

# Design in Practical Application, Creativity and Process to form an Expertise

# Overview

1. Design and Creativity. L1
2. The Internal Challenge. L2
3. The External Challenge. L3
4. Recommendations L4

# L1 Design and Creativity

1. Information vs Knowledge
2. Creativity
3. Limitations to creativity
4. Balancing
5. Creativity Training
6. Task 1 and Book 1

# Intro: Technical Knowledge

## Antikythera:

- Island in the Aegean Sea
- 20 km<sup>2</sup>
- ~ 25 inhabitants



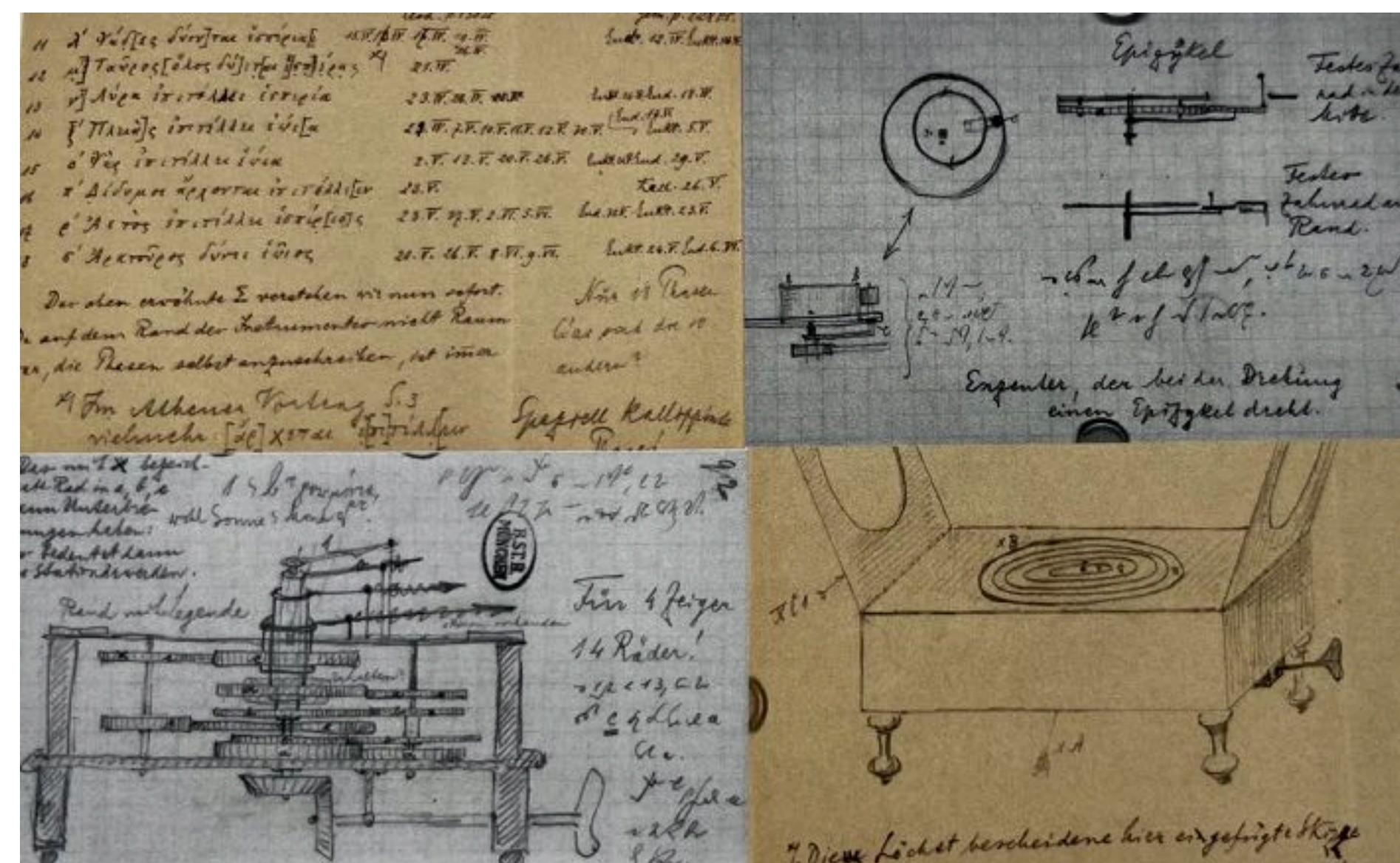
Source : GOOGLE EARTH



# The Mechanism of Antikythera (1)

1900 accidental discovery:

- Roman Ship loaded with Antiquities
- Wrecked in storm ca. 70-60 AC
- 7 larger clumps
- 75 smaller fragments
- First vague understanding by Albert Rehm 1907



Source : Maschinenraum der Götter. Wie unsere Zukunft erfunden wurde;  
(C) 2023 Liebieghaus Skulpturensammlung



# The Mechanism of Antikythera (2)

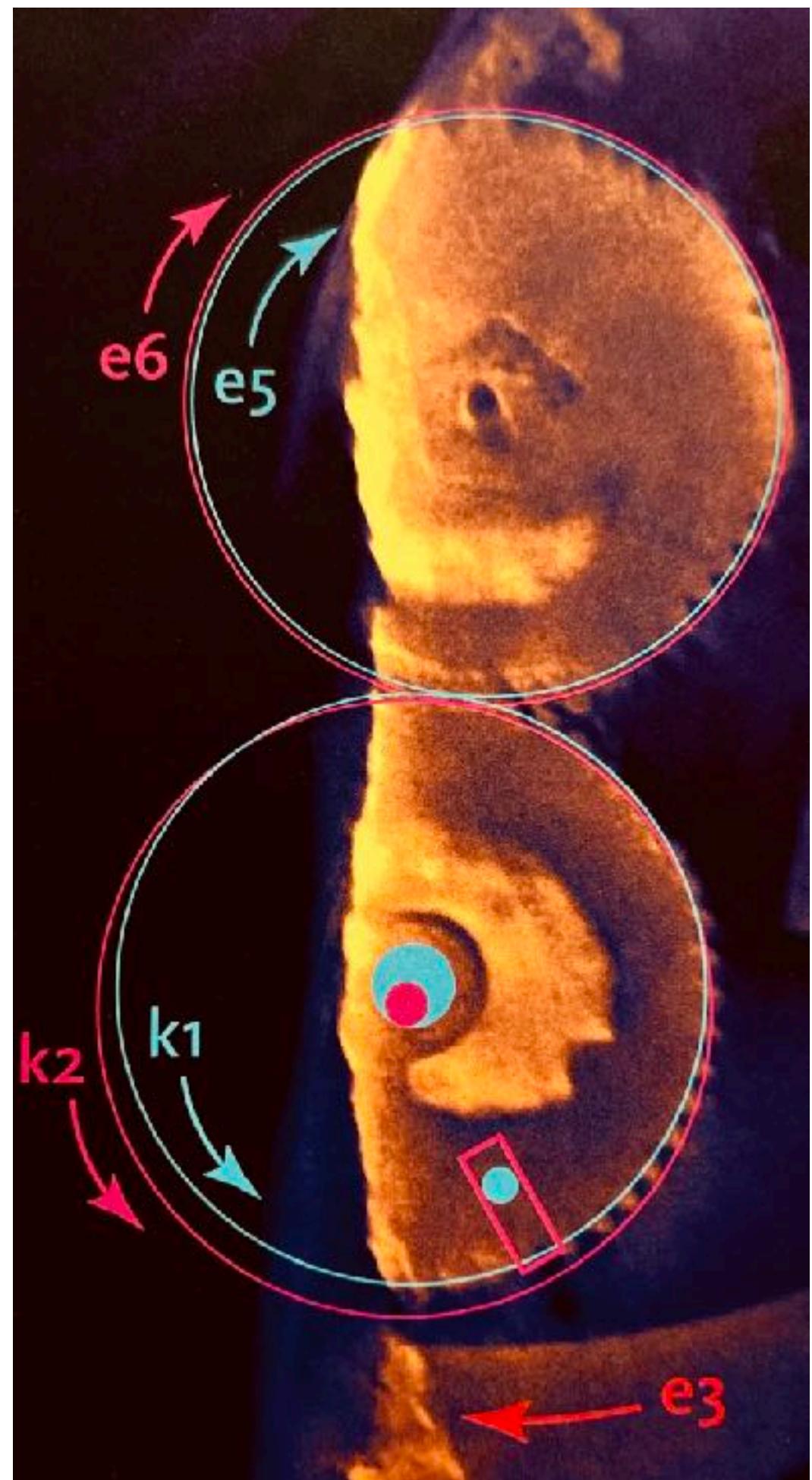
2005 to 2008 interdisciplinary project :

- National Museum of Athens
- Micro Focus CT 3D X-Ray (hp)
- Polynominal Texture Mapping (PTM)

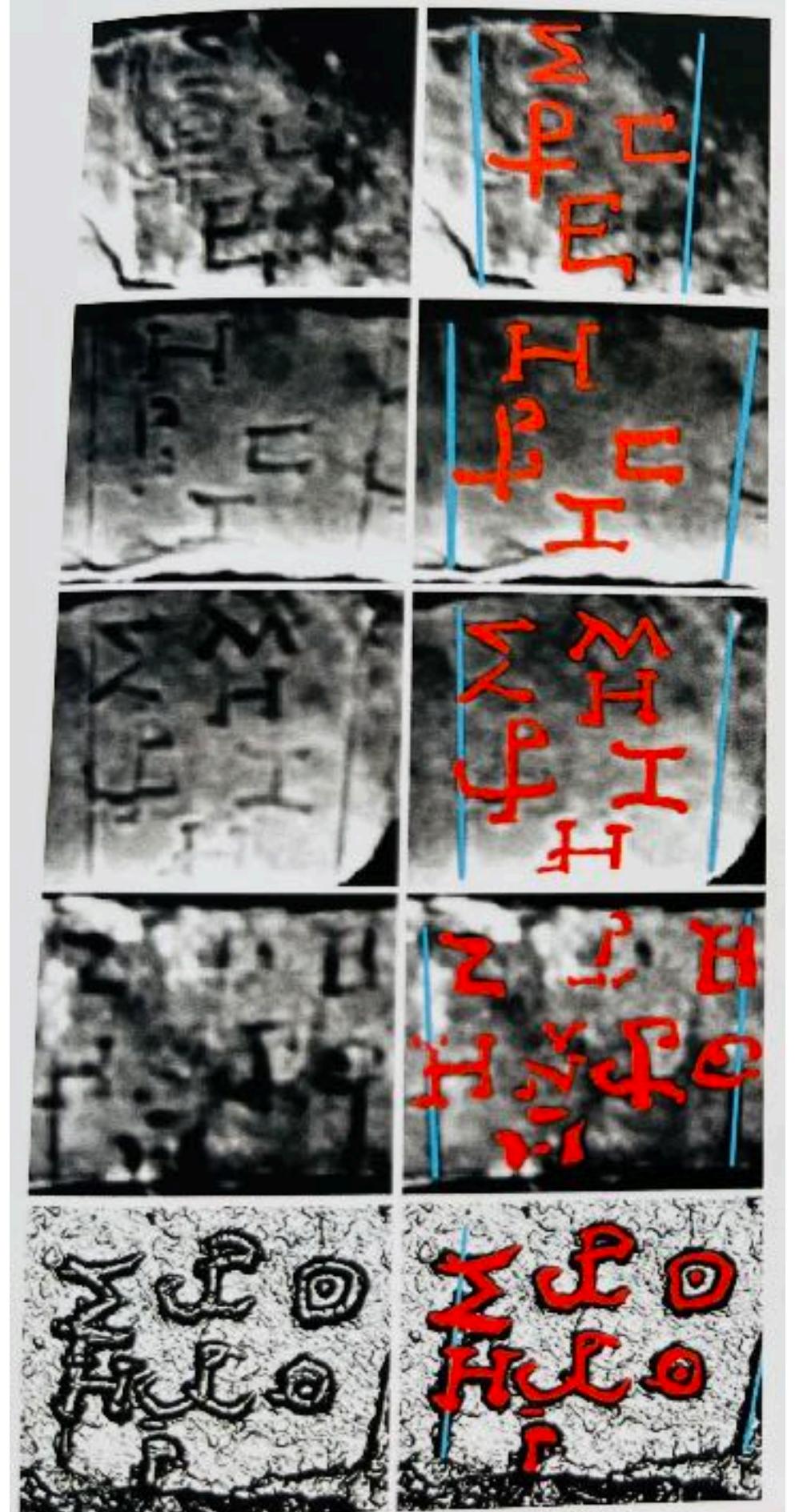


Synodical Cycles of Mercurius,  
Venus and Mars seen from Earth

Source : *Maschinenraum der Götter. Wie unsere  
Zukunft erfunden wurde;*  
(c) 2023 Liebieghaus Skulpturensammlung



Epicyclical Gear in MFCT

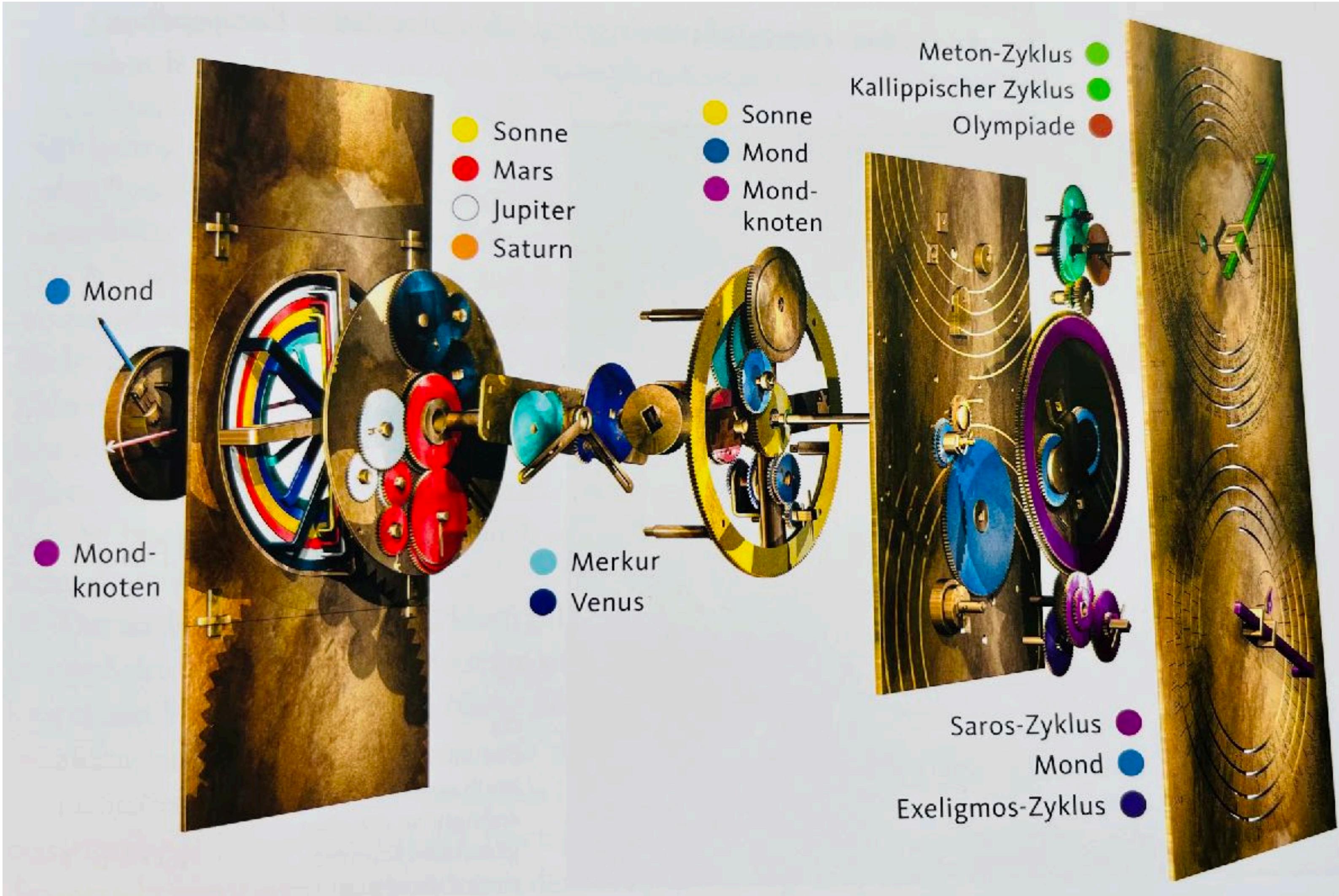


Timing of Eclipse lunar ( $\Sigma$ )  
and solar ( $H$ ) in PTM

# The Mechanism of Antikythera (3)

## Complete Analysis and Reconstruction:

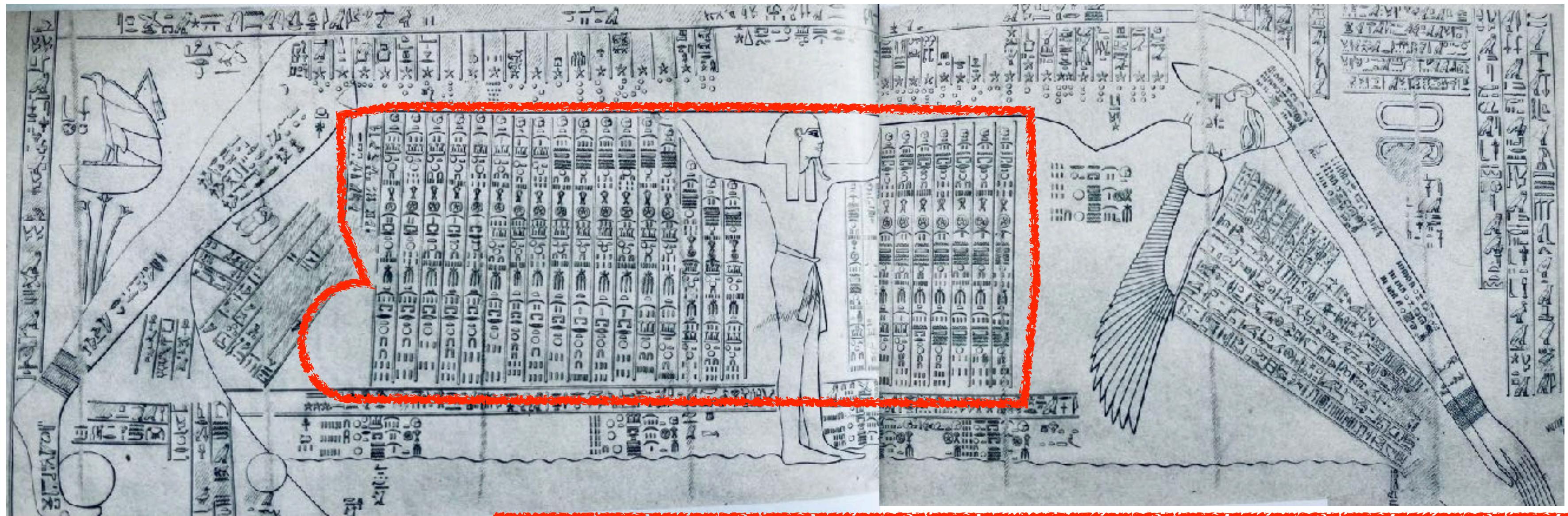
- Metonic and Kallipic Cycle
- Egyptian Calendar
- Position and phase of the moon
- Orbital Nodes of the moon and eclipses
- Position of sun and planets
- Synodic positions of the planets
- Olympiads and other periodic festivals
- Methon Cycle discovered ca. 500 BC Babylon
- Kallipic Cycle described 370 BC
- Connected to Archimedes (Cicero)
- Possibly built Appolonius of Perge 265 -190 BC



Source : Maschinenraum der Götter. Wie unsere Zukunft erfunden wurde;  
(c) 2023 Liebieghaus Skulpturensammlung

# Science and Engineering

Source : Maschinenraum der Götter;  
Wie unsere Zukunft erfunden wurde;  
(c) 2023 Liebieghaus  
Skulpturensammlung



Nut, goddess of the night covers the position list of the 36 dekan stars;  
Drawing of the stone relief in the ceiling of the tomb for Osireions Abydos,  
Egypt 1294 - 1279 BC

## Historic conditions :

- Development of scripture
- Tradition and Teaching

## First documented science (Egypt) :

- Astronomy
- Mathematics
- Medicine

# Information versus Knowledge (1)

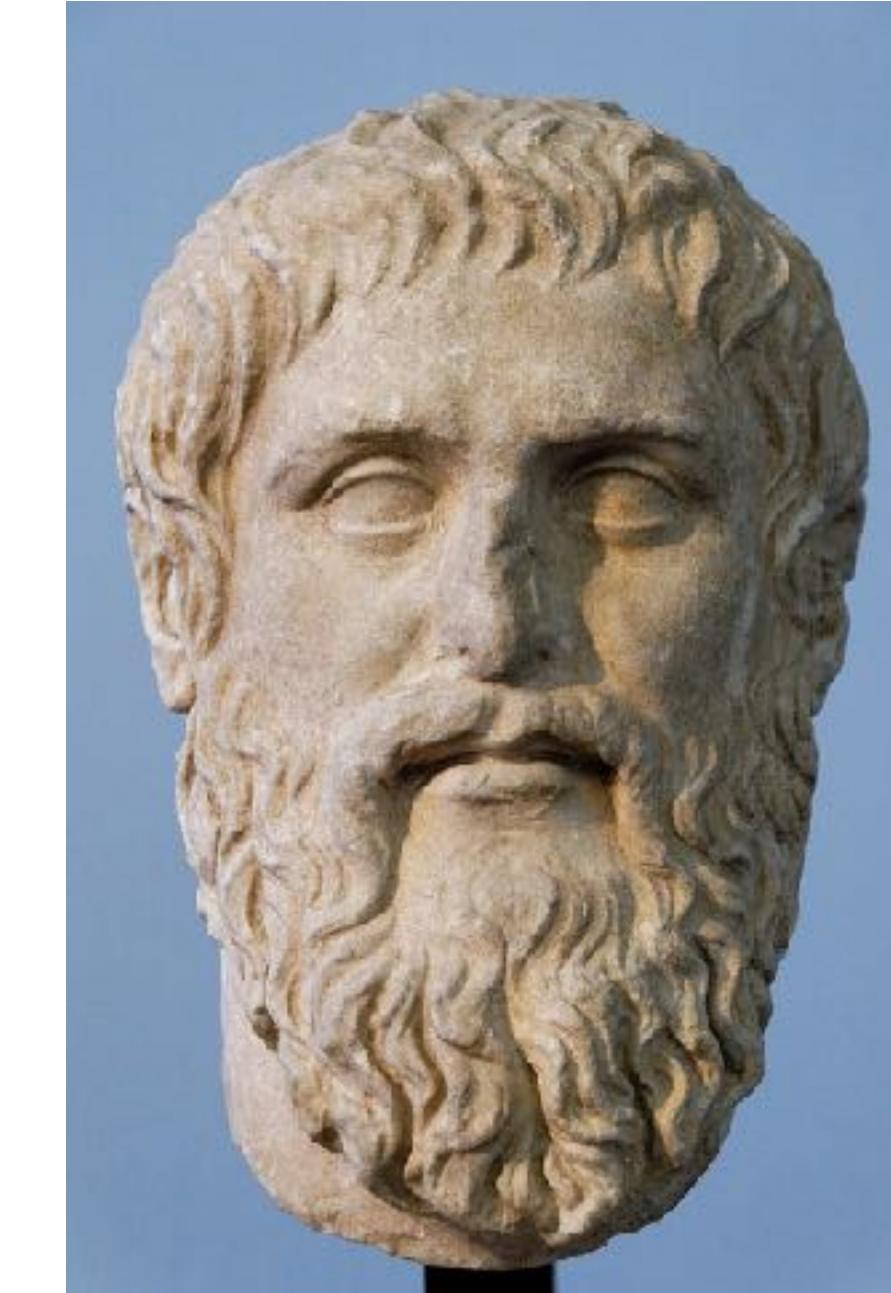
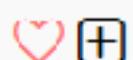


[Bill Gates Quotes](#)



Information technology and business are becoming inextricably interwoven. I don't think anybody can talk meaningfully about one without talking about the other.

[Bill Gates](#)



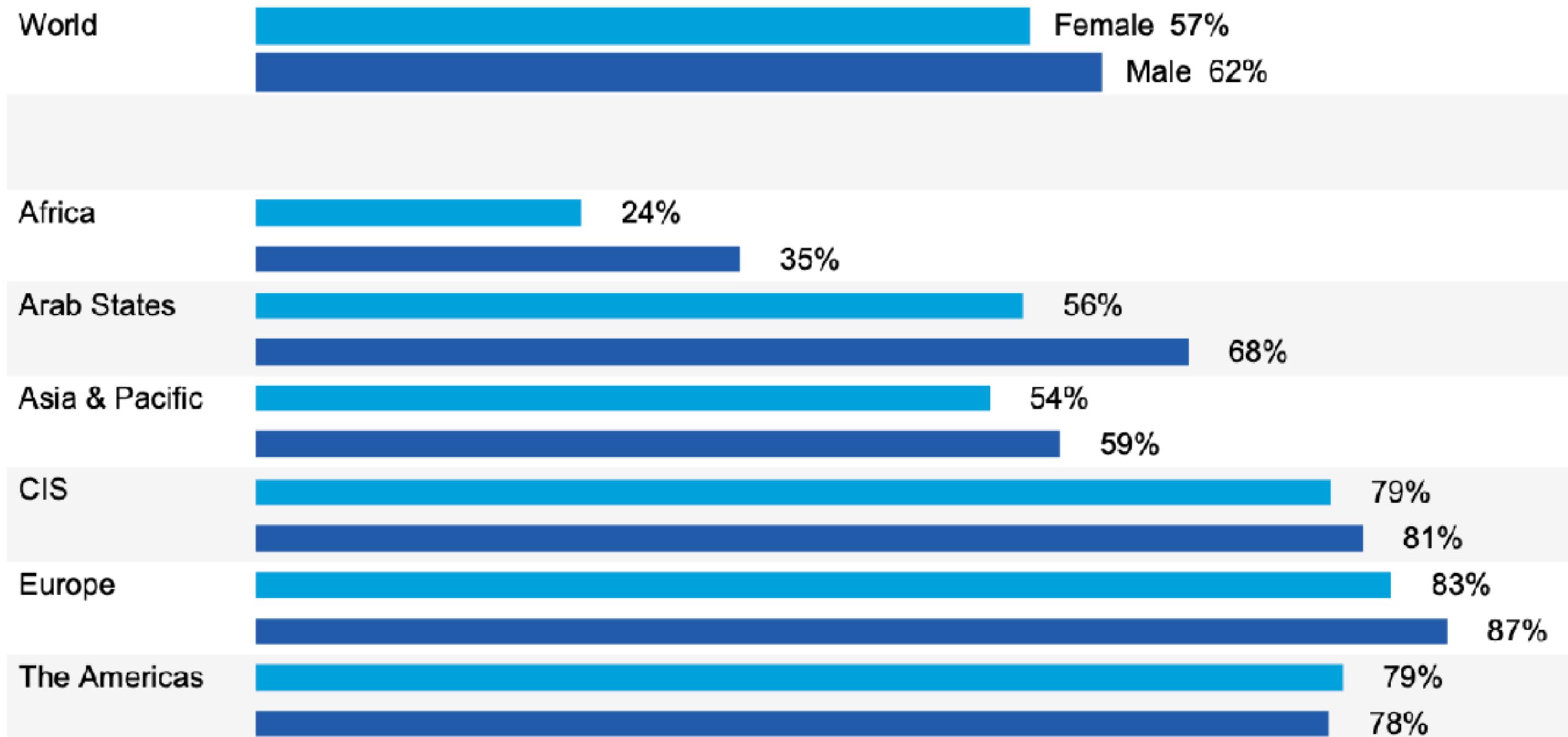
Source : WIKIPEDIA ;  
Roman copy of a Platon portrait bust by Silanion for the Academia in Athens (ca.370 BC)

Platon ( 427 - 348 BC) :

- Justified
- True
- Believed

# Information versus Knowledge (2)

Percentage of female and male population using the Internet, 2020



Source : *itu International Telecommunication Union FactsFigures2021.pdf*

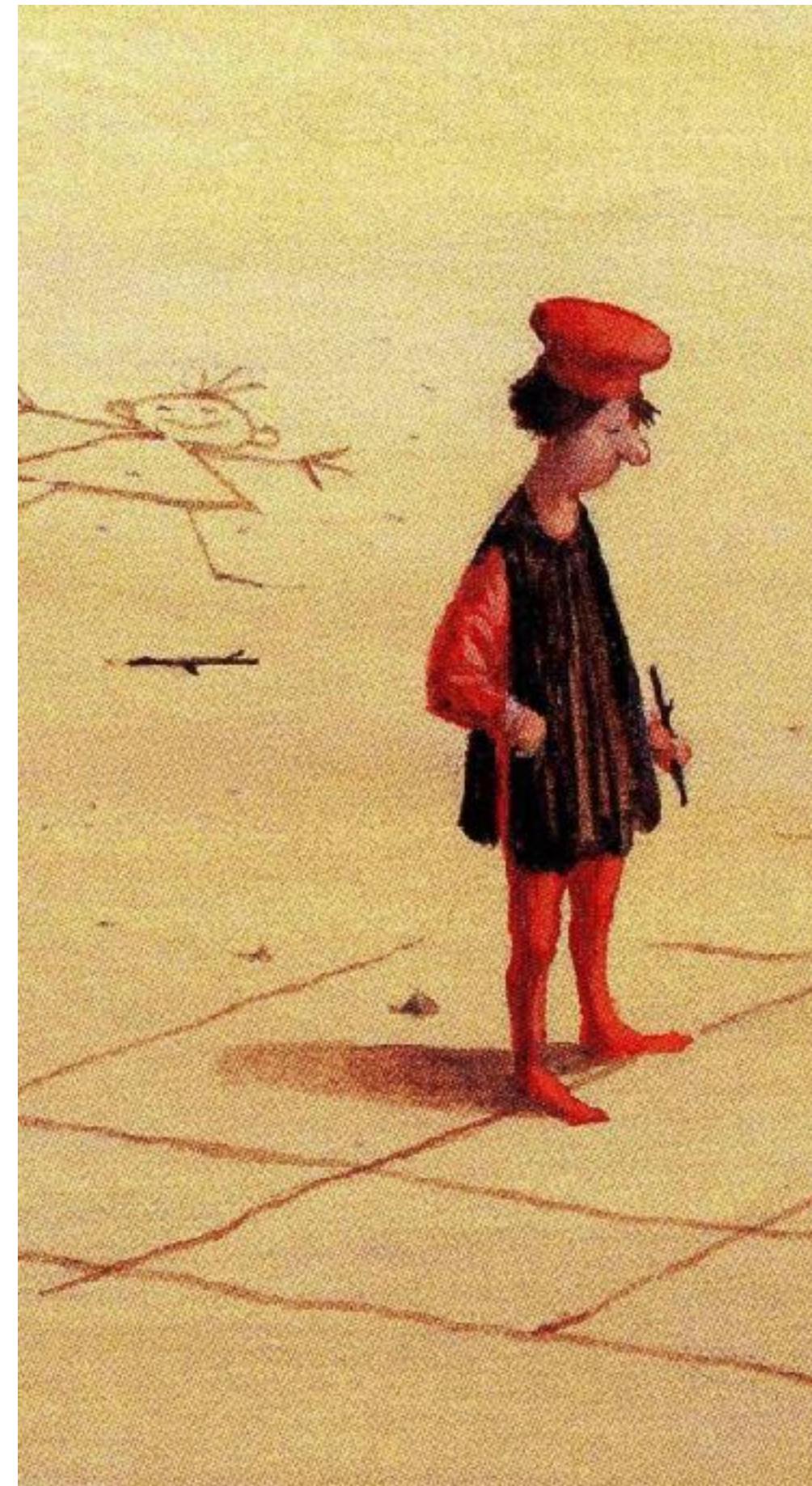
GDP per capita 2021

Country		GDP	Rang
Luxembourg	LUX	117'846.14	1
Singapore	SGP	98'520.03	2
Switzerland	CHE	71'745.30	6
United States	USA	63'206.52	10
Germany	DEU	54'844.55	19
Russian Federation	RUS	29'812.21	58
Chile	CHL	25'110.16	67
Equatorial Guinea	GNQ	17'940.52	90
China	CHN	17'210.76	92
Ukraine	UKR	13'054.76	123
Jordan	JOR	10'355.01	144
India	IND	6'503.95	163
Guinea	GIN	2'817.32	212
Congo, Dem. Rep.	COD	1'141.82	236

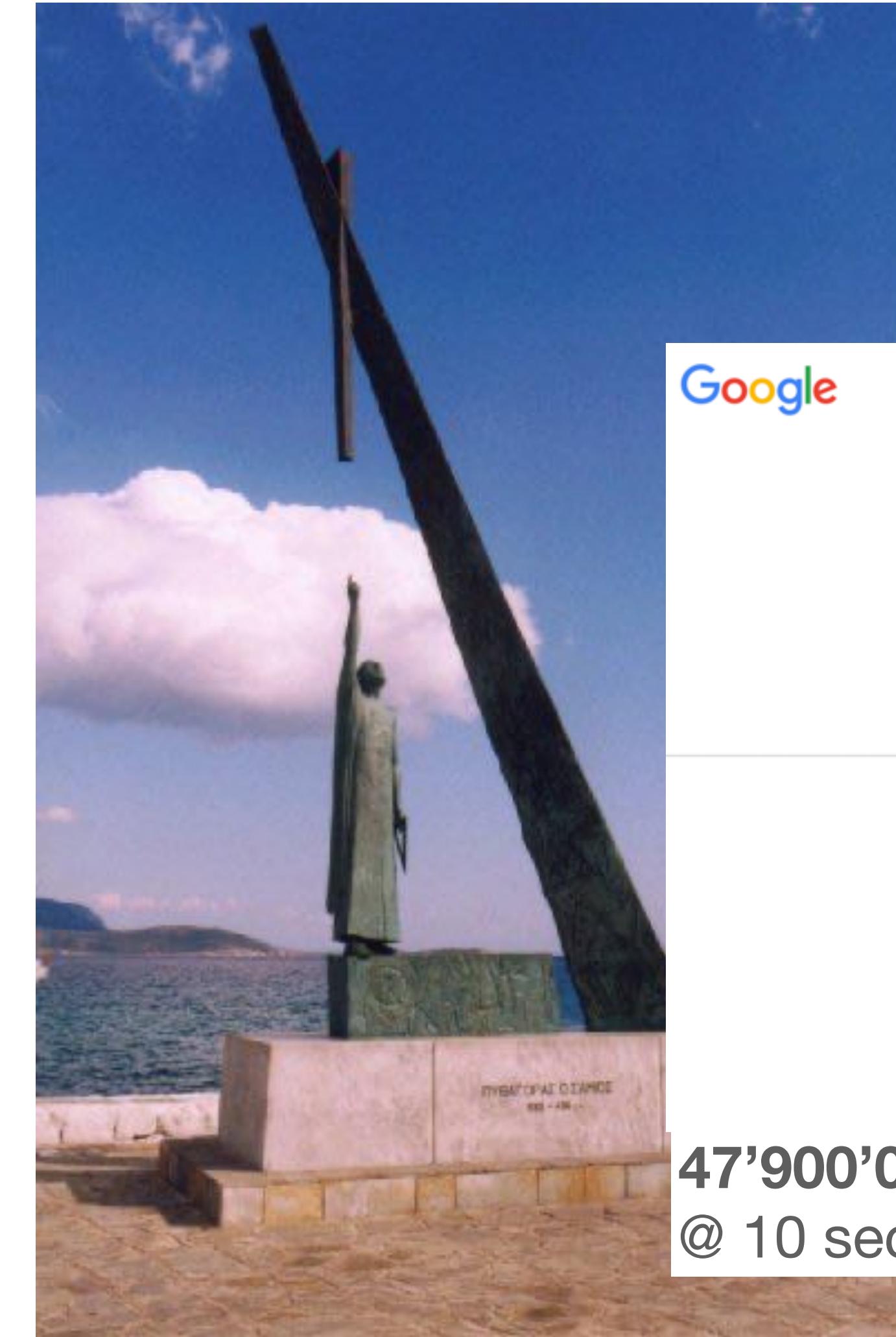
Source : World Bank; <https://datatopics.worldbank.org/world-development-indicators/themes/economy.html#gross-national-income>

GDP Gross Domestic Product: measure of all goods and services produced by country

# Intro Research: information vs knowledge (3)



Scientists :  
- Observe  
- Explain  
- Predict  
Phenomena



Pythagoras Statue at Samos

What we know :

- Empirical
- Theoretical
- Practical

pythagoras formula

All Images Books Videos News More

About 47,900,000 results (0.61 seconds)

Pythagorean theorem :

Formula

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

$a$  = side of right triangle

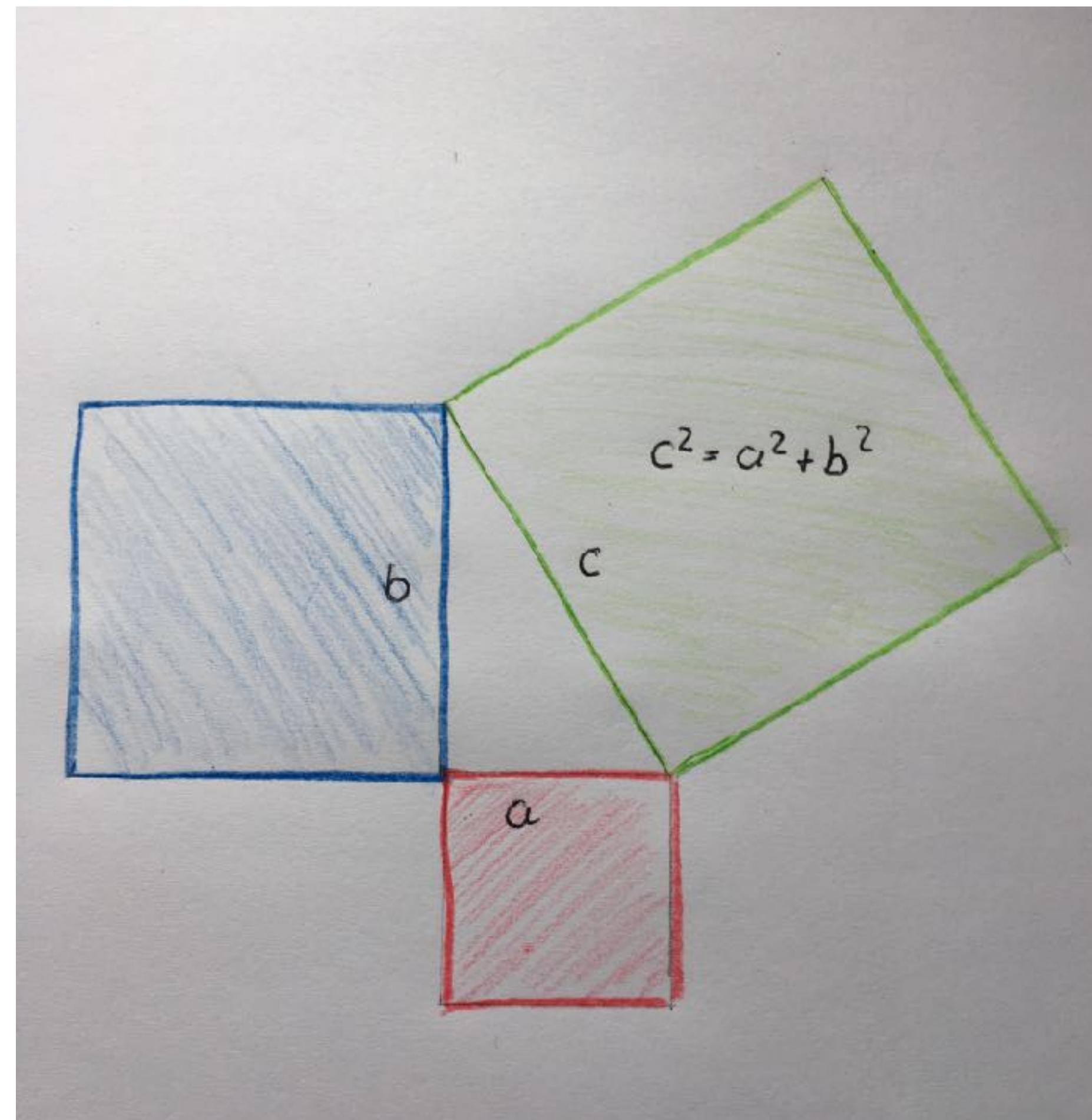
$b$  = side of right triangle

$c$  = hypotenuse

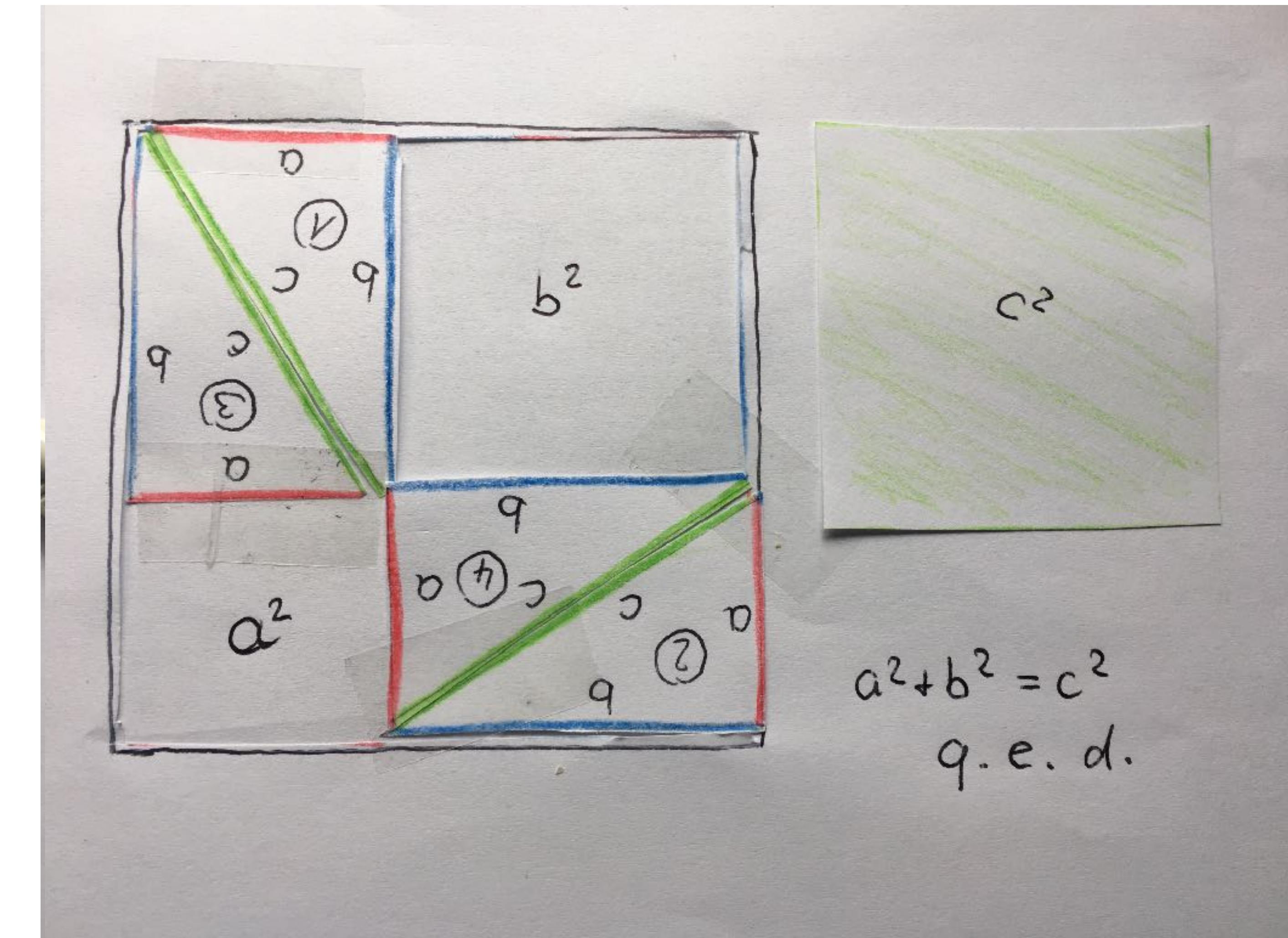
47'900'000 results :

@ 10 sec reading time ~ 65 years of work

# Intro Research : information vs knowledge (4)



Pythagoras Theorem



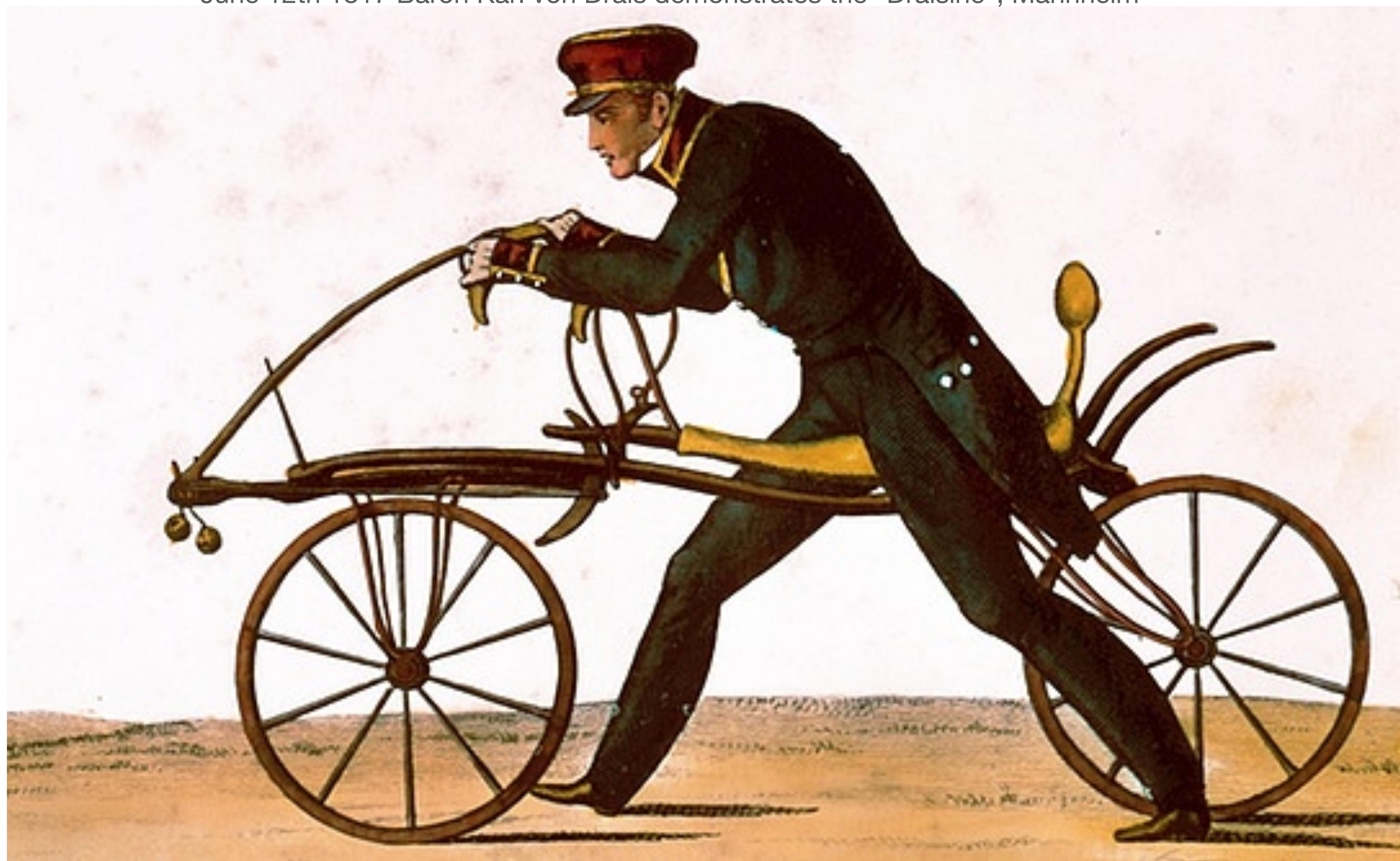
# Creativity (1)

June 12th 1817 Baron Karl von Drais demonstrates the “Draisine”; Mannheim

What is it ?

It creates something :

- New
- Valuable
- appropriate



# Creativity (2)

It is relevant to :

- solve issues in the job and every day life

Will lead to :

- new scientific findings
- new objects of art
- new inventions
- New social programs
- New political movements

BUT ! What is it really ?

....it is of paramount economic importance

# What is creativity ?

It is what the Muses will fill in the empty container of our souls : inspiration (Plato)

It is a special way of thinking(s) (data based, intuitive, critical, generative . . .) (deBono)

It arises from the tension between conscious reality and unconscious drives (desires) (Freud)

It is measurable in simple testing : fluency (n), flexibility (cat); originality ; elaboration (Torrance)

It is generative and explorative thinking (smith Ward and Finke)

It is a synthesis of out-of-the-box, analytical-critical and practical-contextual thinking Sternberg)

BUT ! What is it really ?

Torrance Test

# What is creativity ? Torrance Test

This is a shoe box



You have 5 min:

- Imagine different use(s)
- Give an elevator talk

....it is 90% transpiration and 10% inspiration !

BUT ! What is it really ?

# Limitations to creativity

- Money : controlling cost is always at the core of any successful enterprise (project)
- Time : Time is Money but also, it cannot be bought for money
- Mother Nature : her laws are to be observed under any circumstances
- Customer : At the end it only counts his/her satisfaction
- Capacity : you have to win the championship with your team
- The law makers : There is no better way to spoil your day

BUT. . . . are these really limitations ?

# Balancing

Money :

Development Budget and Business Plan 

Time :

Realistic estimation of steps and gateways (-30% rule) 

Mother Nature :

Knowledge in theory and experience 

Customer :

know your customer's thinking 

Capacity :

you are as good as the team behind you 

The law makers : Read things which are absolutely boring 

# Creativity Training

A small little test for you :

Mobile phones provide excellent records of best practice, repairs, navigation, cooking etc.

Alas, you may want to follow the instructions on screen and use both hands. Build a device which is universally applicable for using screen based instructions from your smart phone

You shall not spend more than 40€

You shall build and install in max. 1 to 2 hrs.

You shall be done in 60min

Group 1 : paper and pencil

Group 2 : laptop

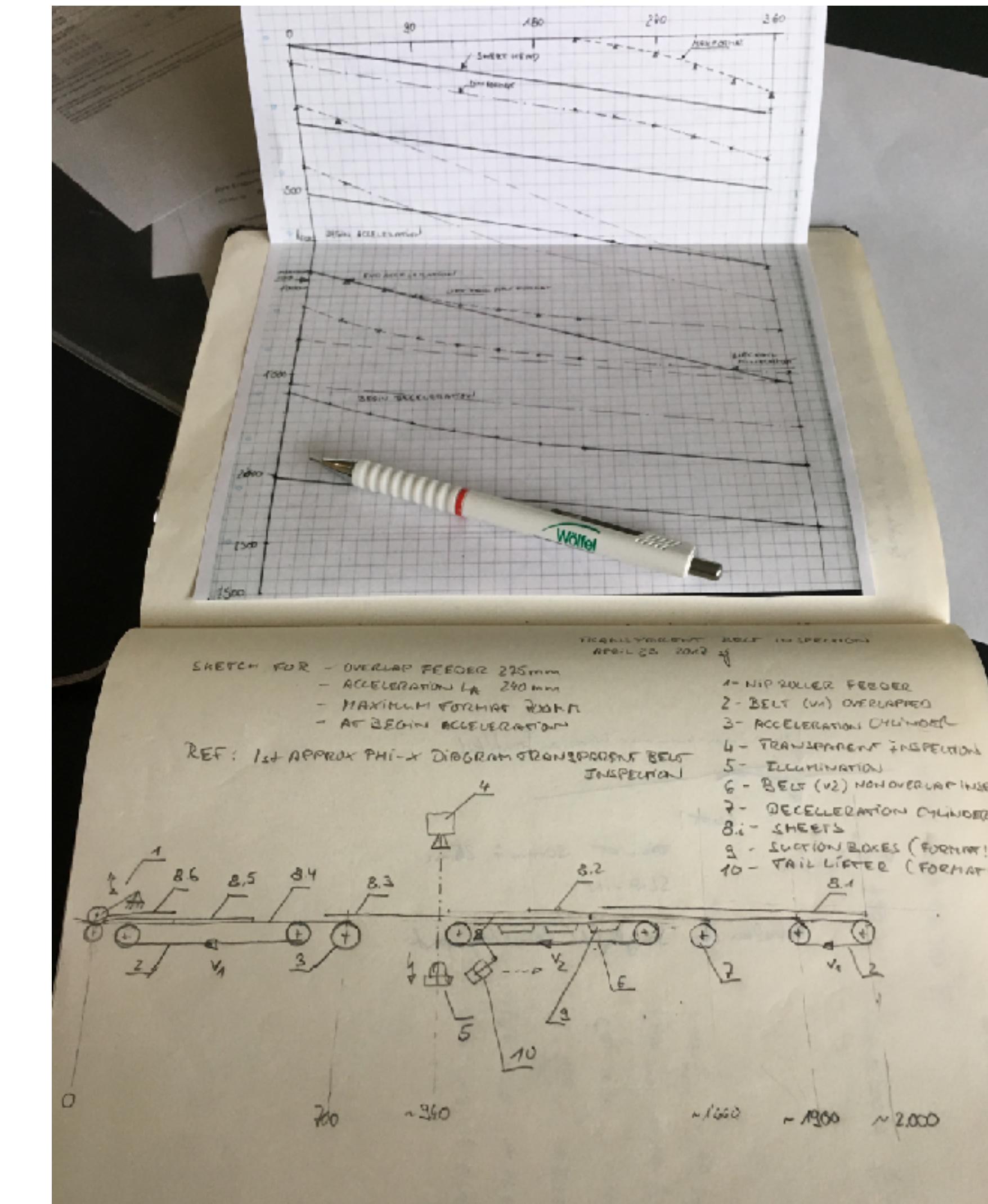
MONEY

TIME

CUSTOMER

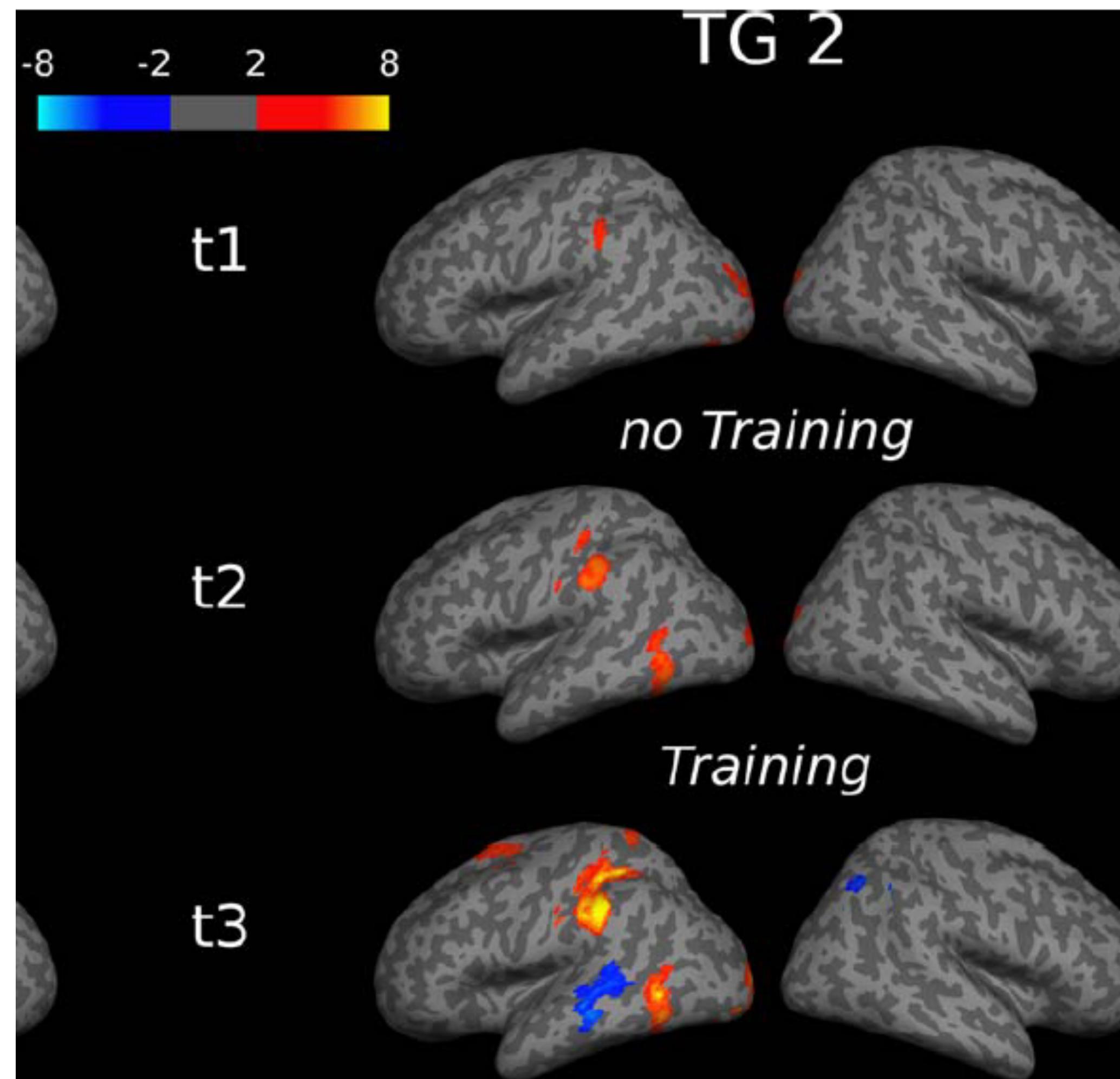
MOTHER N

# Creative Tools (2)



Anything you can design with a sheet of DIN4 paper and pencil cannot be too complicated to manufacture (Wolfgang Richter)

# Creative Tools



Source : Human Brain Mapping 36:4104–4115 (2015)

Training of Verbal Creativity Modulates Brain Activity in Regions Associated with language- and memory-Related Demands

Creativity demands computing capacity in your cortex

Computing Capacity is about 10 FLOPS<sup>1)</sup>

i.e. our capacity is limited

1) FLOPS : Floating Point Operations per Second

# A small little exercise

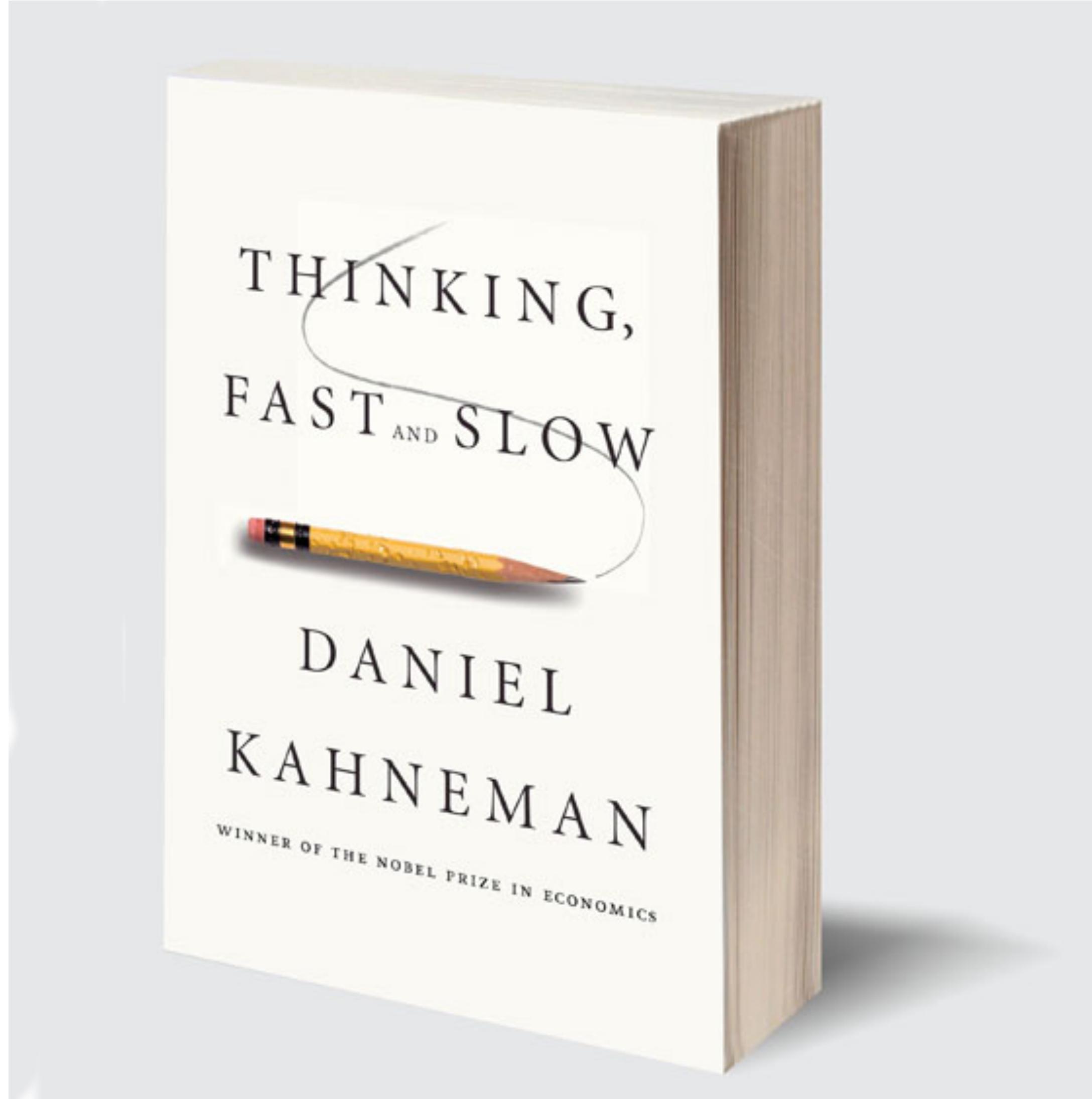
A small little exercise for you :

You have learned about the most important limits and balancing parameters for creativity.

It is always good to apply the theory to a practical exercise.

- Select one of your favourite projects you have realised (at school or in industry) and identify the parameters in this project
- Point out what your most difficult parameter has been
- Make a 5min presentation for your colleagues for next lesson to explain

# A reading recommendation



Thank you, and  
have fun !