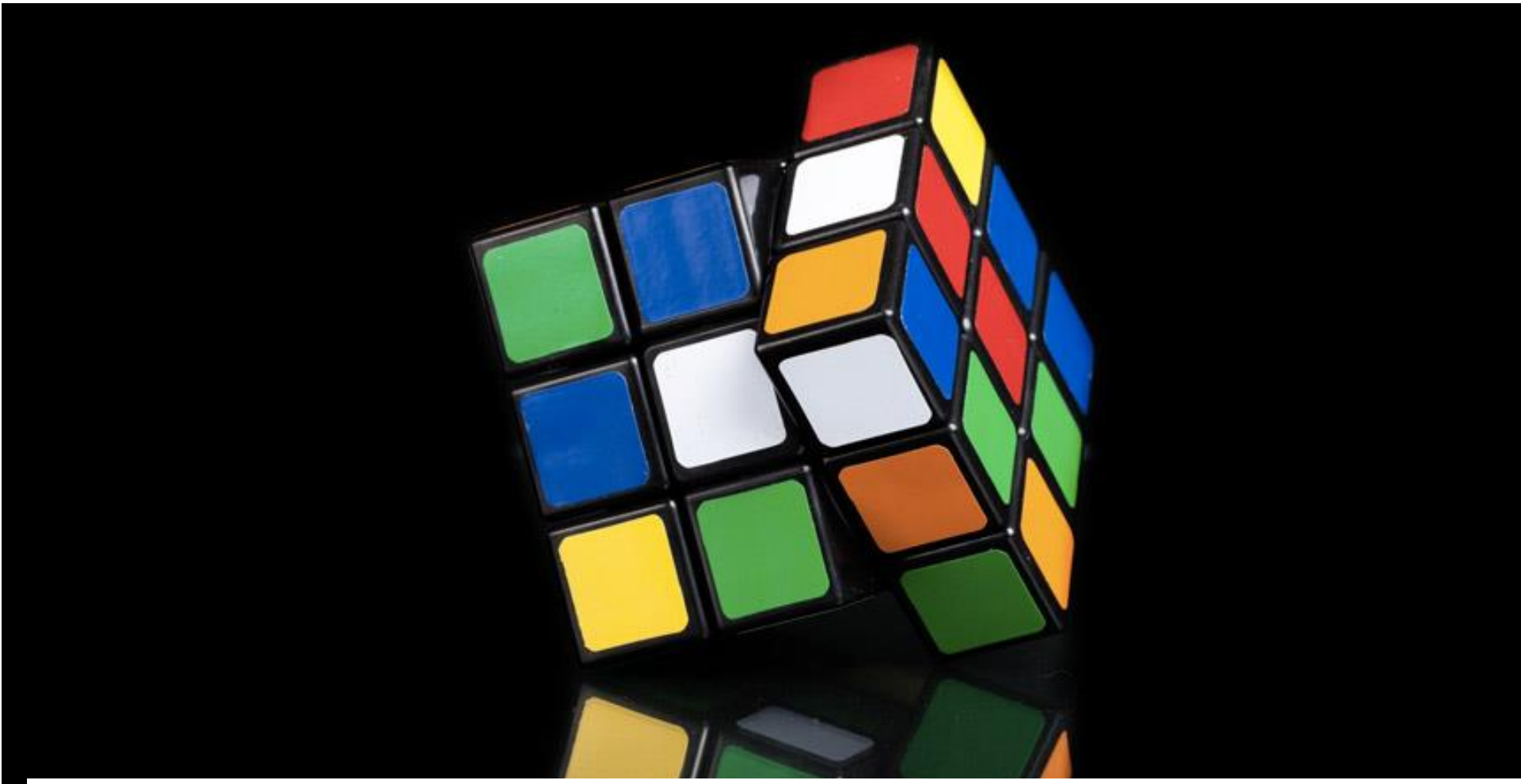
# MATH



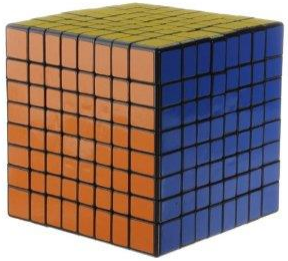
From the movie "The Matrix"



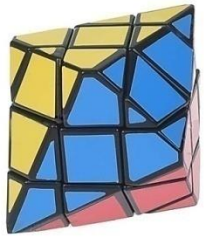
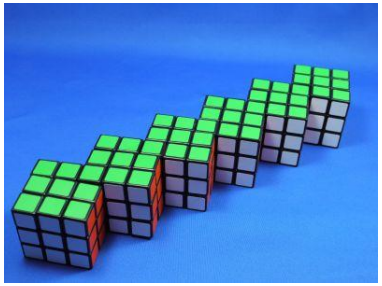
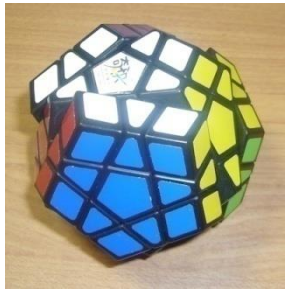
# RUBIK’S CUBE



**APPROXIMATELY 43,252,003,274,489,856,000 POSSIBILITIES!!!!!!!!!**

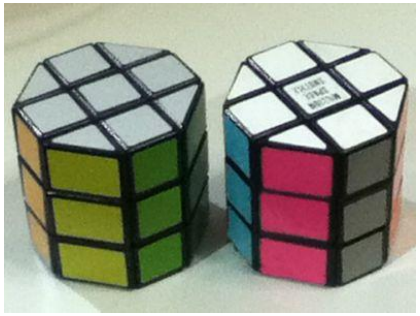










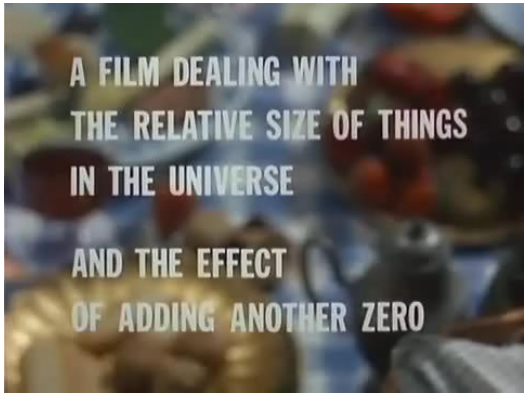
Curvy Starminx

# ORIGAMI

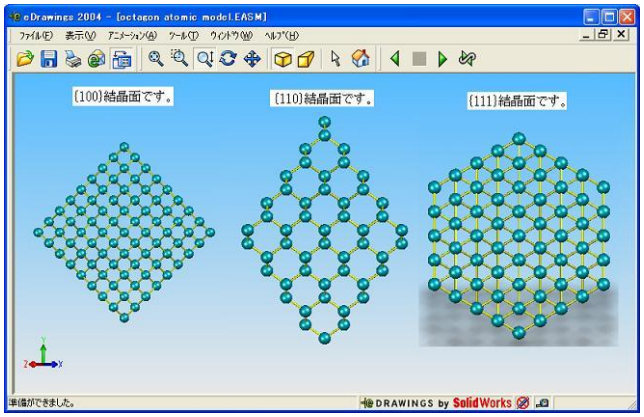
# HOW BIG ARE WE?

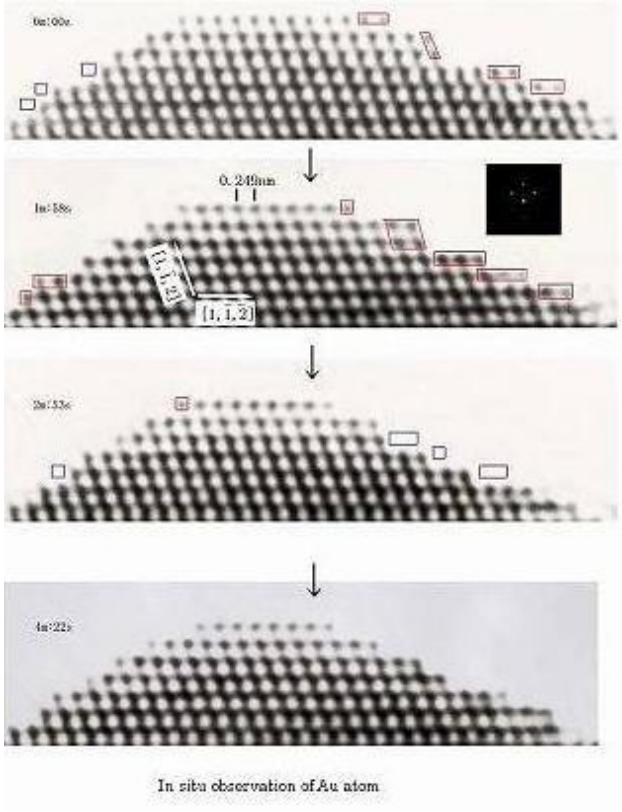
# MEASUREMENT OF THE UNIVERSE


Next-global-jungle

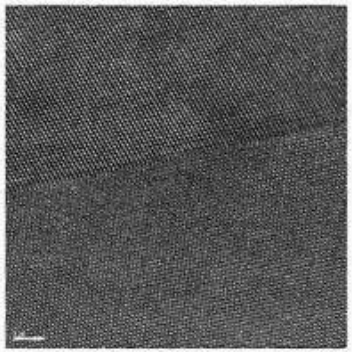



Power-of-ten

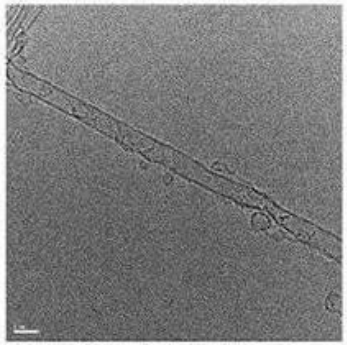


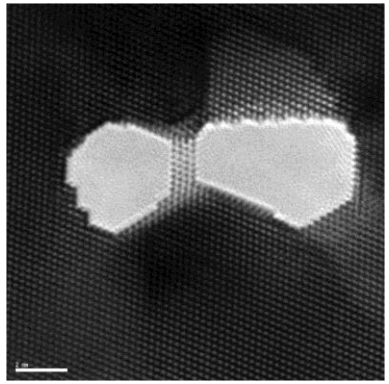

In situ observation of Au atom



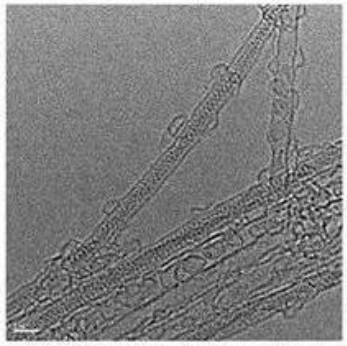
Si-Si



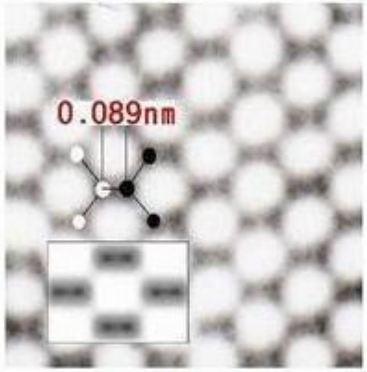
Single lay of carbon nanotube



Metal interjacency

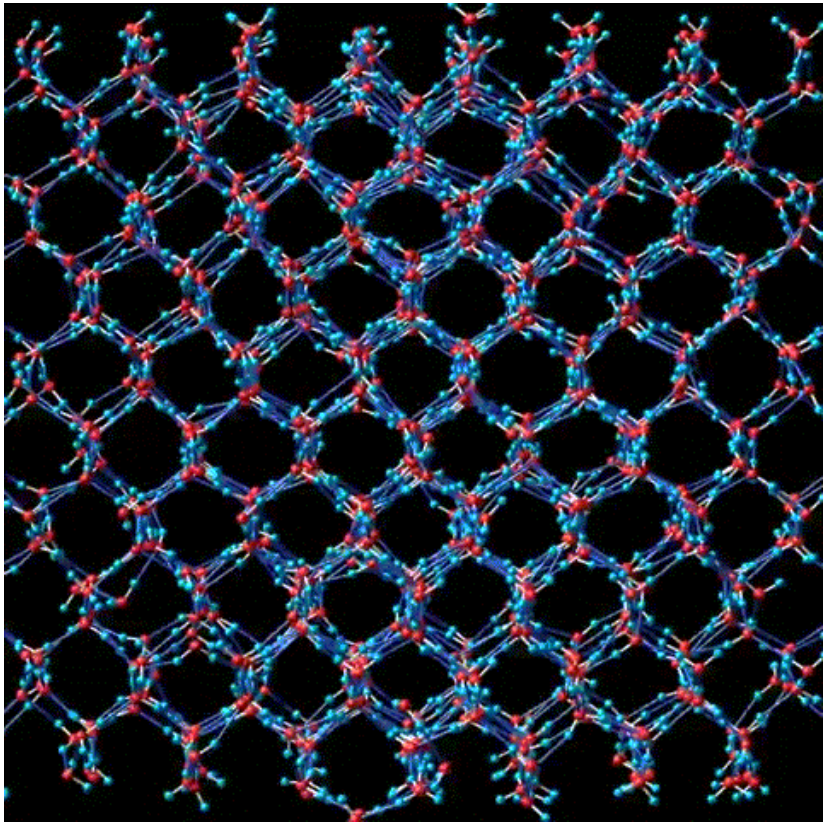


Single metal atom in carbon nanotube



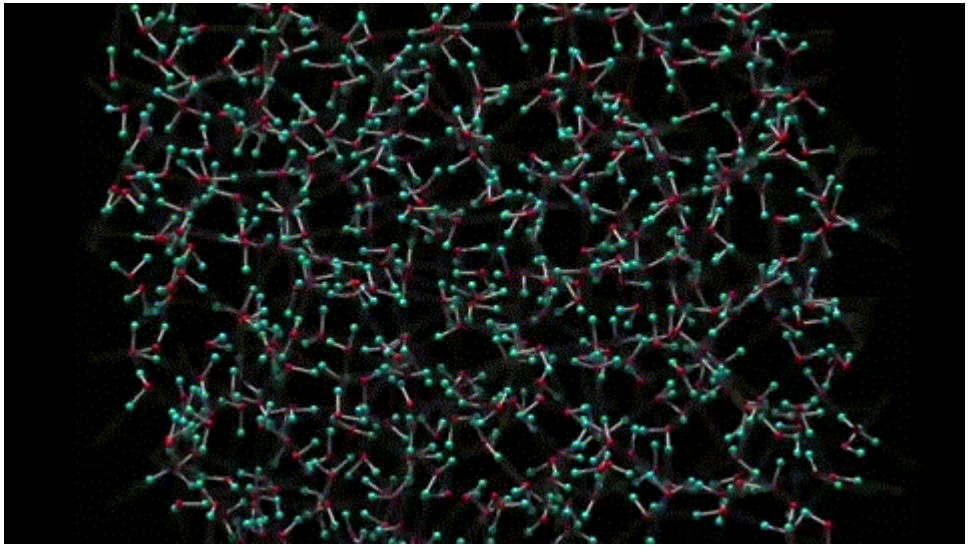

Atomic structure of diamond

# MATERIAL WORLDS



Ice to water

Water to ice



# WHERE CAN YOU FIND MATH?

# EVERYWHERE.

# WHERE CAN YOU FIND MATH?

## 1. PLANTS

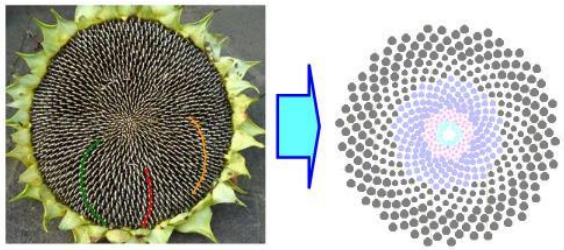
# FIBONACCI NUMBERS

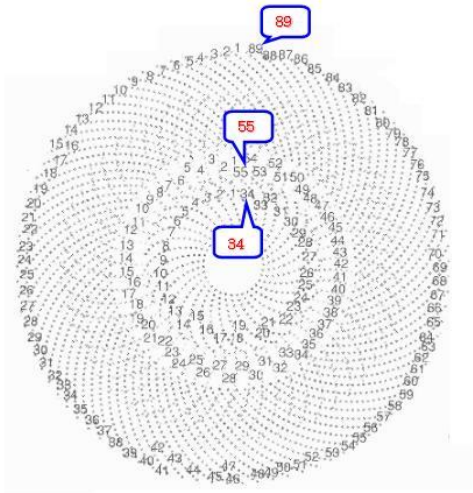
*Leonardo Pisano*

*AKA: Fibonacci*

# FIBONACCI NUMBERS

**Fibonacci numbers are the numbers that every number after the first two is the sum of the two preceding ones: 1 , 1 , 2 , 3 , 5 , 8 , 13 , 21 , 34 , 55 , 89 , 144 , …**

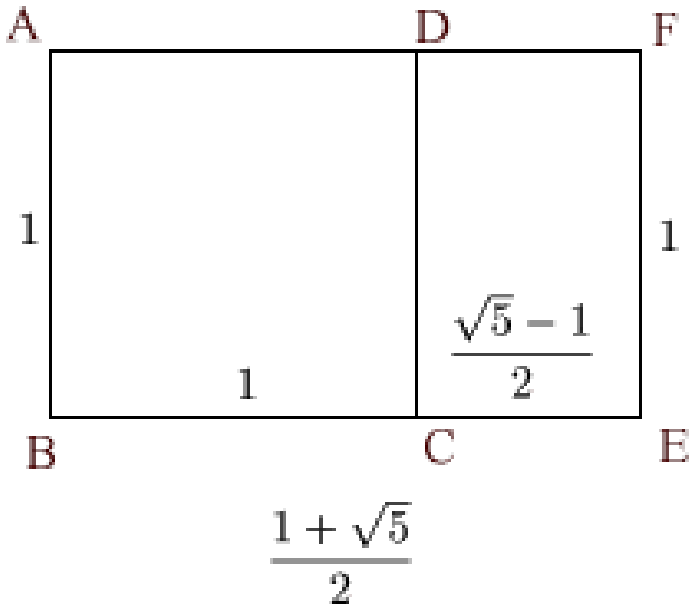





ひまわりの内側から 34, 55, 89 と巻いている。


**3 5 8 13 34**

# GOLDEN RATIO



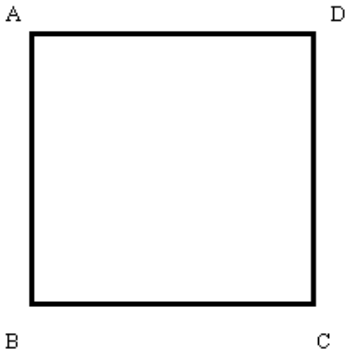

$$CE : EF = \frac{1+\sqrt{5}}{2} - 1 : 1$$

$$= \frac{\sqrt{5}-1}{2} : 1$$

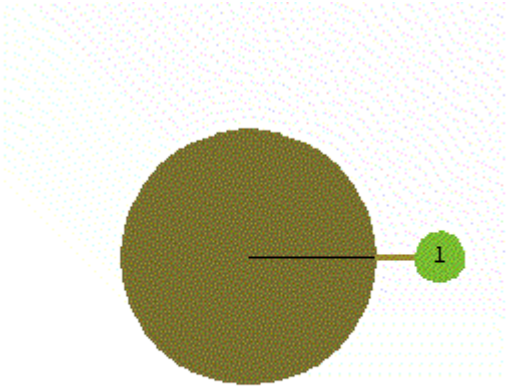
$$= 1 : \frac{1}{\frac{\sqrt{5}-1}{2}}$$

$$= 1 : \frac{1+\sqrt{5}}{2}$$

$$\frac{\mathbf{1+\sqrt{5}}}{\mathbf{2}}$$



# GOLDEN RATIO OF PLANTS

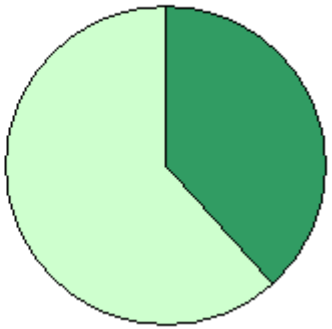


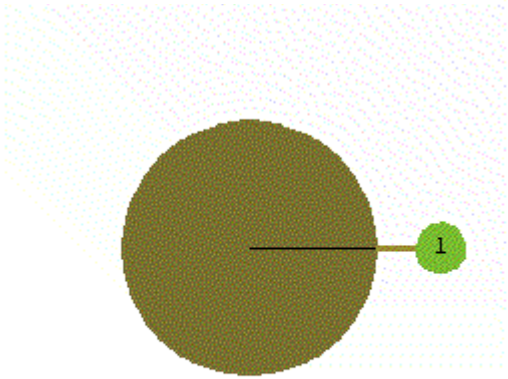

GOLDEN ANGLE

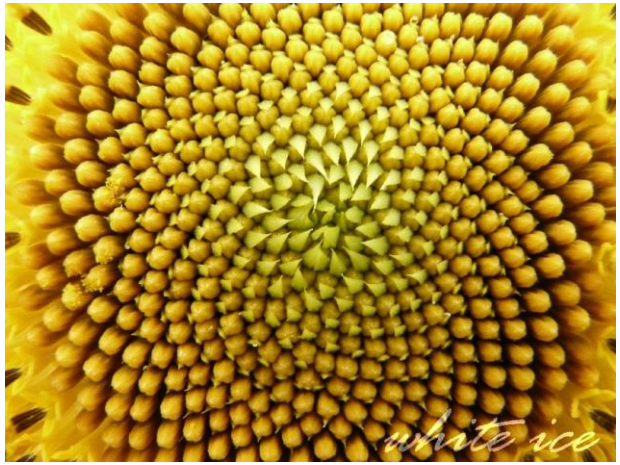
Golden Angle is a circumference with the ratio of $\frac{1+\sqrt{5}}{2}$ to 1.

$$360^\circ \times \frac{\cdot}{1+\frac{1+\sqrt{5}}{2}} = 137.507764\cdots$$

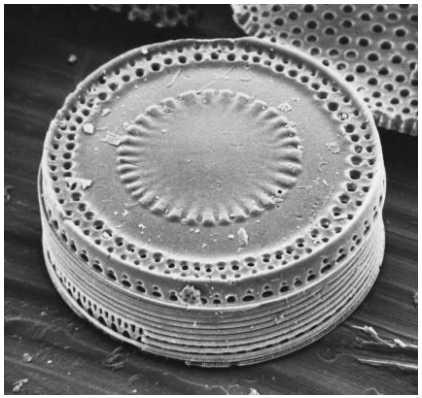
**137.507764…**






white ice


Banggood




gettyimages
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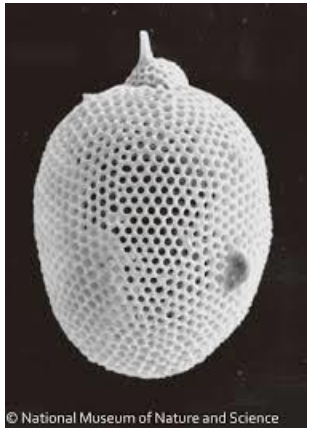
128625814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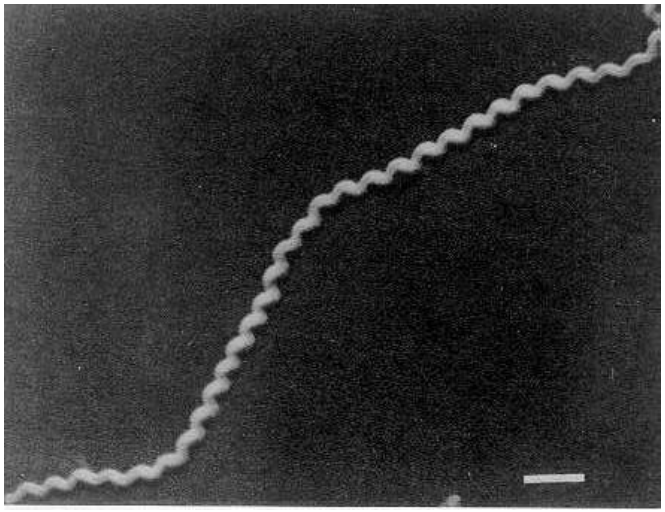
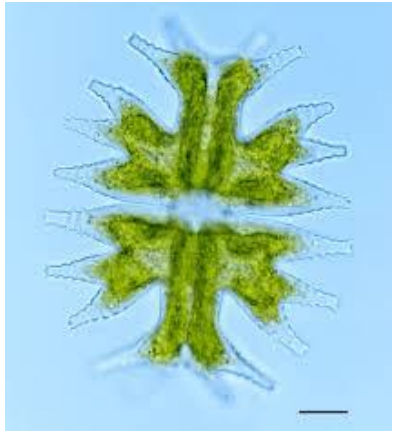
3


10 μm



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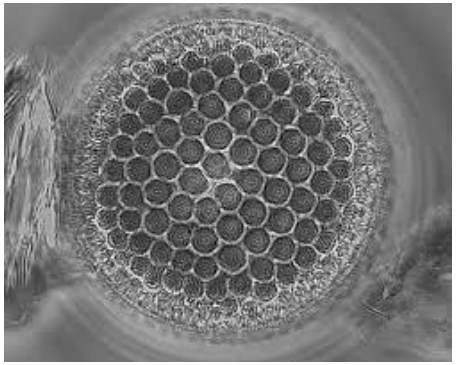
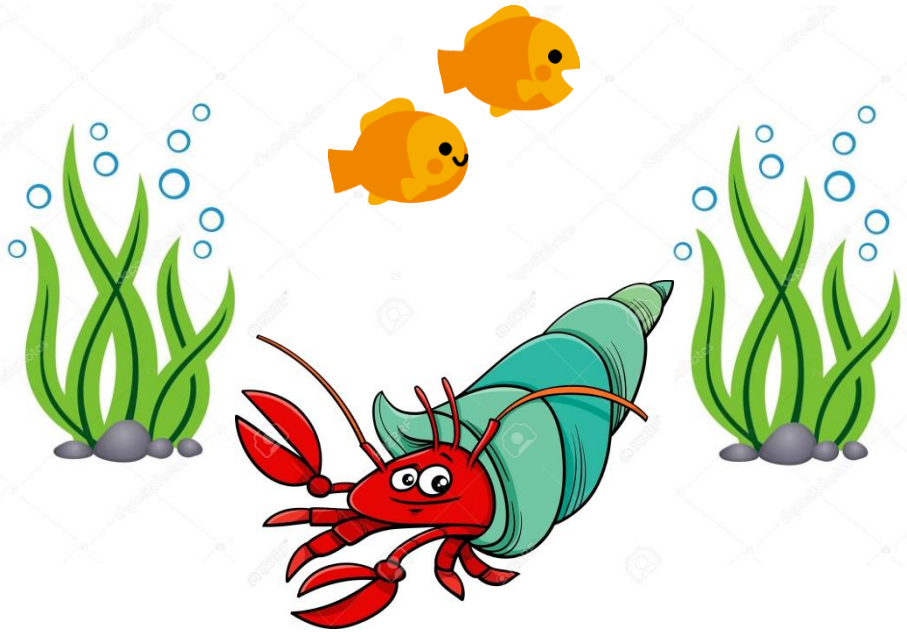


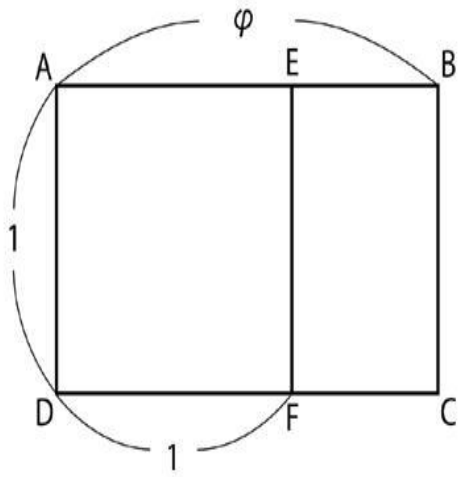
# WHERE CAN YOU FIND MATH?

## 2. SHELLS



# NAUTILUS

# GOLDEN RATIO OF SHELLS



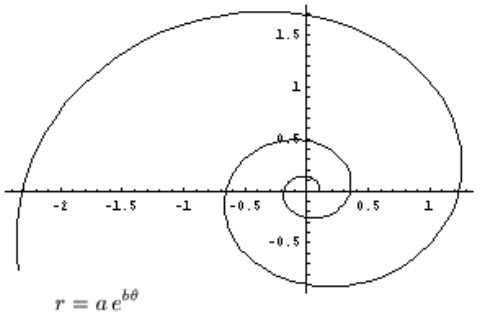

$1:\phi=(\phi-1):1$

$\phi^2-\phi=1$

$\phi^2-\phi-1=0$

よって、$\phi=\dfrac{\sqrt{5}+1}{2}(\phi>0)$

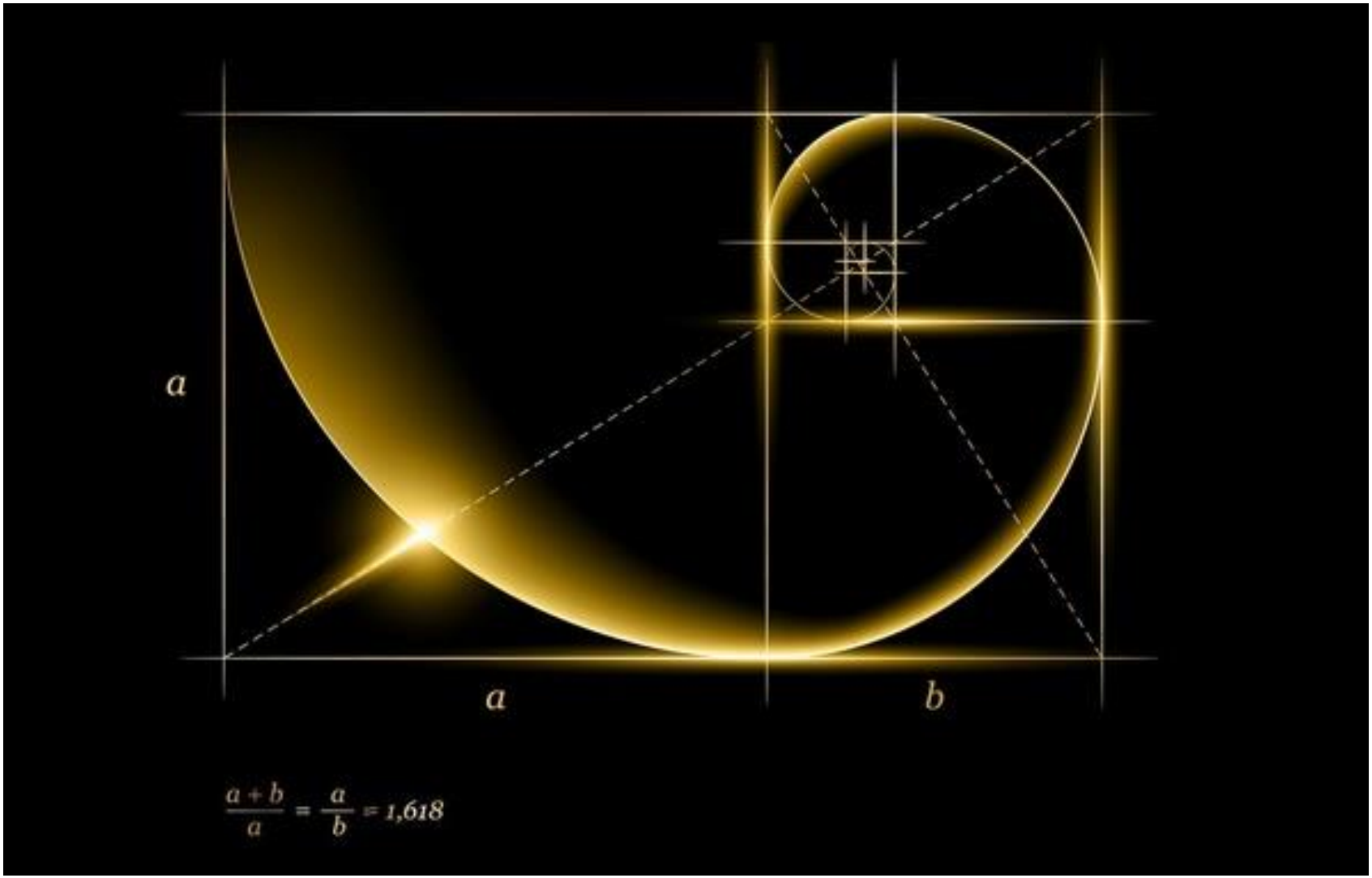
## This is also based on Fibonacci numbers!




$r = a\,e^{b\theta}$

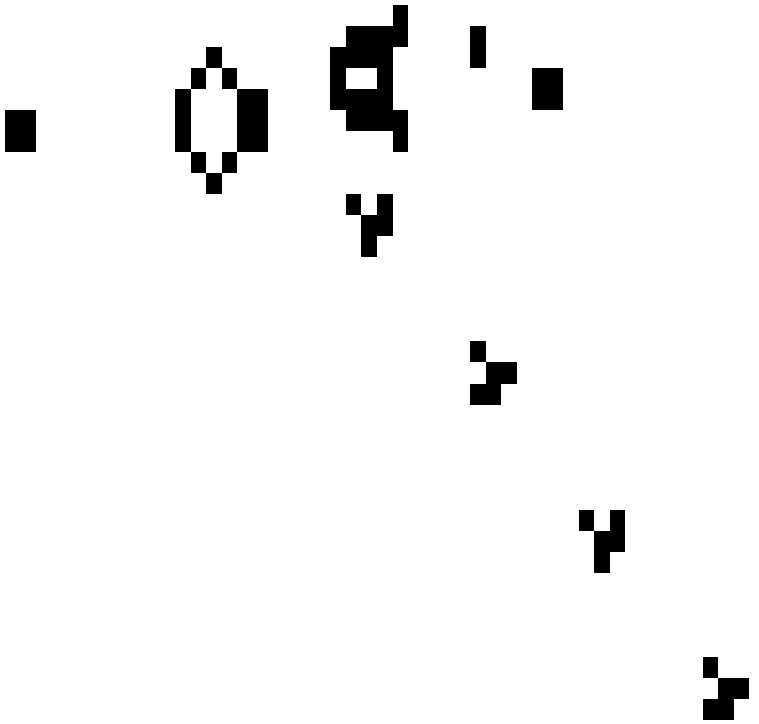
$a = 0.1,\ b = 0.2$ のとき

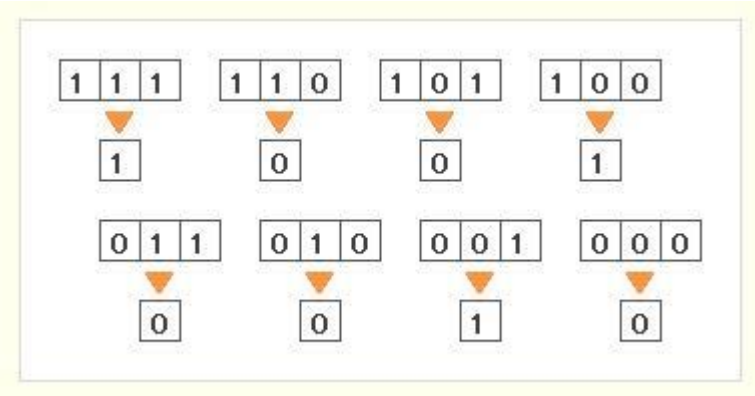
# GOLDEN RATIO



# CONUS TEXTILE

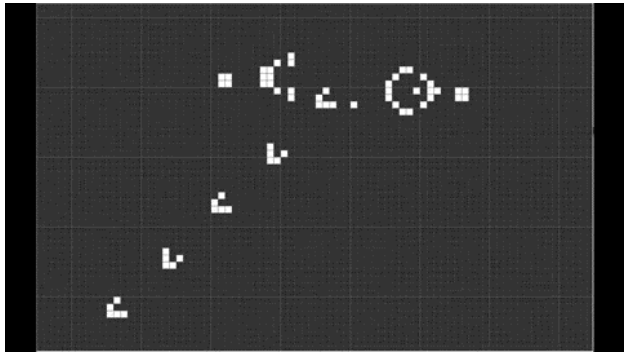
# CELLULAR AUTOMATON

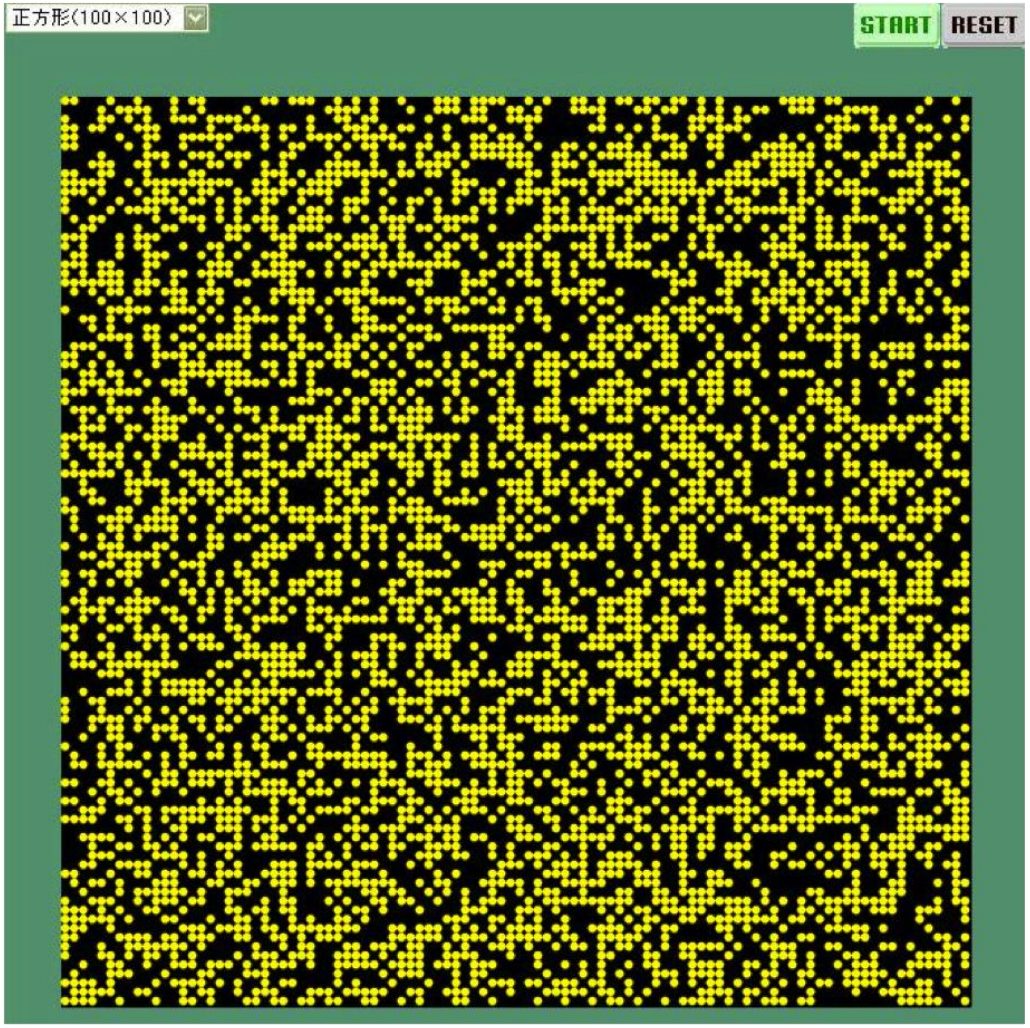






**THE FIRST GENERATION CELL WILL BE STORED IN 360 UNITS,**
**AND REPRESENTED WITH DIGITS OF 0 AND 1.**
**THE NEXT GENERATION WILL BE DECIDED BY CHANGING A PARTICULAR CELL**
**WITH THE RULES WRITTEN AT THE RIGHT (ARTIFICIALLY DECIDED).**
**THE START AND END POINT SHOULD ALSO BE CONNECTED(IN CIRCLES).**

# MORE ABOUT CELLULAR AUTOMATON



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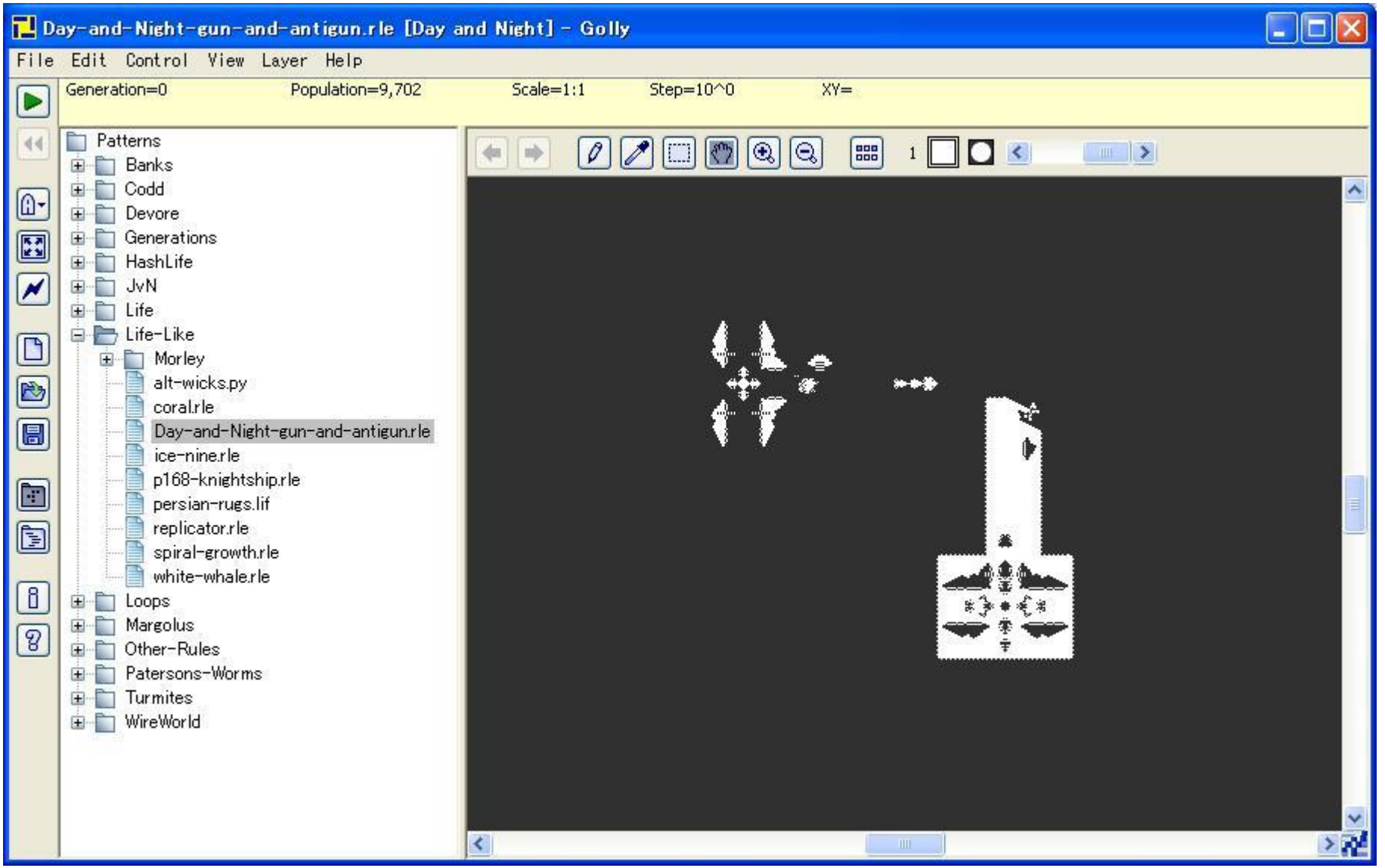
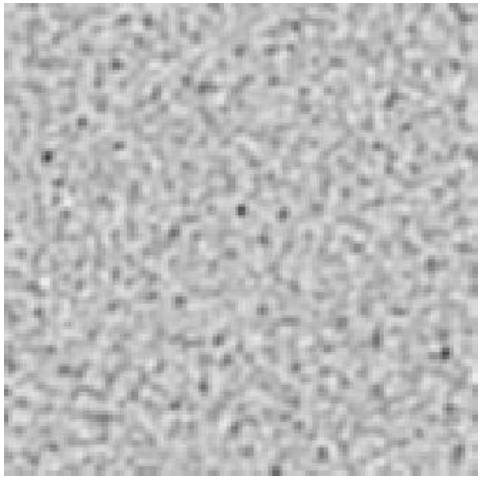
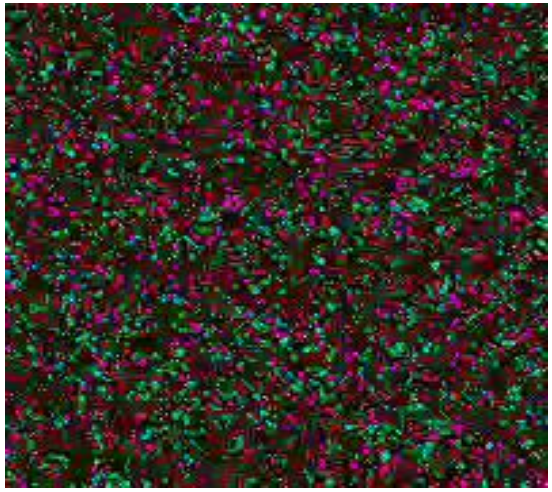
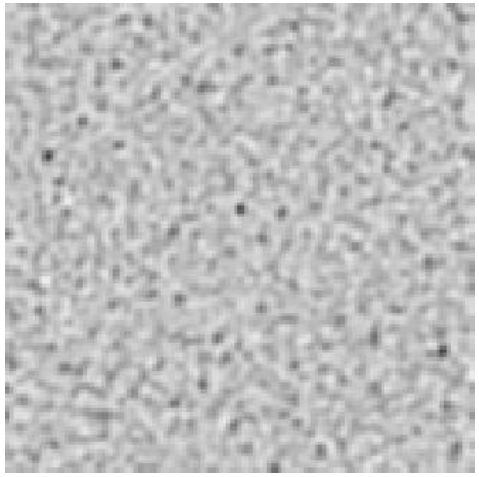
**POSSIBILTIES TO FORM THIS CELLULAR AUTOMATON!!!!**


Day-and-Night-gun-and-antigun.rle [Day and Night] - Golly
File Edit Control View Layer Help
Generation=0 Population=9,702 Scale=1:1 Step=10^0 XY=
Patterns
Banks
Codd
Devore
Generations
HashLife
JvN
Life
Life-Like
Morley
alt-wicks.py
coral.rle
Day-and-Night-gun-and-antigun.rle
ice-nine.rle
p168-knightship.rle
persian-rugs.lif
replicator.rle
spiral-growth.rle
white-whale.rle
Loops
Margolus
Other-Rules
Patersons-Worms
Turmites
WireWorld

# SELF-ORGANIZING







***Order made from chaotic structures***

# WHERE CAN YOU FIND MATH?

## 3. Look Around !

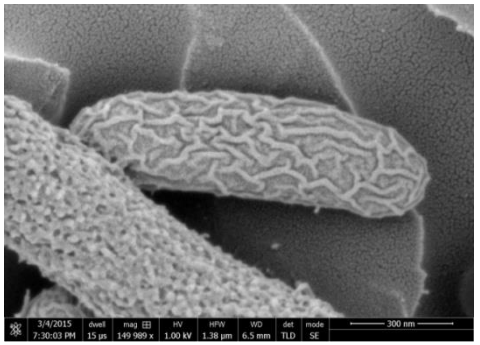
# FRACTALS

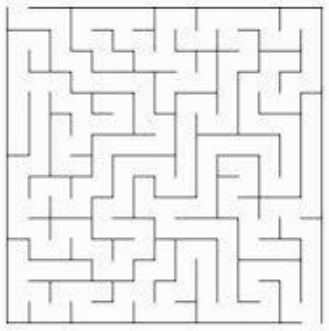
## Regularity of complex structures

Clouds, shorelines, cracks of dried earth,

they all look like the same.

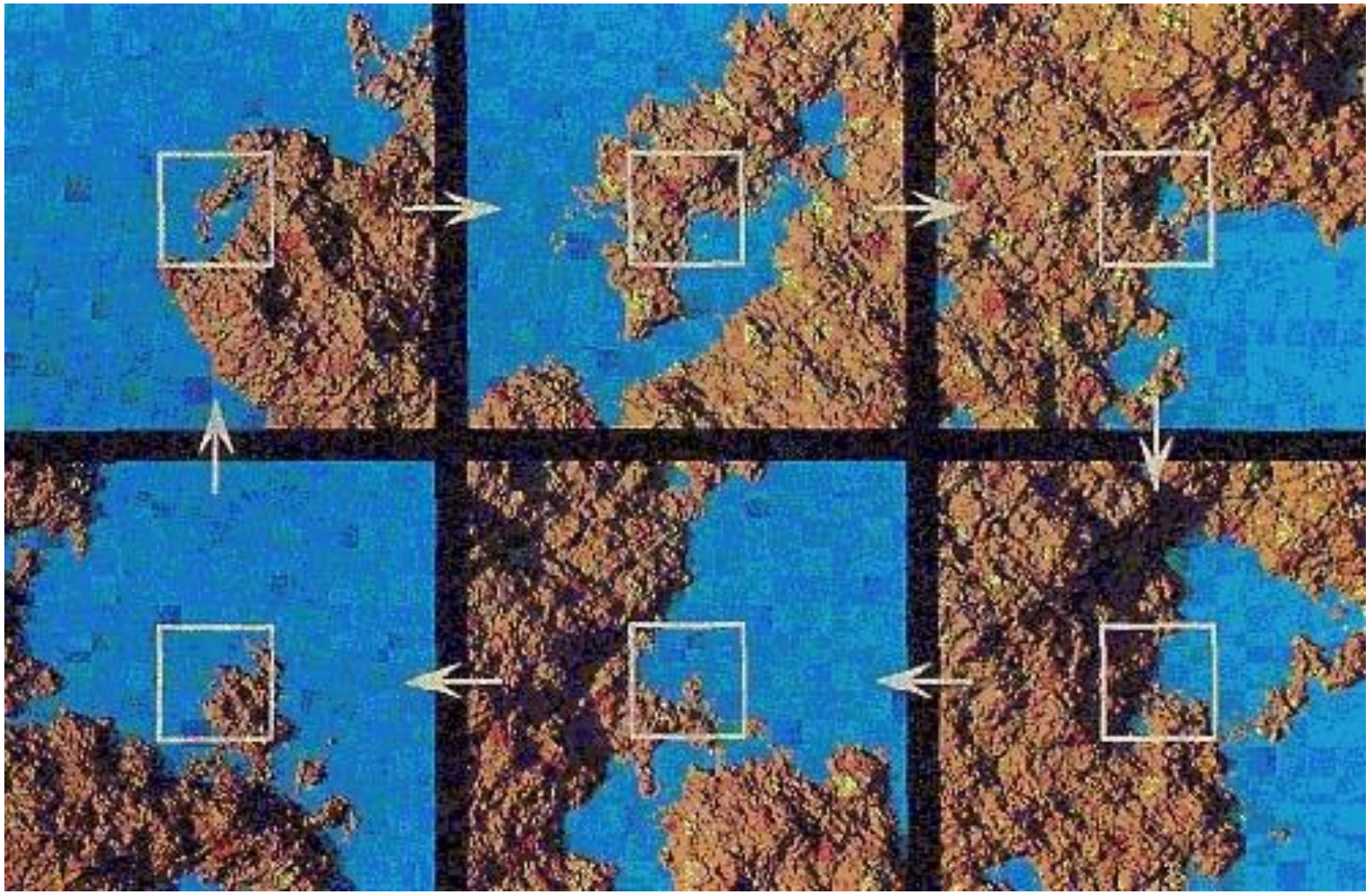
Are there any common natures of these things?





**A fractal is an infinitely self-similar mathematical set. Fractals exhibit similar patterns at increasingly small scales, also known as expanding symmetry or evolving symmetry.**

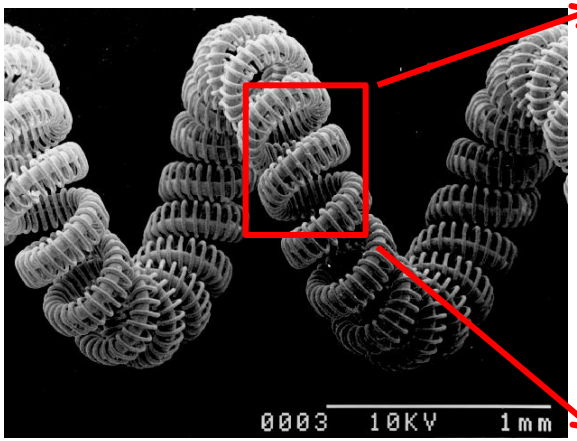
# HOW FRACTALS LOOK LIKE

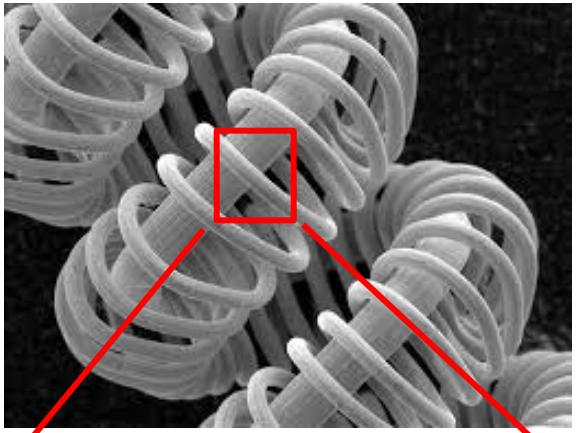


The shape of shorelines does not change even if you zoom closer.

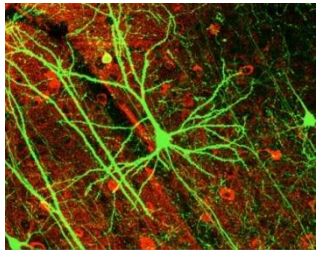
**FRACTAL**

# EXAMPLES:

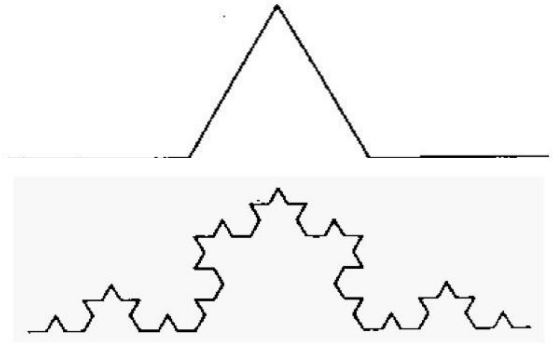



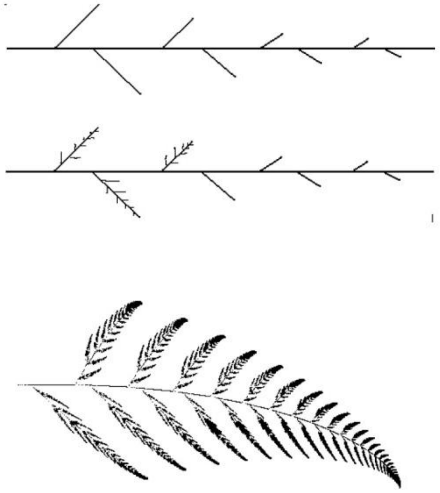
LIGHT BULB FILAMENT

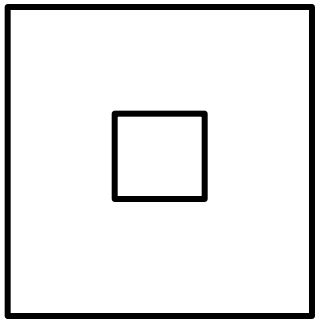


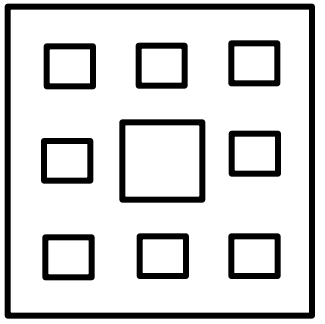
# EXAMPLES:

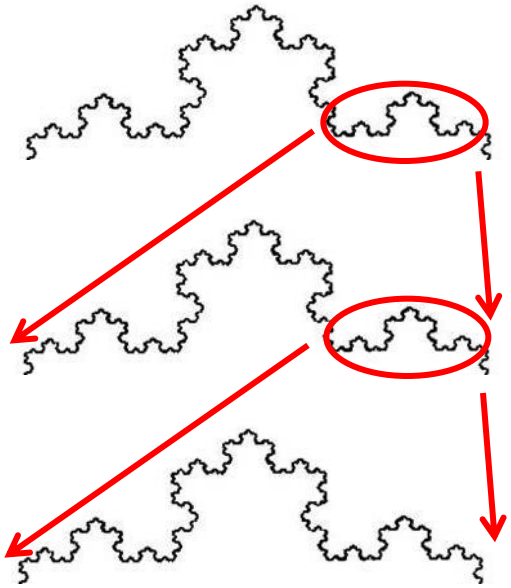
**Koch curve**

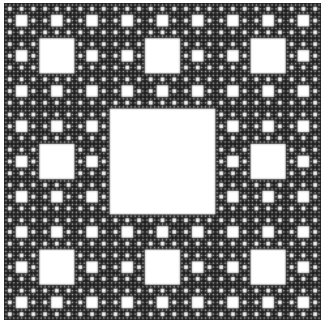




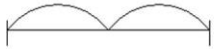


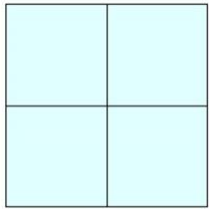


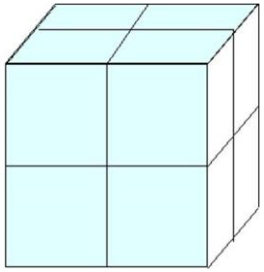




# DIMENSIONS

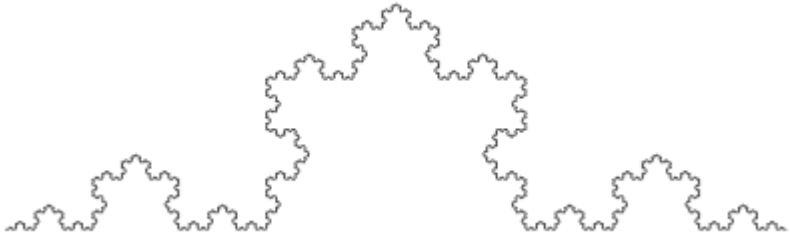




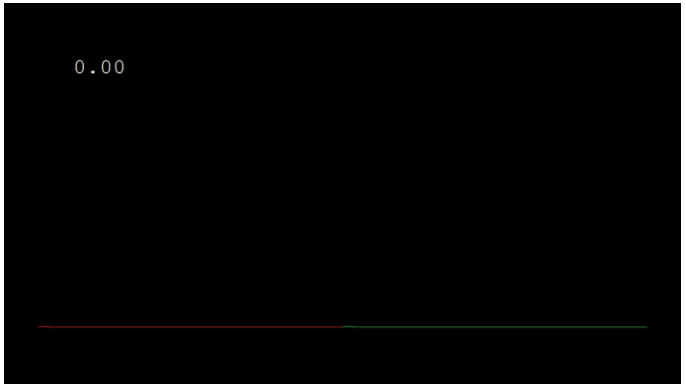


$Nr^{D_T} = 1$ **When divided into N amounts of 1/r segments,**

$$D_T = \frac{\log N}{\log 1/r}$$ **This numeral** $D_T$ **is called the inductive dimension**



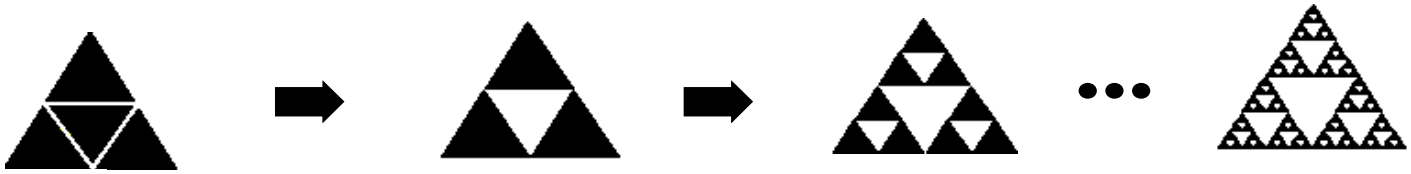
**Koch curve**




**You can make lines of** $N = 4^n$ **with lengths of** $r = \left(\frac{1}{3}\right)^n$ **so**

$$D_H = \frac{\log 4}{\log 3} \cong 1.26$$

# A FRACTAL: SIERPINSKI GASKET



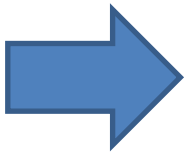
**You can make triangles $N = 3^n$ with lengths of $r = \left(\frac{1}{2}\right)^n$ so**

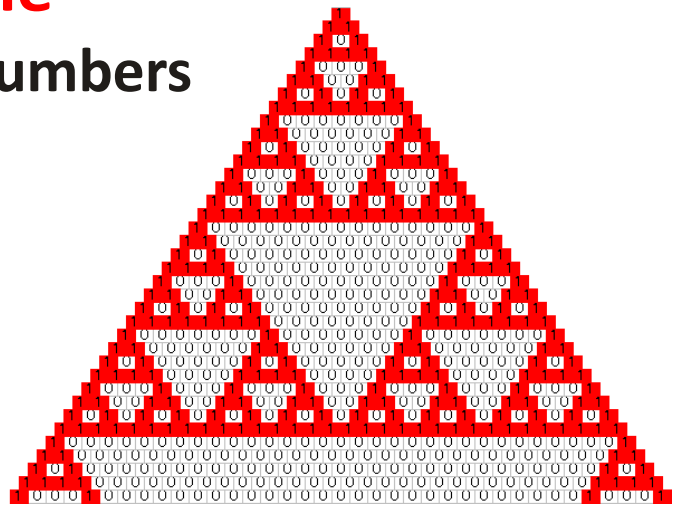
$$D_H = \frac{\log 3}{\log 2} \cong 1.58$$

## Pascal's triangle

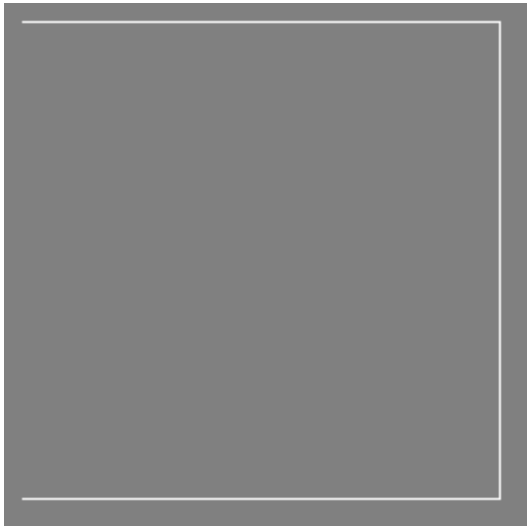
**When you color odd numbers**

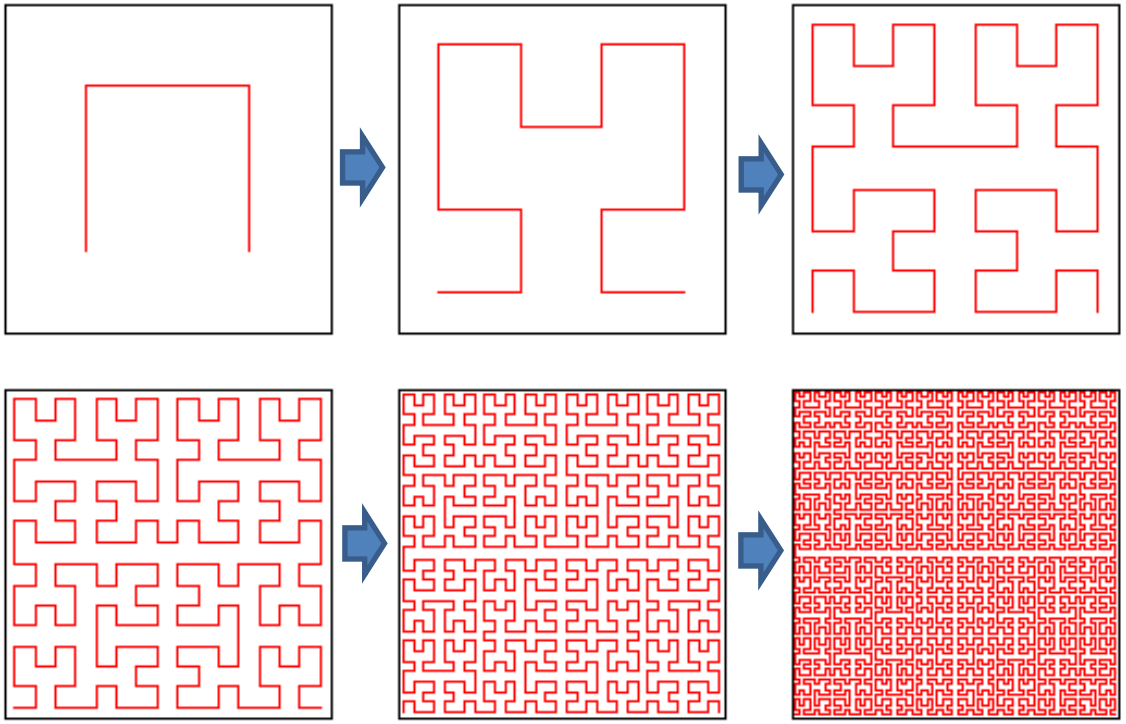
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | | | | |
| | | 1 | | 1 | | | |
| | 1 | | 2 | | 1 | | |
| 1 | | 3 | | 3 | | 1 | |
| | 1 | | 4 | | 6 | | 4 | | 1 |
| 1 | | 5 | | 10 | | 10 | | 5 | | 1 |
| | 1 | | 6 | | 15 | | 20 | | 15 | | 6 | | 1 |
| 1 | | 7 | | 21 | | 35 | | 35 | | 21 | | 7 | | 1 |

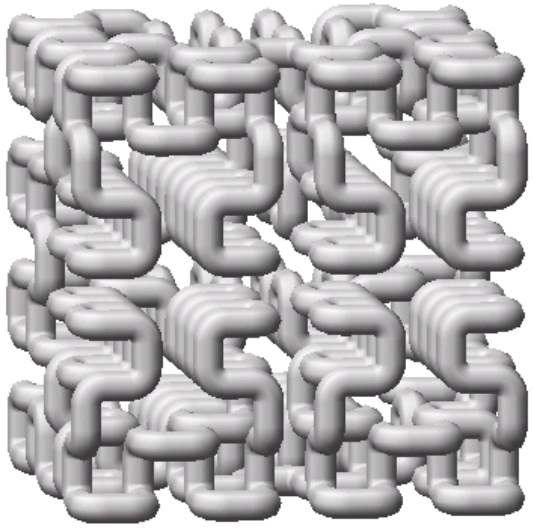




# PEANO CURVE



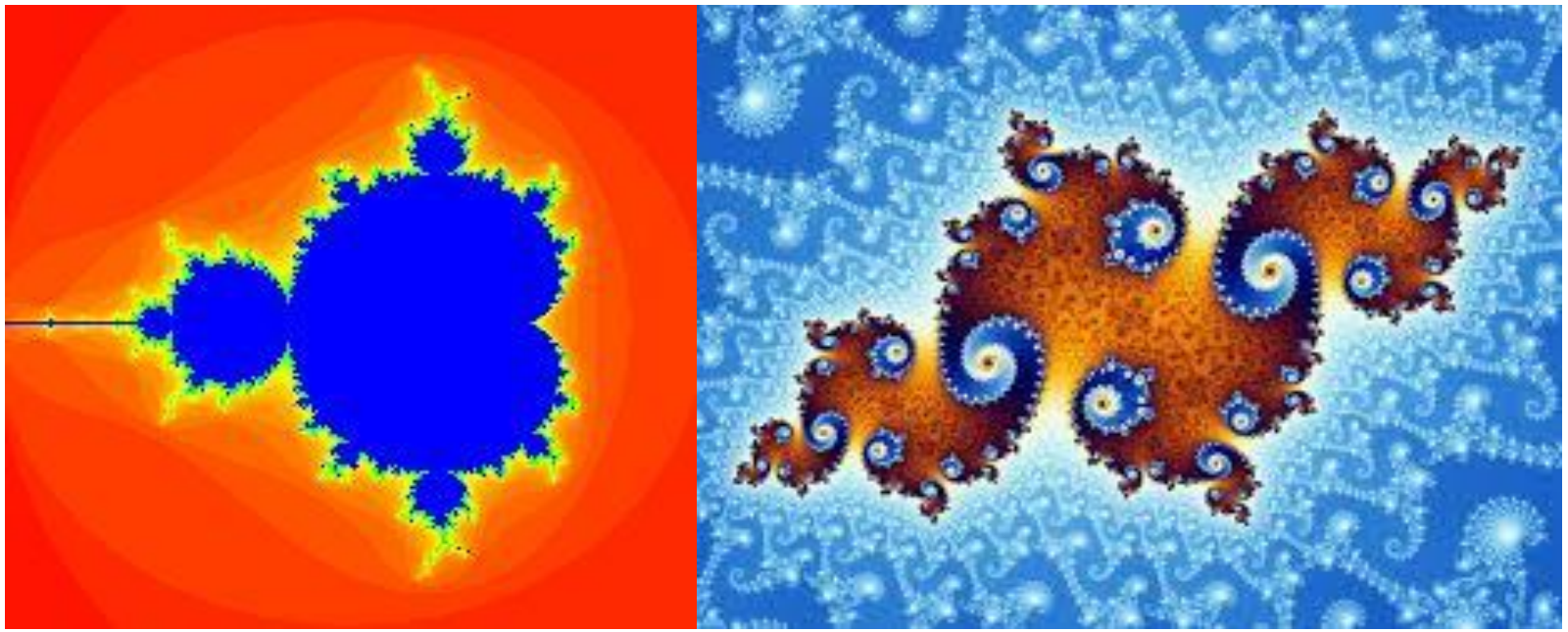




**You can make lines of $N = 4^n$ with lengths of $r = \left(\frac{1}{2}\right)^n$ so**

$$D_H = \frac{\log 4}{\log 2} \cong 2.0$$

# MORE CRAZY LOOKING FRACTALS



**Mandelbrot set** **Julia set**

$$z_n = z_{n-1}^2 + c, \quad n \in Z, \quad z, c \in C$$

## Our inductive dimensions

| | |
|---|---|
| Shorelines, rivers | 1.1～1.5 |
| Water level of lakes | 1.1 |
| Pulmonary blood vessels | 2.17 |
| Brain wrinkles | 2.73～2.79 |
| Dispersion of galaxies | 1.2 |
| Dispersion of Moon craters | 2.0 |
| Clouds | 1.33 |
| Metal crystals | 1.66 |

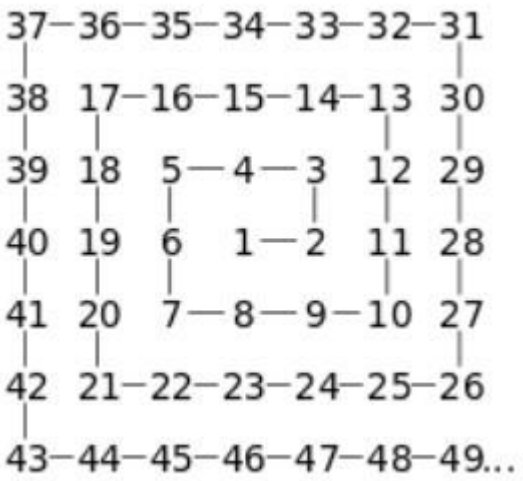
## Usage of fractals

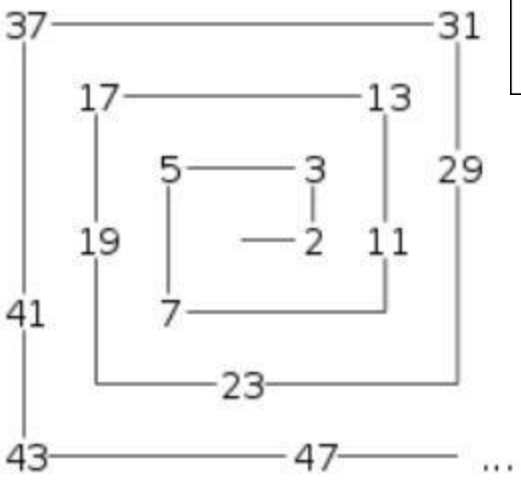
- Predict random phenomenon (Stock fluctuations etc.)
- Reproduce shapes close to nature with simple equations
- Create 3D realistic figures
- Encrypting and image analysis etc.

# INTERESTING THINGS ABOUT MATHEMATICS

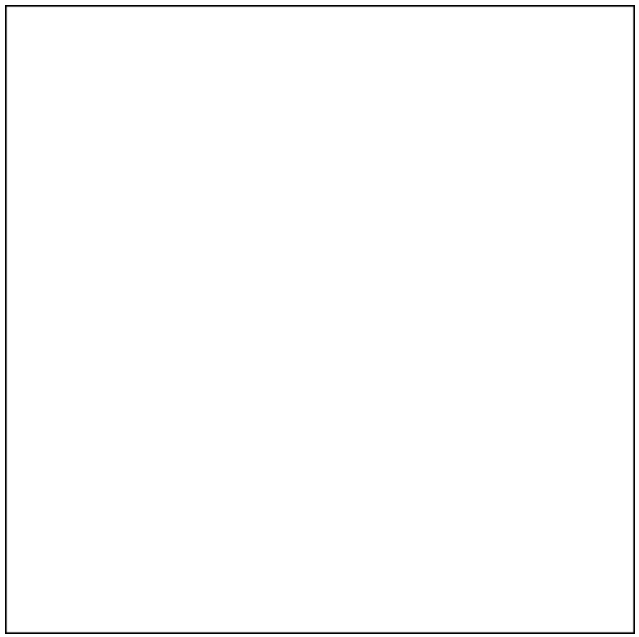
# DOG WHEEL

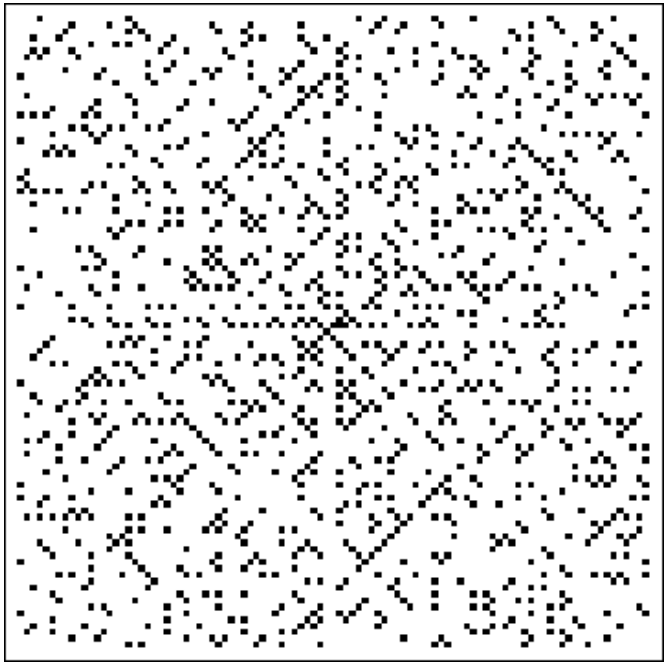

# ULAM SPIRALS



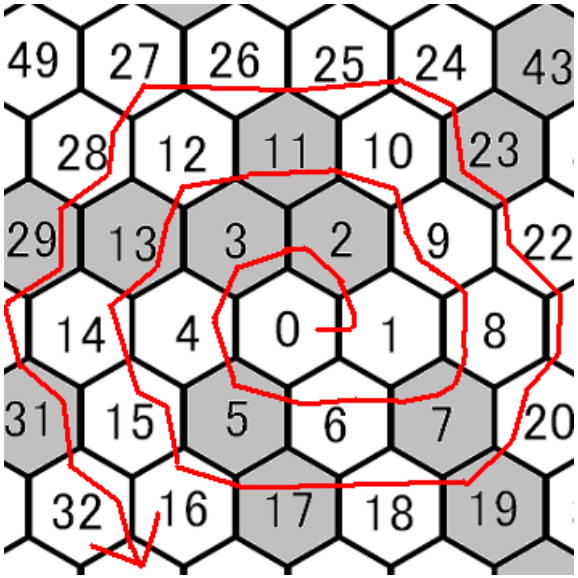




**Ulam spiral**





# Hexagonal Ulam spiral




# Triangular Ulam spiral...?

line:1 1

line:2 **2** **3**

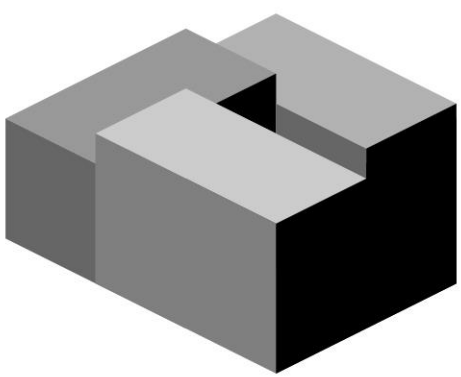
line:3 4 **5** 6

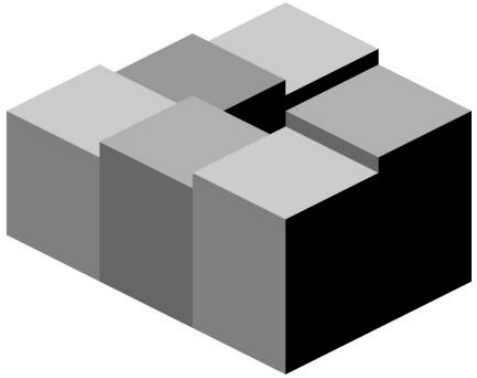
line:4 **7** 8 9 10

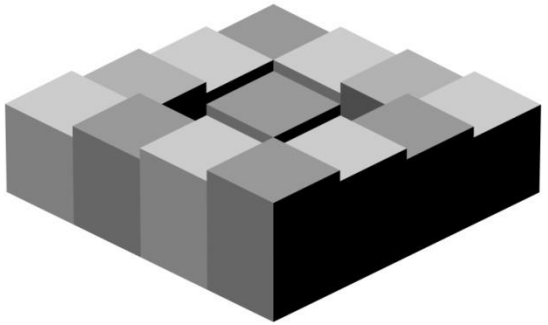
line:5 **11** 12 **13** 14 15

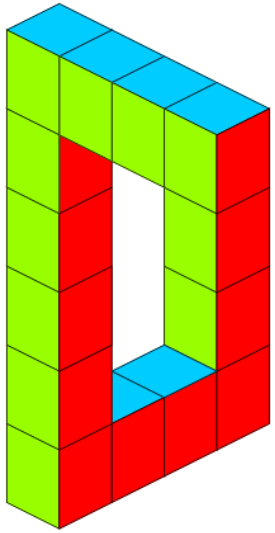
.....

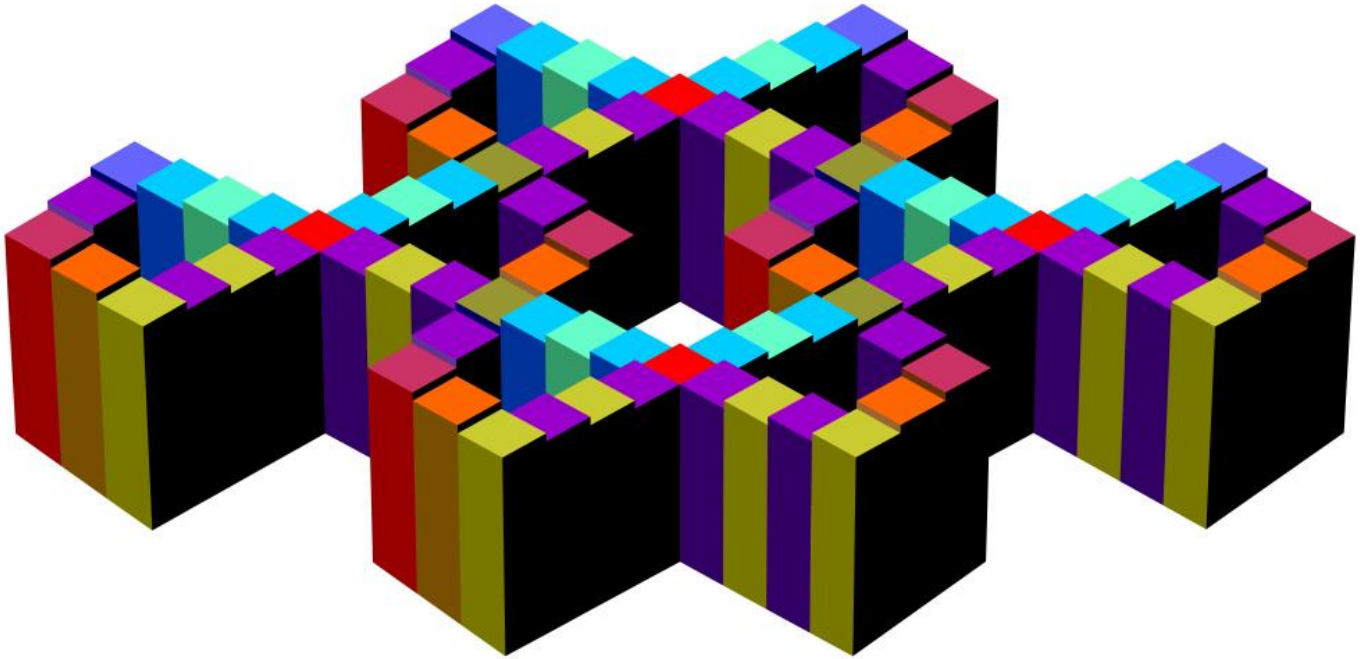
# PENROSE STEPS











# HOW DO THINK ABOUT MATH NOW?

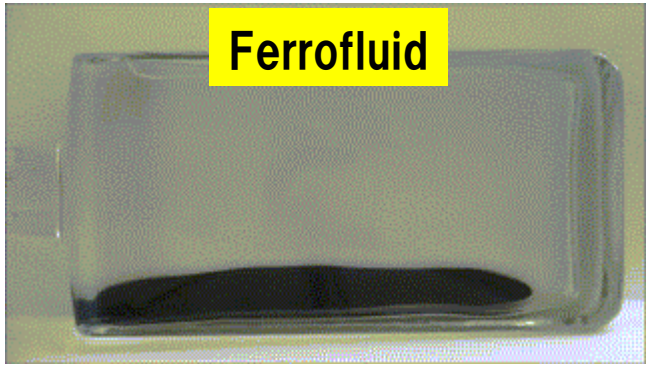
◆MY MESSAGE TO YOU

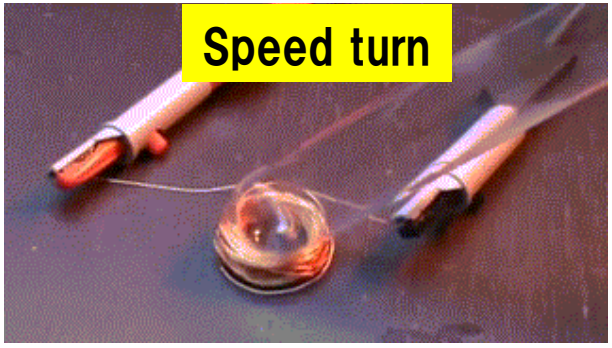
# 『The pale blue dot』from Dr. Carl Sagan

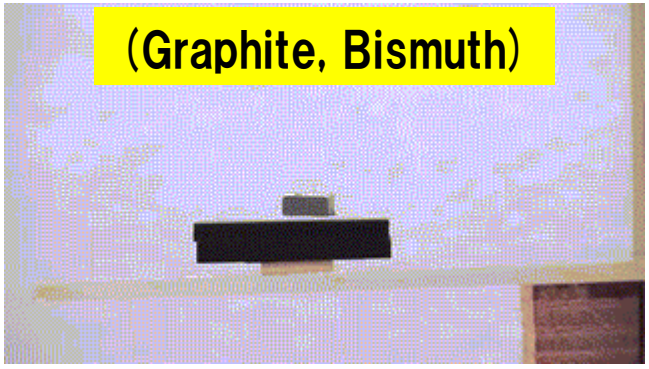

one another, and to preserve and cherish the pale blue dot, the only home we've ever known."

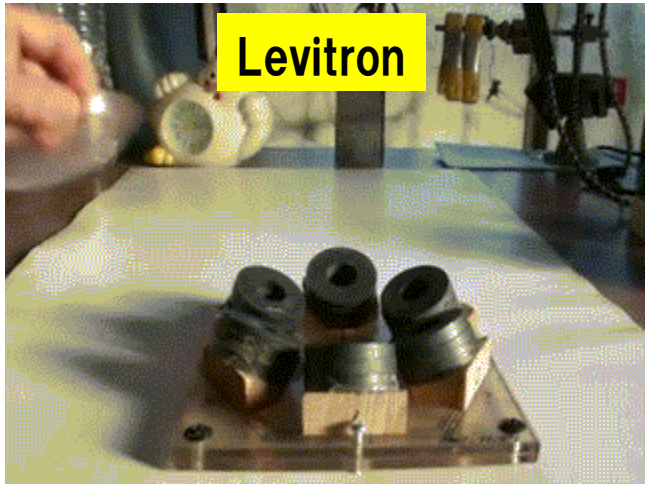
In association with NPO MathMathGood

Diamagnetic substances

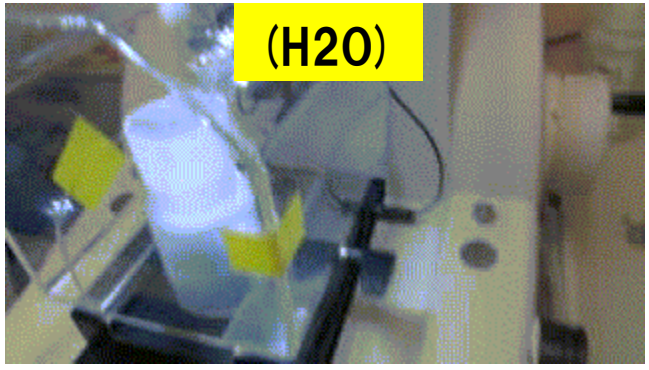


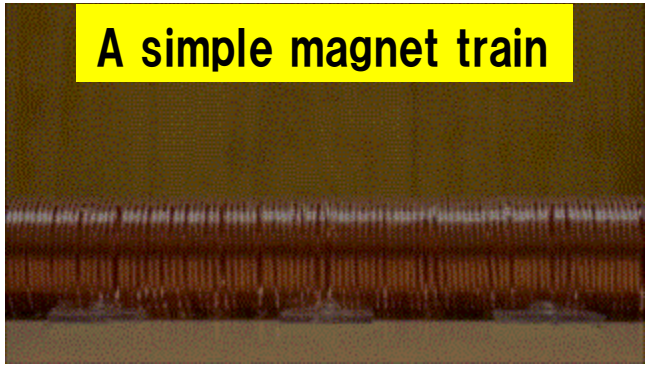



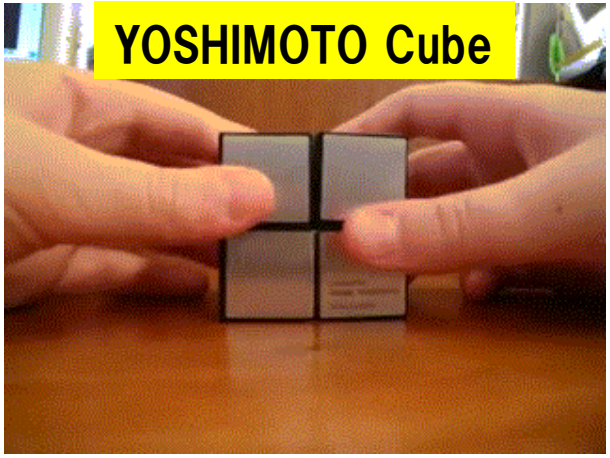



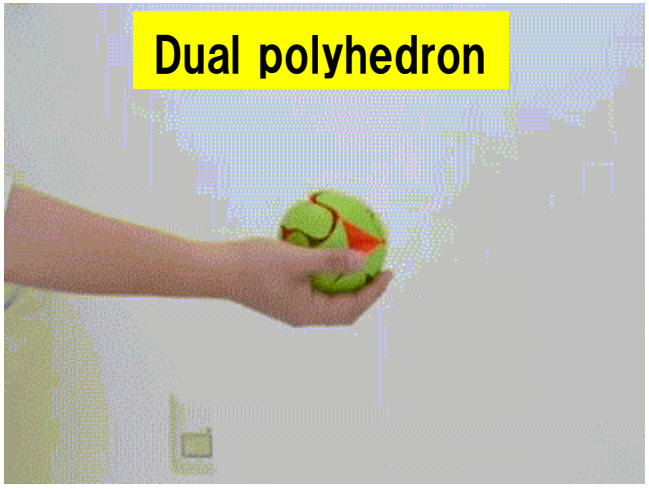







# WHAT IS MATHEMATICS?

**What is your impression of mathematics?**
**A complicated set of equations that you will never use in real li**
**Or is it just something you learn for your examinations?**
**I can assure you: Those thoughts are actually not right.**
**Mathematics is not something you use to calculate your checks**
**but it is the essential tool to clarify everything that surrounds u**
**Math can change your views of everything. So why not take a look? Let me be your guide!**

***Please contact us for applying your name and the number of your party.***
***Mail form is also available on our website. We will be happy to assist you.***

**LOCATION: Nirai Center**


This center is next to the Chatan town library.
Address: Nakagami District, Chatan, Kuwae 467-1 中頭郡北谷町字桑江467番地1
Tel: 098-936-3424 Zip:904-0103

## *VISIT & CONTACT US!!*

**MATH LAB**
**URL: http://mathmathgood.com**
**MAIL: math@mathmathgood.com**

**CLASSES: Interacting with Math**
Date: **UNDETERMINED**
Time: Undetermined
Entry Qualifications: None
Language: English , Entrance Fee: None(Free)

*NPO MathMathGood presents*


平成26年6月21日（土）
第10回数学研究会


平成26年7月21日（月）
設立総会


平成27年8月4日（火）
沖縄県立図書館　講演会


平成27年8月22日（土）
高校数学集中講義

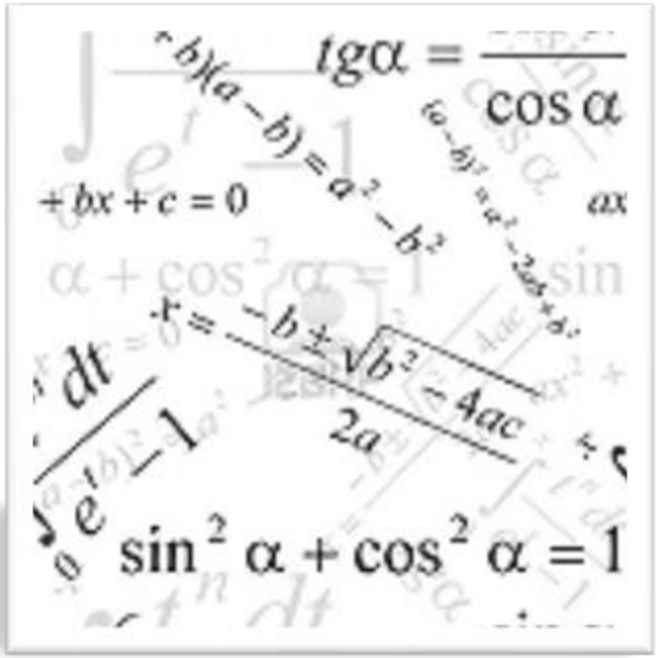

平成27年8月30日（日）
高校数学集中講義


平成26年9月19日（金）、宜野湾市立図書館。
第20回数学研究会


平成29年2月11日（土）
沖縄県立糸満青少年の家
「ありあり！ワラバー塾」算数の調べ学習

# 数学研究会のお知らせ

皆さん、こんにちは。
数学とは神秘的で奥深い意味を
持っていると思います。私たちと
一緒にその謎の答えにたどり着く扉を
開けましょう。




日時：　毎週水曜日17:00−19:00。
　　※途中参加もOK。

場所：宜野湾市立図書館2階会議室
主要文献：算数•数学オリンピック問題集等
参加資格：数学が好きな小学生～高校生大歓迎。


**NPO法人　数学・科学技術推進協会 MathMathGood**
**080-3000-0432**
**http://mathmathgood.com/**
**math@mathmathgood.com　oabcabcabc@yahoo.co.jp**

# THANK YOU FOR WATCHING!


Lecturer: Haruyuki Sasaki

In association with

NPO Mathematics and Science Technology Promotion Association
MATHMATHGOOD & MATH LAB

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