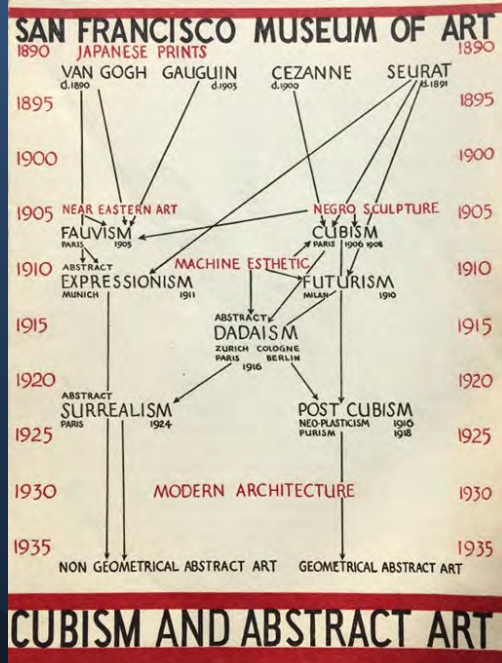


Physics and Arts

some thoughts ... “in progress”



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the European Union**



In 1610 Galileo Galilei in a letter to some of his correspondents (among them some Jesuits and Johannes Kepler) wrote:

*smaismrmilmepoetaleumib
unenugttairas*

Saturn devouring his children

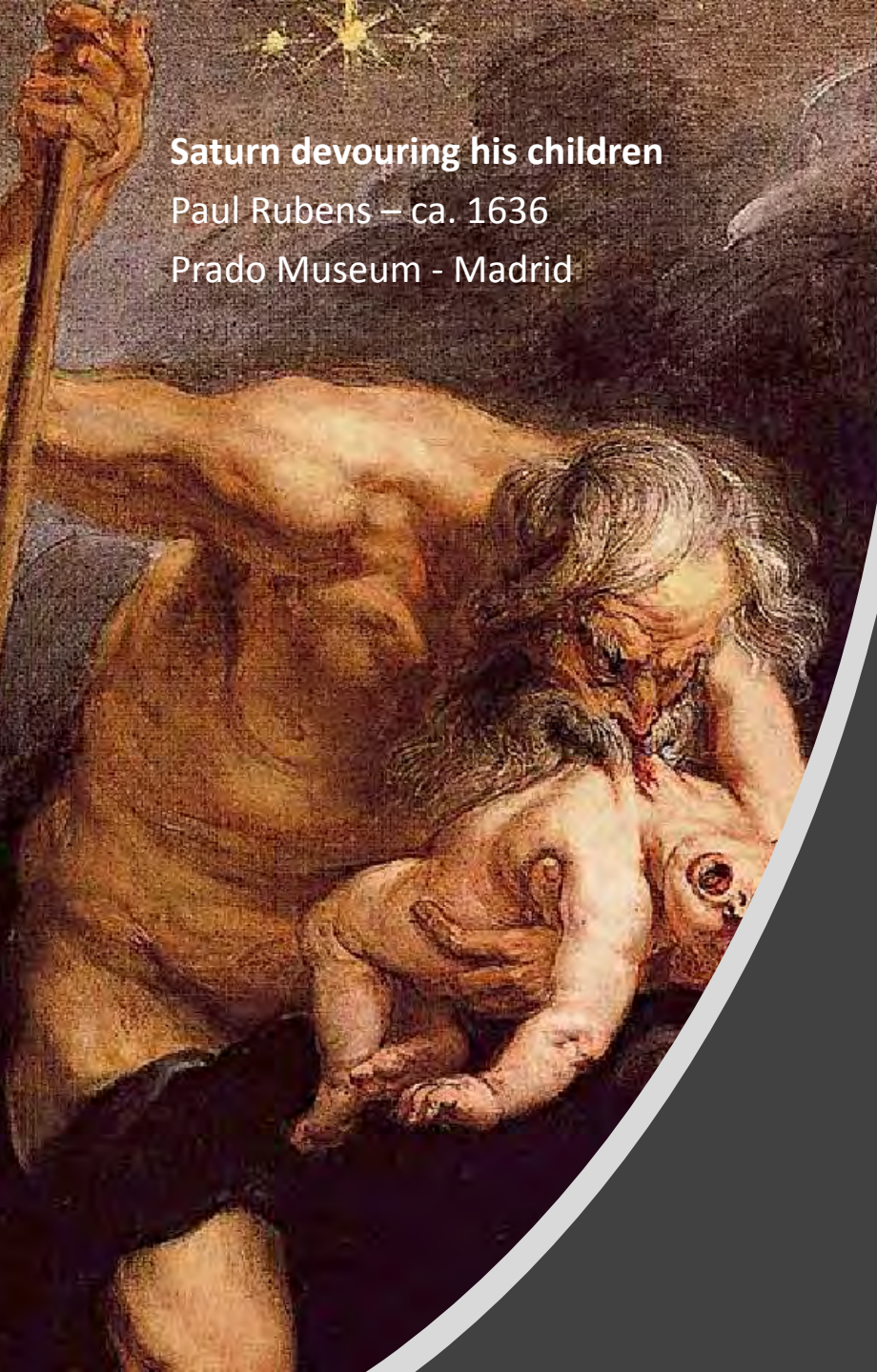
Paul Rubens – ca. 1636

Prado Museum - Madrid

Saturn devouring his children

Paul Rubens – ca. 1636

Prado Museum - Madrid



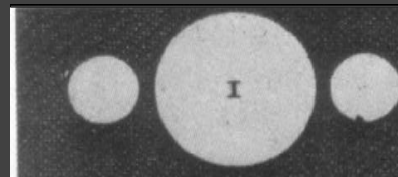
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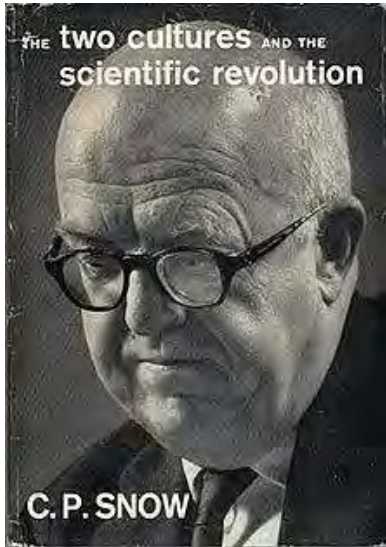
*smaismrmilmepoetaleumib
unenugttauras*



***Altissimum planetam tergeminum
observavi..***

...I observed the highest (more distant) planet
as a triple star





(rather trivial) ansatz of our project:

Humans evolve slowly from a biological point of view, but since the Neolithic, we, as a species, have passed the «biological teleonomic filter» stage and...

... we adapt to a changing environment through culture shifts and not anymore through gene mutation ...

In a given society, culture is a «whole» and defines the paradigm through which we perceive and interact with our epoch and with the world

Logic, mathematics, music, art ... are nothing but specialised linguistic structures.

Jean Piaget



**"Have no fear of perfection,
you'll never reach it"**

- Salvador Dali

**Technology affects our perception
(...**AWARENESS** of the **WORLD**...)
and triggers **similar revolutions** in both fields**

The awareness of your time ... is incredibly powerful

So insightful that it might seem magic...



Ippolito Nievo

(Padova 1831- Tirrenian Sea 1861)

Writer, journalist and patriot

In 1860 he writes a short essay (less than 50 pages):

«*Storia Filosofica dei secoli futuri*» ...

Published in ... a satirical journal ...

- Decay of the age of Empires
- Advent of socialism and extreme forms of socialism in Eastern Europe
- East Asia as a leading economic power
- World Wars (I & II)
- Creation of EU
- Explosion of technology and creation of computing machines
- Advent of Artificial Intelligence with the creation of robots (Omuncoli) substituting humans in routinary jobs
- Huge turmoil in a depressed society where most men have no longer a work and a purpose
- Even the advent of minimum wages for unemployed people



“...There are only two types of artists: revolutionaries and plagiarists...”

Paul Gauguin

“... There is a revolutionary science and a paradigmatic one...”

Thomas Kuhn



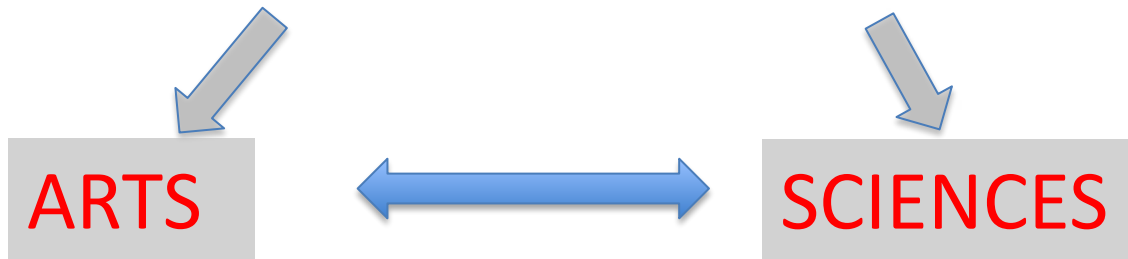
Fra Luca Pacioli
(founder of modern economics)

Revolutionary period (1895-1930)

Photographic process, instruments, thermology, electricity, electromagnetism, etc... change the perception of the world, apex of the colonialism and imperialistic age, apex of industrialization, growth of «socialism and communism», ecc.



Cultural (social) perception of light, space and time change



In the XX century , **many** times **arts precede sciences...**

and ...

some times **sciences precede arts**

the end of the IX century: Paradigmatic period...



Old fisherman (1895)

Science and charity (1893)



- I. **Absolute, true and mathematical time**, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration...
- II. **Absolute space**, in its own nature, without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies ...



I. Newton, Principia



... **Space is not an empirical concept**, generated by external experiences.

Space is not something objective and real, nor a substance, nor an accident, nor a relation; instead, it is subjective and ideal, and originates from the mind's nature in accord with a stable law as a scheme, as it were, for coordinating everything sensed externally.

E. Kant, Critique of Pure Reason, 1770

End of XX century: apex of colonial age

The artworks of «primitive» and oriental artists do not reflect the external appearance of an object but rather the perception of that object by the artist.

... I don't know any inuit who describes space in visual terms. For them **space is not static, hence it is not measurable. They have not units to measure space as well as they have no uniform division for time.** The artist is indifferent to reality and leaves each piece of art free to occupy its own space . By filling it the artwork create its own world without any reference to the background or anything external.

Edmund Snow Carpenter - antropologist

Perception of **space** and **time** in both primitive and oriental cultures (as well as for kids) **is not newtonian.**

For Western standards of the epoch, primitive art shows that a different perception of space and time is possible



Signs on pottery, ropes or fabrics are simple geometrical forms charged of symbolic meaning



1900- Exposition Universelle (Paris – parc du Trocadero)

The apex of the imperial (colonial) age brings to Paris Artefacts from all over the world

This starts a hype for primitive and oriental cultures



«Immortal in splatter
China, XII

Exposition Universelle 1900

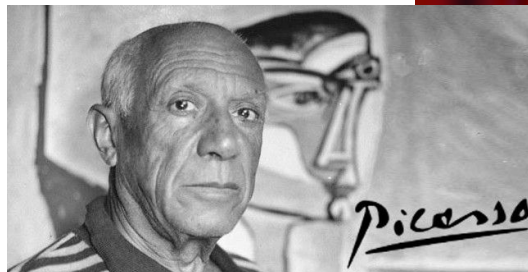
Parc du Trocadero – Vue Générale – Les Pavillons de l'Algérie, de la Russie, du Canada



© 1900- Exposition Universelle (Paris – parc du Trocadero)



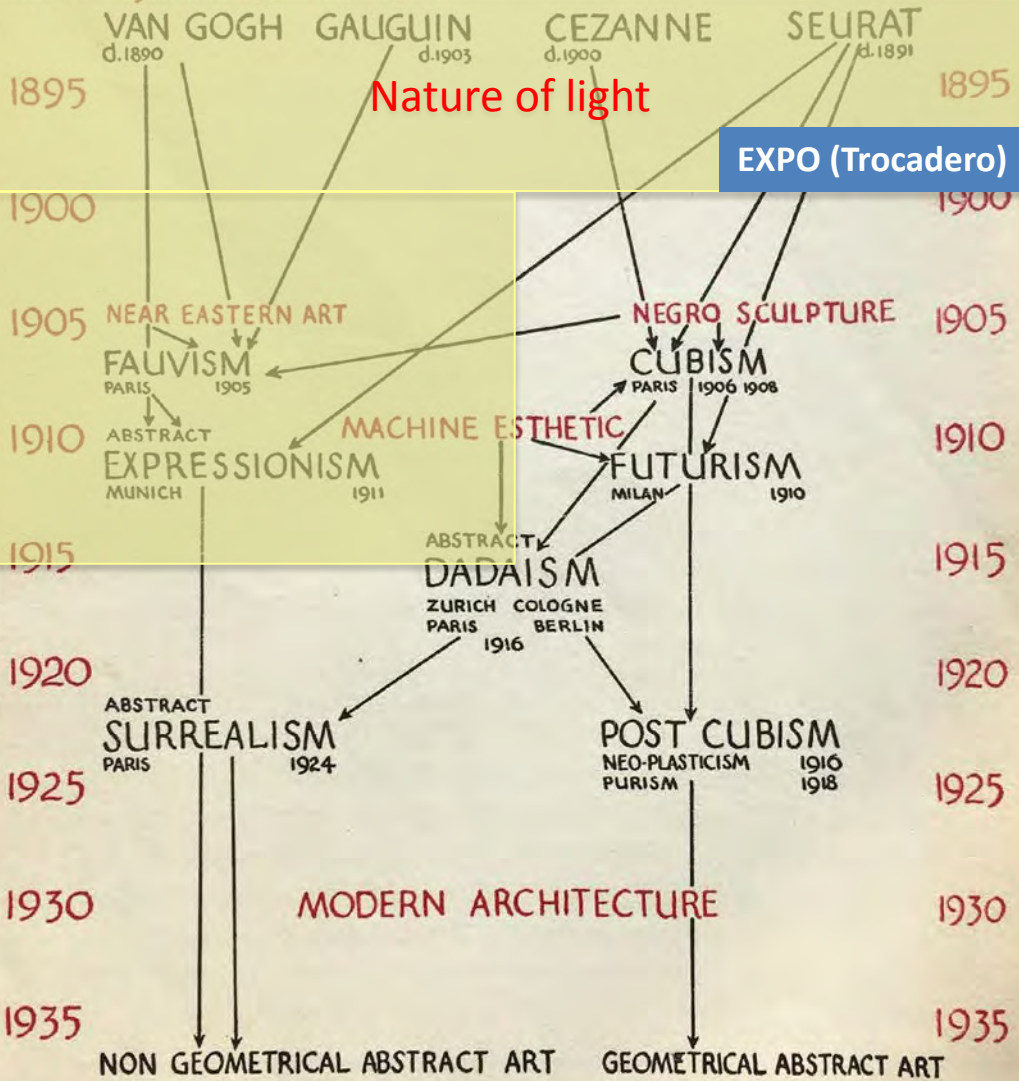
Pablo Picasso (1881-1973)



Les Femmes d'Alger
(1906-1907)

SAN FRANCISCO MUSEUM OF ART

1890 JAPANESE PRINTS 1890



PHYSICS

Planck's Theory

Quantization of light (photons)

CUBISM AND ABSTRACT ART

Arts precedes sciences (by far) in revising the concept of light



Paul Sérusier 1888
The Bois d'Amour à Pont-Aven

La zingara addormentata - Henry Rousseau - 1897



FAUVISM

Fauvism: (beasts, natives) early XX century, short period ... huge impact



The woman with the hat
Henry Matisse (1905)

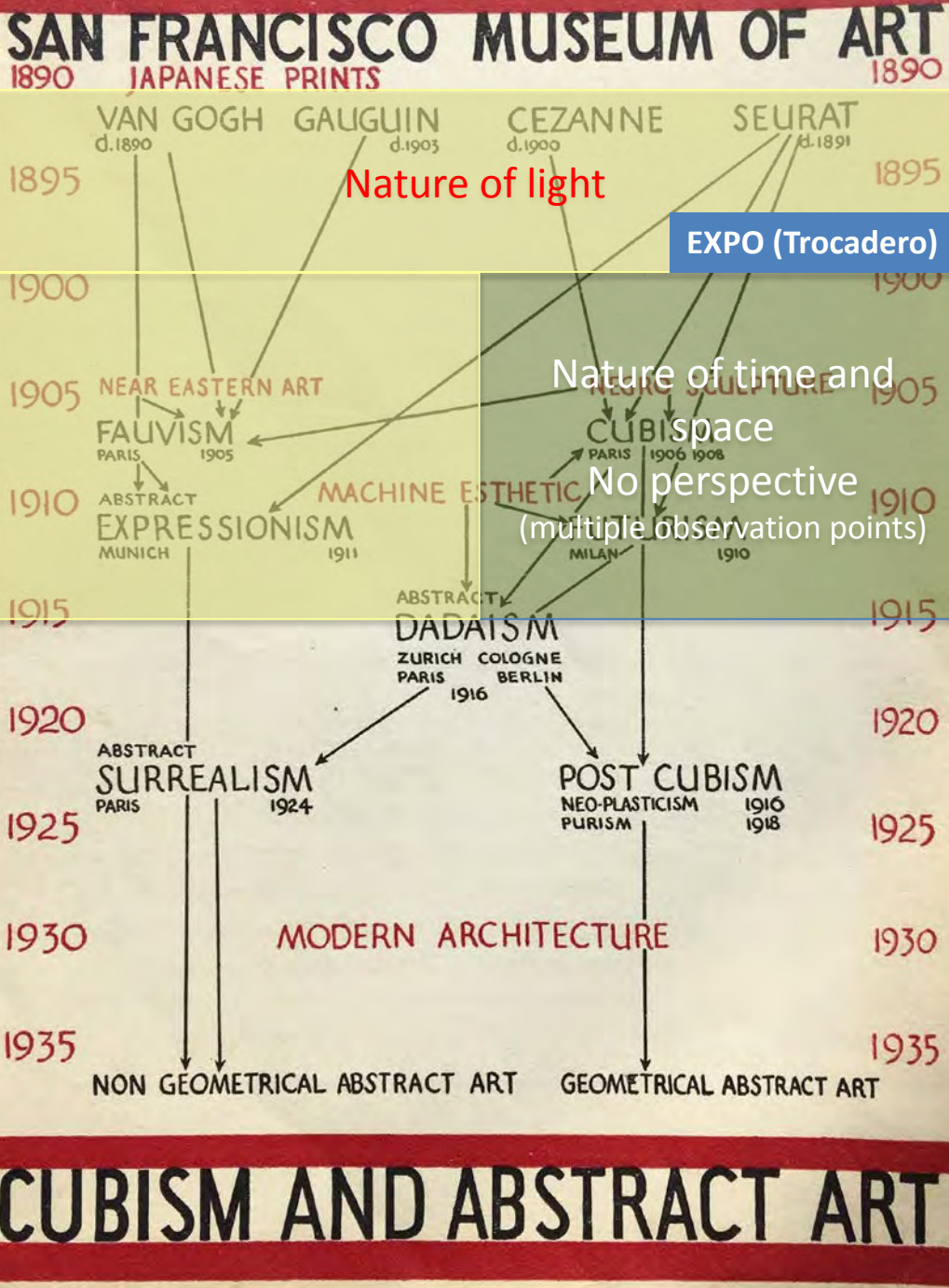


Charing Cross Bridge
André Derain, (1906)

The realism of the impressionism is abandoned in favour of a strong chromatic impact ... **light becomes color.**

Post Impressionism (Les Nabis)

PHYSICS



Planck's Theory

Quantization of light (photons)

Special relativity
Photoelectric effect
Brownian motion

Space and time non absolute, photons

Space and time become relative and interconnected

Role of the observer-observed pair appears in Physics



Cubism and space



Many consider this the most important event in modern art (1907-1920)

Cubism unifies space and time

An object is decomposed in visual fragments which are redistributed over the canvas so that the **observer cannot see them in any sequence (neither spatial nor temporal)**

... all fragments are perceived simultaneously by the observer

... there is no there, there...

... there is **no clear distinction between observer and observed**

Gertrude Stein

Houses at l'Estaque - George Braque (1908)



Violino e candela - Georges Braque 1910



Zapata style landscape - Diego Rivera 1915

John Berger identifies the essence of Cubism with the mechanical diagram.

"The metaphorical model of Cubism is the diagram: The diagram being a visible symbolic representation of invisible processes, forces, structures.

A diagram needs not eschew certain aspects of appearance but these too will be treated as signs, not as imitations or recreations.

John Berger

**THE MOMENT OF
CUBISM**
and other essays



PANTHEON BOOKS
A Division of Random House, New York

SAN FRANCISCO MUSEUM OF ART

1890 JAPANESE PRINTS 1890

1895 VAN GOGH d.1890 GAUGUIN d.1903 CEZANNE d.1900 SEURAT d.1891 1895

1900 EXPO (Trocadero) 1900

1905 NEAR EASTERN ART FAUVISM PARIS 1905 CUBISM PARIS 1906 1908 1905

1910 ABSTRACT EXPRESSIONISM MUNICH 1911 MACHINE ESTHETIC MILAN 1910 1910

1915 ABSTRACT DADAISM ZURICH COLOGNE PARIS BERLIN 1916 1915

1920 ABSTRACT SURREALISM PARIS 1924 POST CUBISM NEO-PLASTICISM PURISM 1916 1918 1920

1925 1925

1930 MODERN ARCHITECTURE 1930

1935 NON GEOMETRICAL ABSTRACT ART GEOMETRICAL ABSTRACT ART 1935

CUBISM AND ABSTRACT ART

PHYSICS

Planck's Theory

Quantization of light (photons)

Special relativity
Photoelectric effect

Space and time non absolute, photons

General relativity

Space and time are merged

Quantum mechanics

Observer & observed are entangled

Our world becomes 4 dimensional...
space and time are inextricably entangled.

Observer and observed become entangled

Nature of light

Nature of time and space
No perspective
(multiple observation points)



Physics

1924 – De Broglie demonstrated the double nature of particles (wave and particle) and finds an equivalence between matter and light

1925 – Werner Heisenberg formulates quantum mechanics

1926 E. Shroedinger provides a new approach to quantum mechanics



There is no clearcut separation between observer and observed (nature is intrinsically affected by the observer)

Some parameters in the physical world are entangled (eg: space & time, position and momentum, energy and time,)



Futurism and time



«Manifesto Futurista»
Filippo Tommaso Marinetti – 1909

Technical manifesto of Futurism (1914)

... in the futurist work is always present the search for dynamism (speed); the subject is never still but moves: an horse has not four legs but twenty

In this way the simultaneity of **vision takes into account the movement and the changing status of a subject.**

Perception **DEPENDS ON THE OBSERVER-OBSERVED** pair



Il Ciclista – Natalia Goncharova 1913



1911-1914 in Paris in Gertrude Stein Atelier

Mix of futurism, cubism and fauvism

Joseph Stella - Battle of Lights (1913)

Yale University Art Gallery

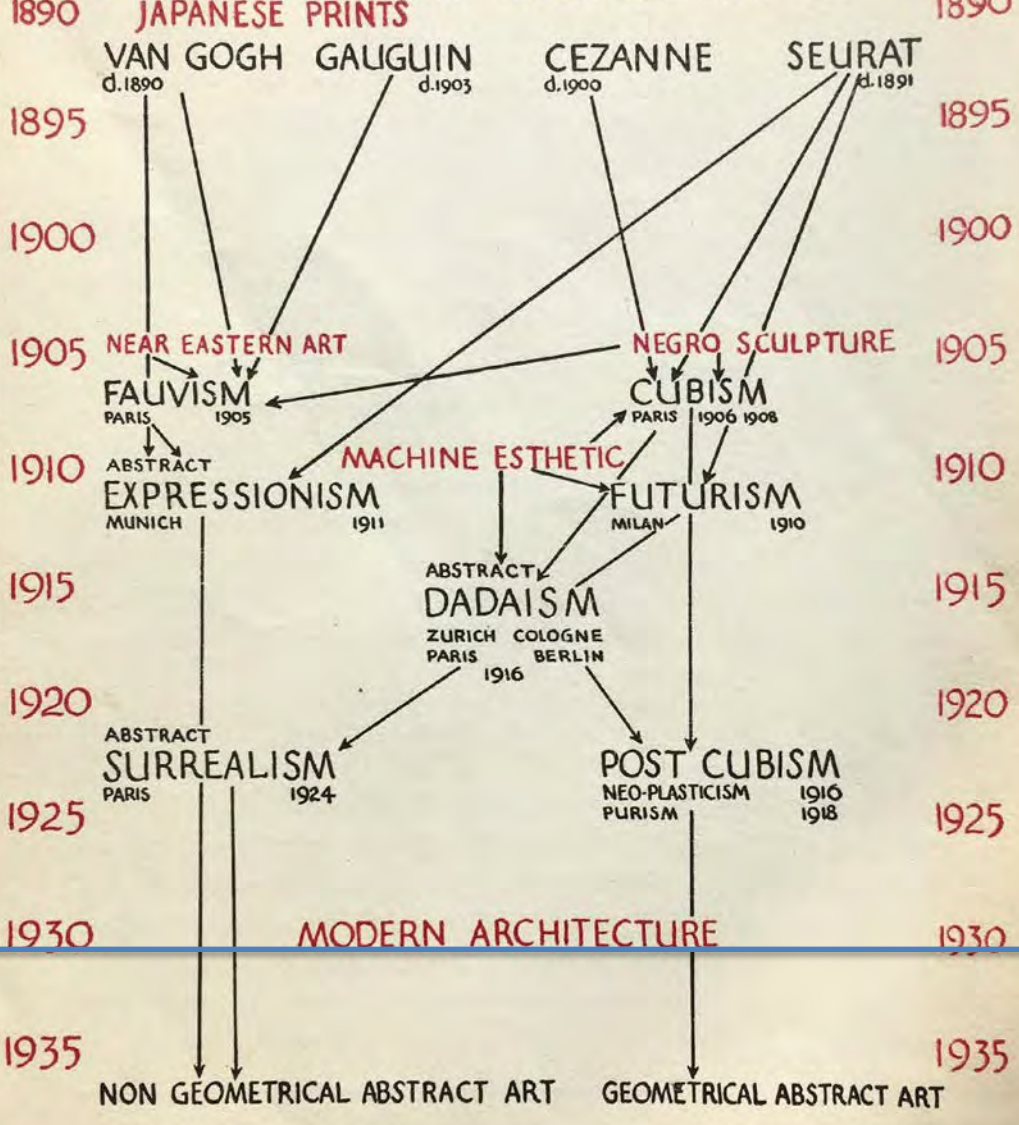
*Both in sculpture and painting, futurist mainly use the concept of «**field lines**» because these lines act on the observer pointing him in a direction, this line by covering different positions go beyond their nature of simple segments and introduce centrifugal and centripetal forces creating a chain of «simultaneous contrasts» and the so called «Universal dynamism».*



U. Boccioni (1910-11)

La Città che Sale

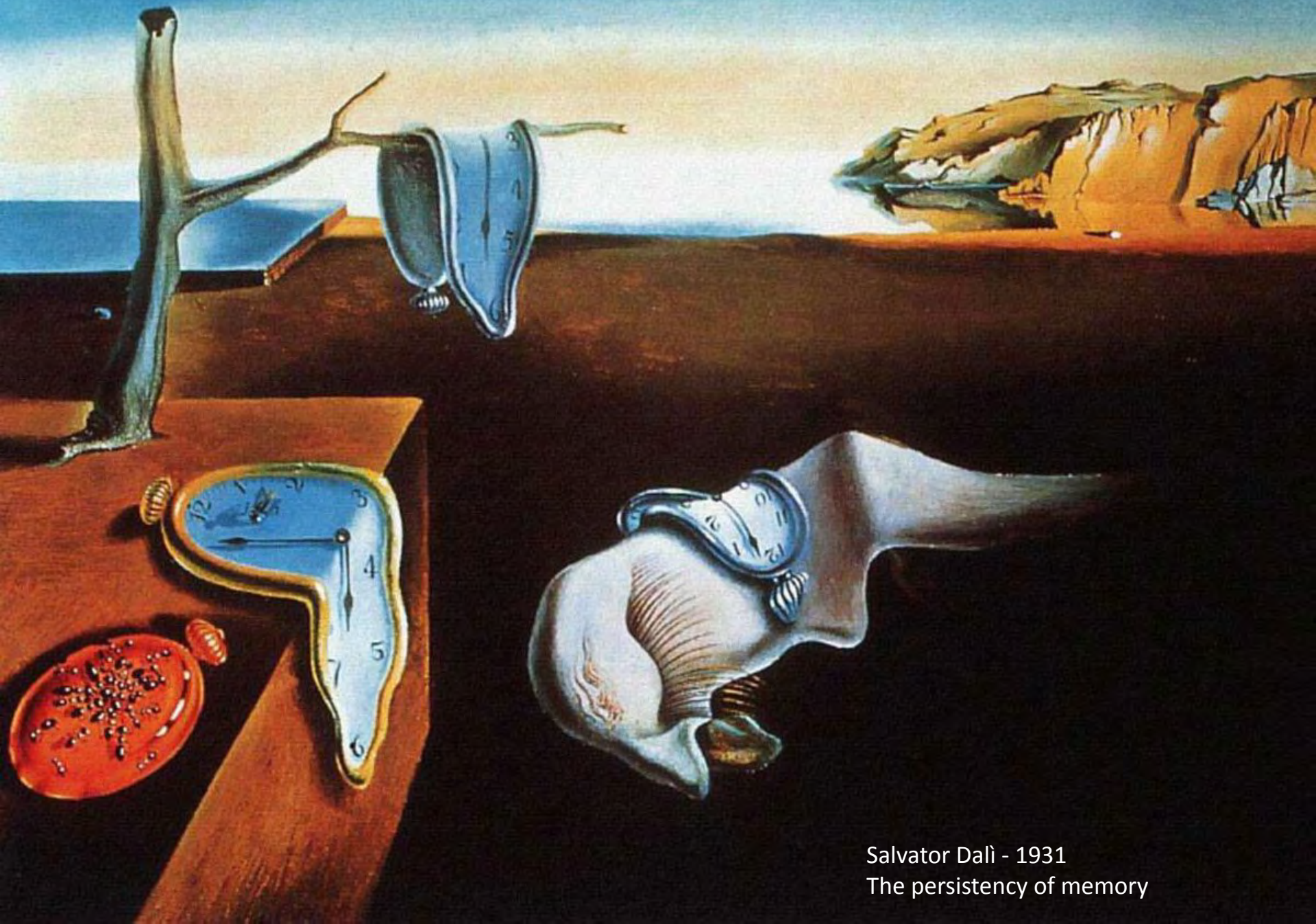
SAN FRANCISCO MUSEUM OF ART



A new paradigm is established both in arts and in science

CUBISM AND ABSTRACT ART

Surrealism and relativistic distortions

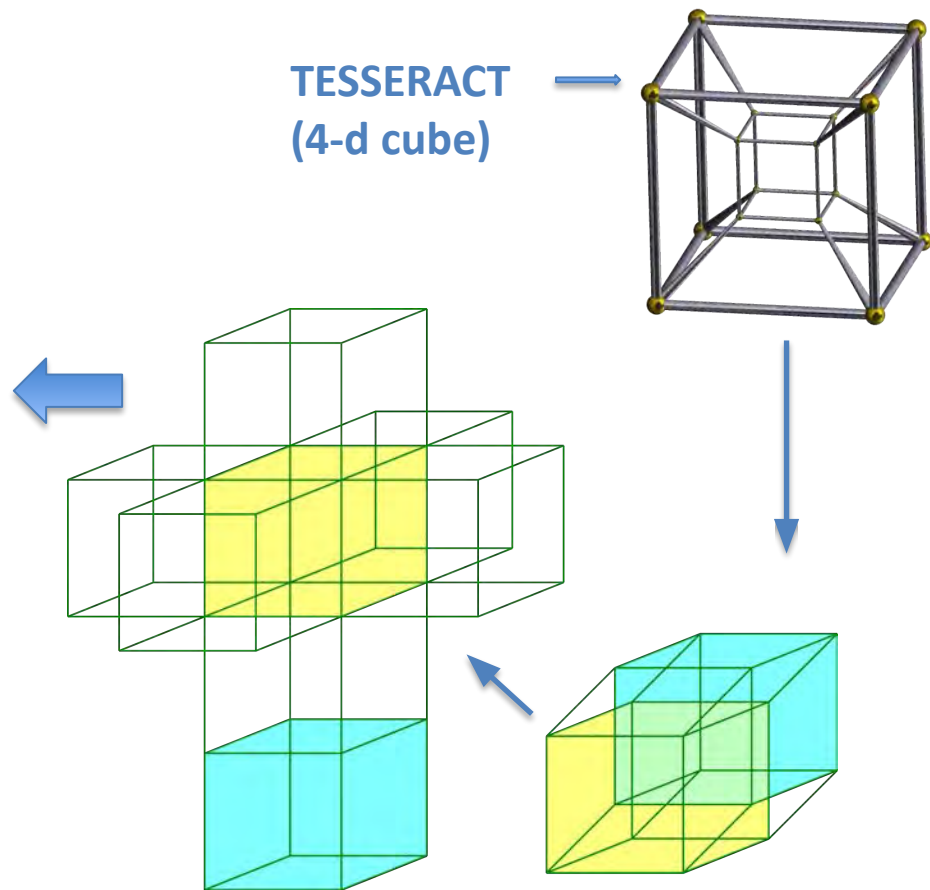


Salvador Dalí - 1931
The persistency of memory

Corpus Hypercubus - 1954
Salvator Dalì

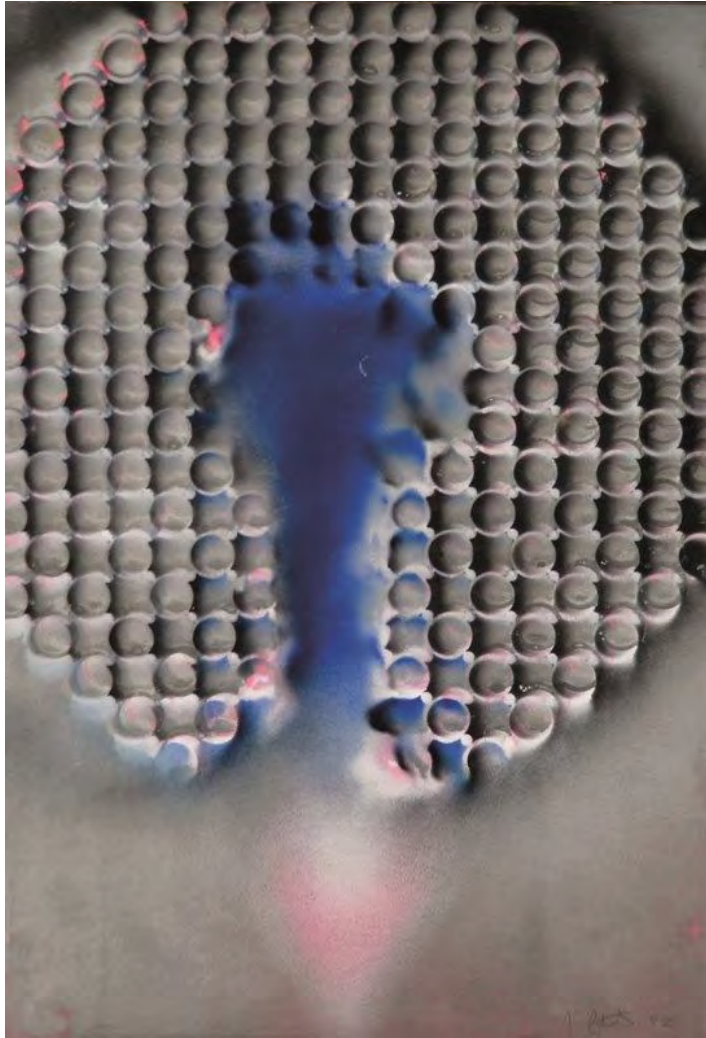


Space and time form a 4 dimensional continuum



3 - d projection of a 4-d cube

When society confronts with new stimuli (even though not yet perceived as such) a new way of thinking emerges through the ingestion of non familiar images and concepts



Franco Costalonga

... Revolutionary arts and revolutionary science create symbolic languages for abstract ideas which cannot be (yet) expressed by words.

... revolutionary art is a **pre-verbal status** of human knowledge, where images come first and words second .

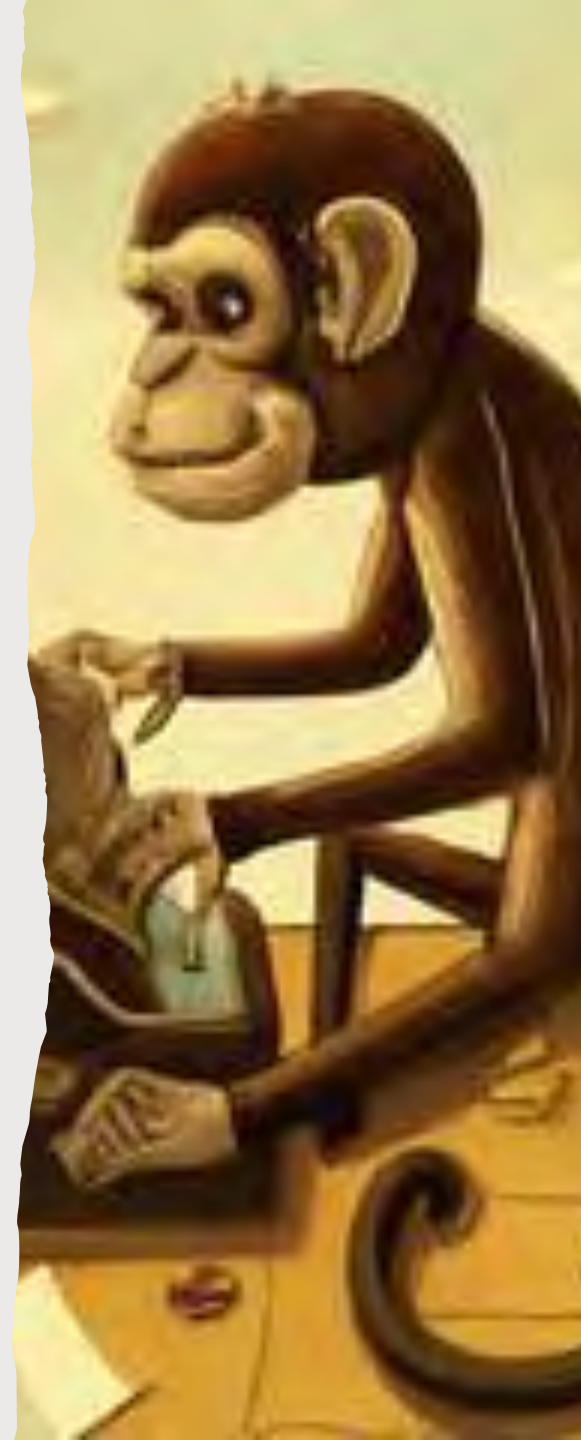
... Revolutionary science is a formal change of human knowledge which translates the new perception into the **formal language** of science .



We live in a revolutionary age started by the advent of Artificial Intelligence

- Infinite monkeys theorem

Cf. Jonathan Swift – Gulliver's Travels



We live in a revolutionary age started by the advent of Artificial Intelligence

Deep learning is largely built on an attempt to reproduce the mechanism of human vision (aka perception)

any phenomenon, art work, literature masterpiece, music piece, can be described as a sample in a very complex probability distribution ...

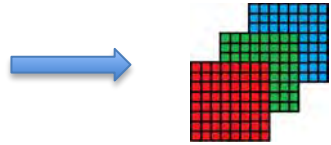
... **incredibly complex** But always of **finite**

complexity...

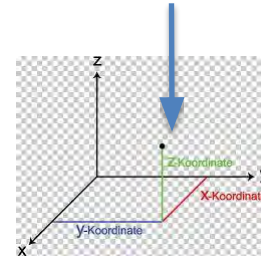
Image of a painting



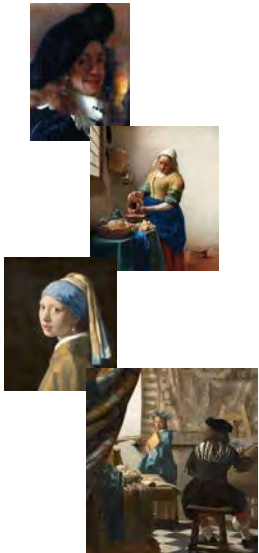
Corresponding numerical matrix (1000 x 1000)



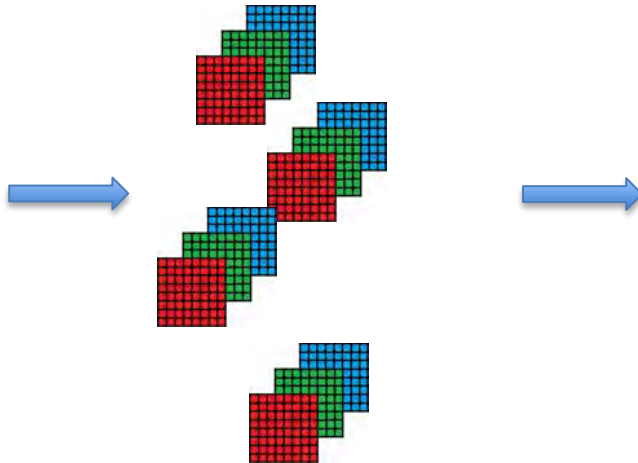
Same painting in the 3 million dimensional space defined by all images



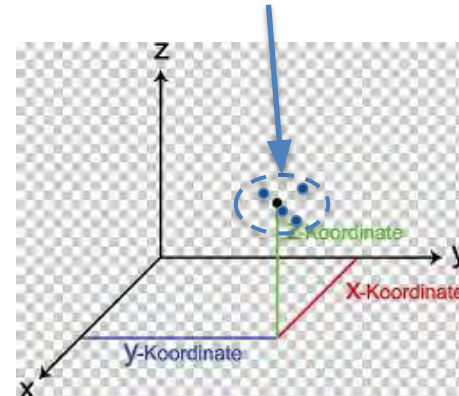
All paintings from a painter



Corresponding numerical matrices



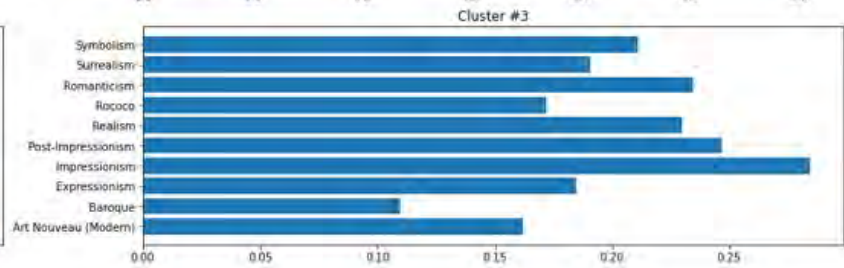
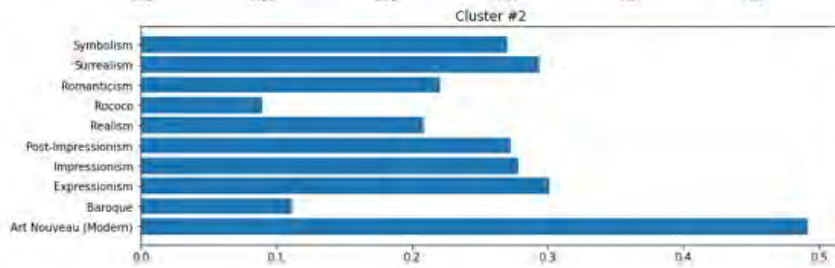
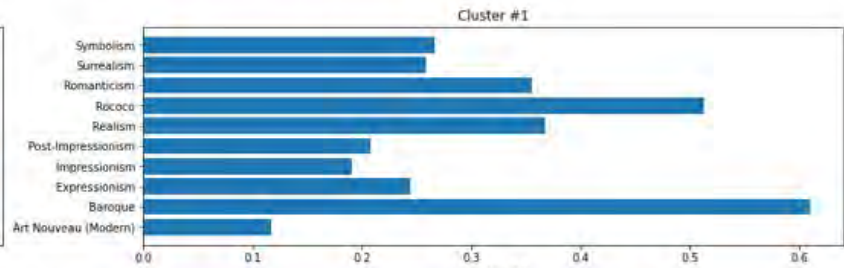
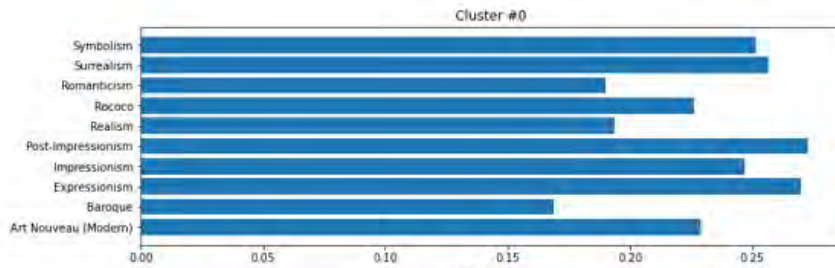
Cluster of points in the (3n x n) dimensional space



The probability distribution behind this cluster identifies Vermeer's style

Some Deep Learning algorithms can do it (e.g. Autoencoders)....

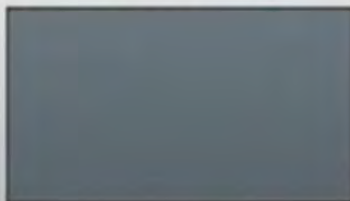
Styles distribution normalized for the total number of images in each style



E. Munch
The Scream
(1910)



Random Image



Mixed



Style

$$\mathcal{L}_{style} = \frac{1}{2} \sum_{l:1}^L (G_{ij}^l - A_{ij}^l)^2$$

100.000 paintings



VGG Network

Content representation

Style representation

Style representation

Content representation

style loss

content loss

Content-Image 1



Content-Image 2



Style Image



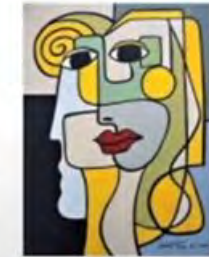
Result



Style Image



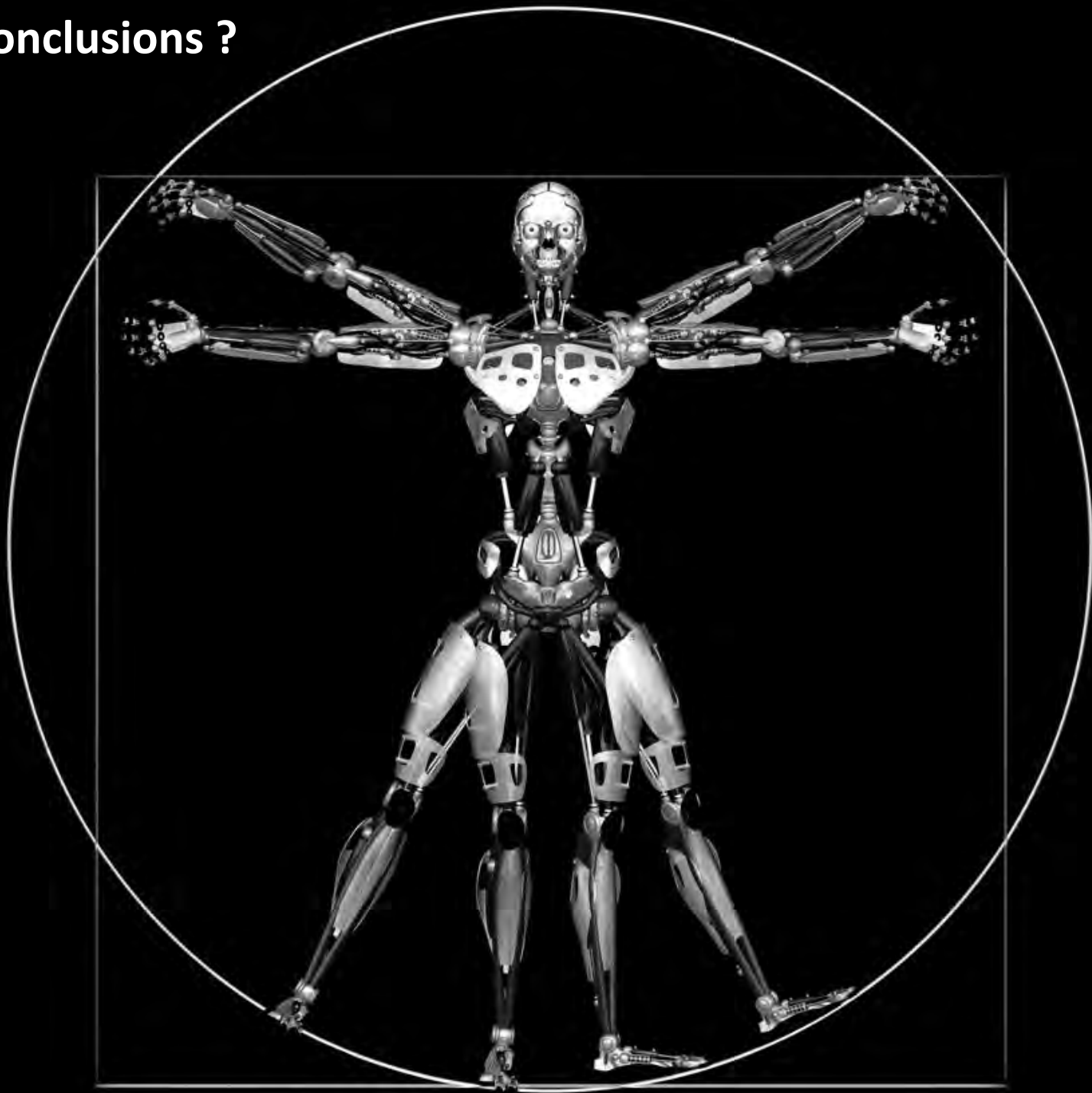
Result



What happens when you explore parts of this hidimensionality space which are not populated by known styles?

How do we interpret the outcome of this exploration?

Some conclusions ?



Some conclusions ?



Since when we left the caves our evolution is no longer dictated by natural adaptation to a changing environment but by a cultural adaptation

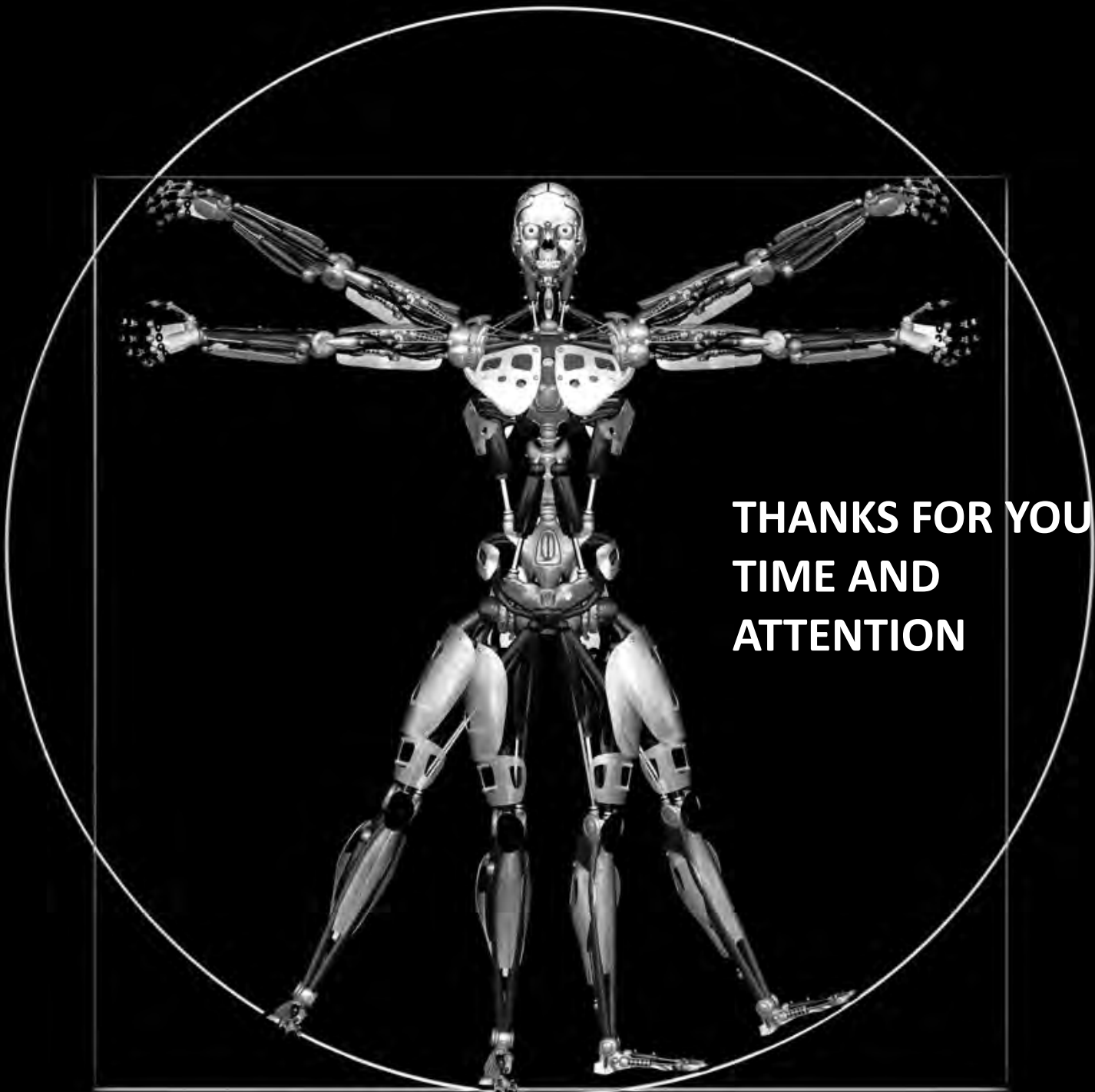
Adaptations which change the cultural paradigm of our society

Arts, music, science, philosophy are all aspects of the same cultural paradigm and therefore they move along parallel tracks ...

We live in the age of machine learning with steroids

Big data, computers, networks, are changing the way we produce sciences, music, texts, paintings, images, sculptures (3-D printing).

**WHAT WILL COME
OUT OF IT?
(in 2 years)**



**THANKS FOR YOUR
TIME AND
ATTENTION**