Post-Graduate Certificate Course on
Mind, Thinking & Creativity
November 6-8, 2017, Inter-University Centre, Dubrovnik, Croatia

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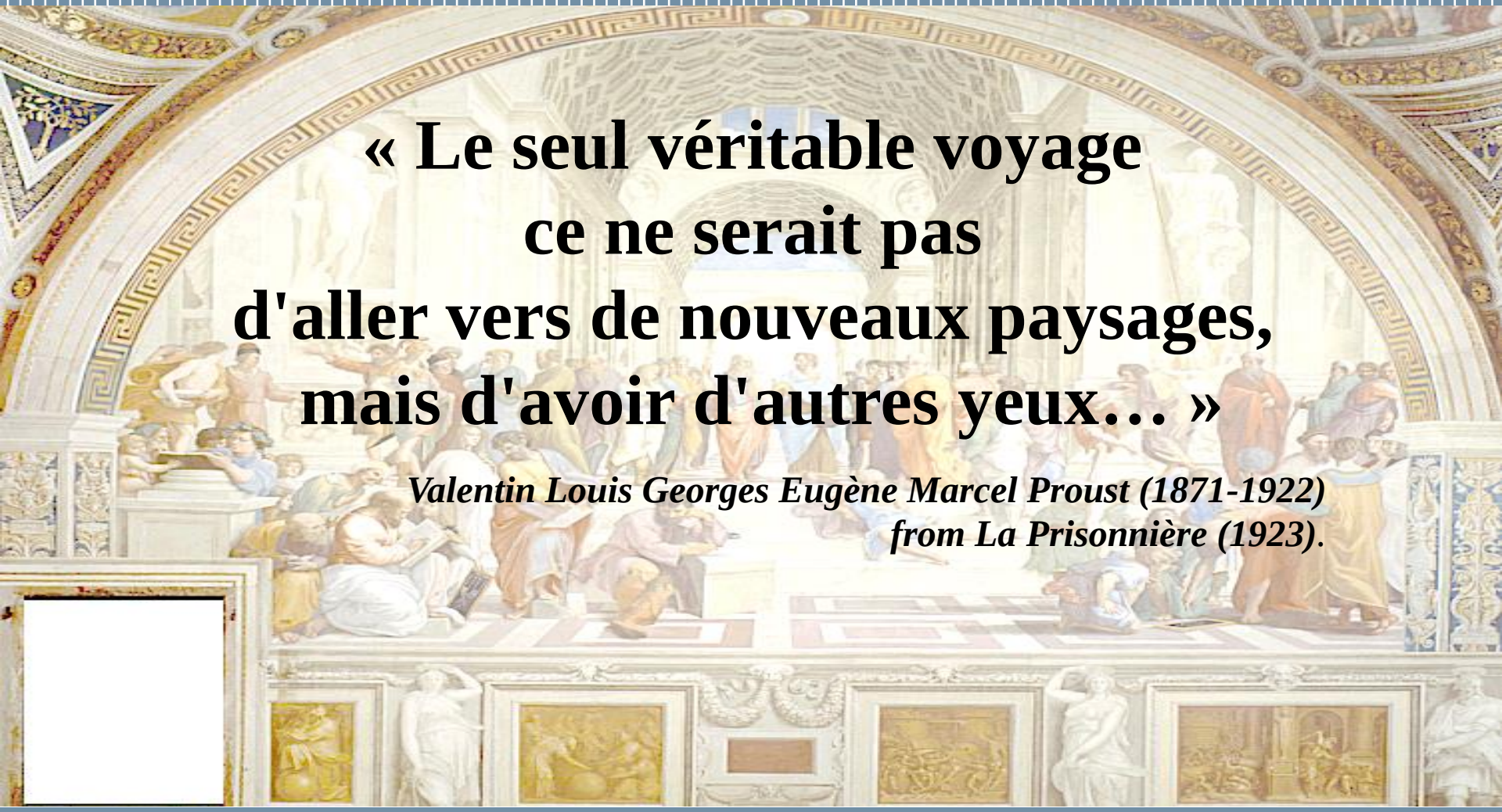
World Academy of Art and Science | World University Consortium | Dag Hammarskjold University College | Istituto dell'Approccio Centrato sulla Persona | The Mother's Service Society | Inter-University Centre

Chance, Causality & Creativity

Rodolfo A. Fiorini

Chance, Causality & Creativity



« Le seul véritable voyage
ce ne serait pas
d'aller vers de nouveaux paysages,
mais d'avoir d'autres yeux… »

Valentin Louis Georges Eugène Marcel Proust (1871-1922)
from La Prisonnière (1923).

Presentation Outline

1. Human Perceived Uncertainties (21)
   - Current Scientific Approach
   - The Root of Current Problem in ACM Modeling
2. A Fresh Approach to System Modeling (08)
   - Building Systemic Antifragility
   - CICT Co-ODR New Awareness
3. New Human Awareness (04)
   - Our Intentions Shape Our Future
   - The New Language for Our Children

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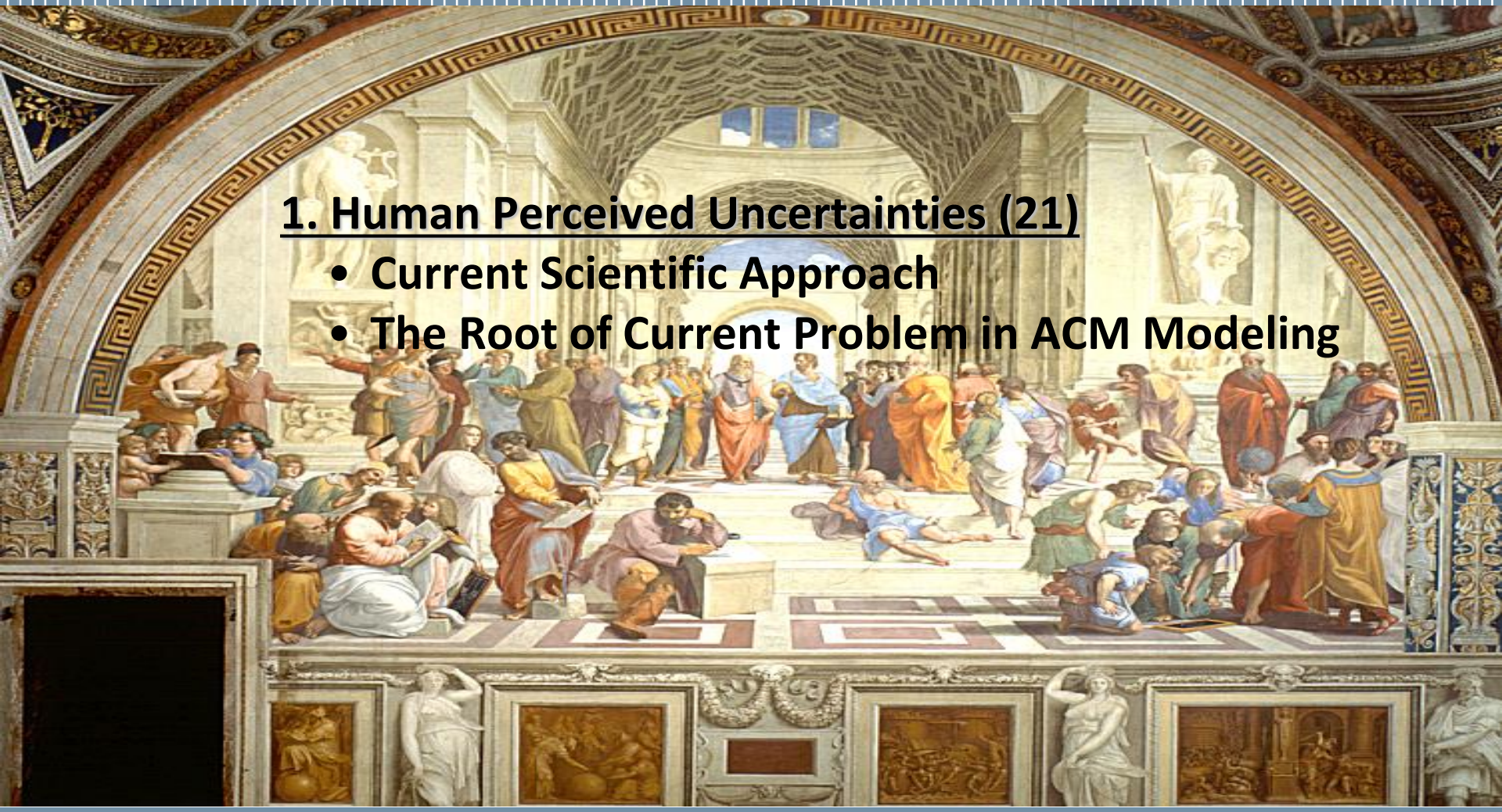

1. Human Perceived Uncertainties (21)

- **Current Scientific Approach**
- **The Root of Current Problem in ACM Modeling**

Arbitrary Complex Multiscale (ACM) System

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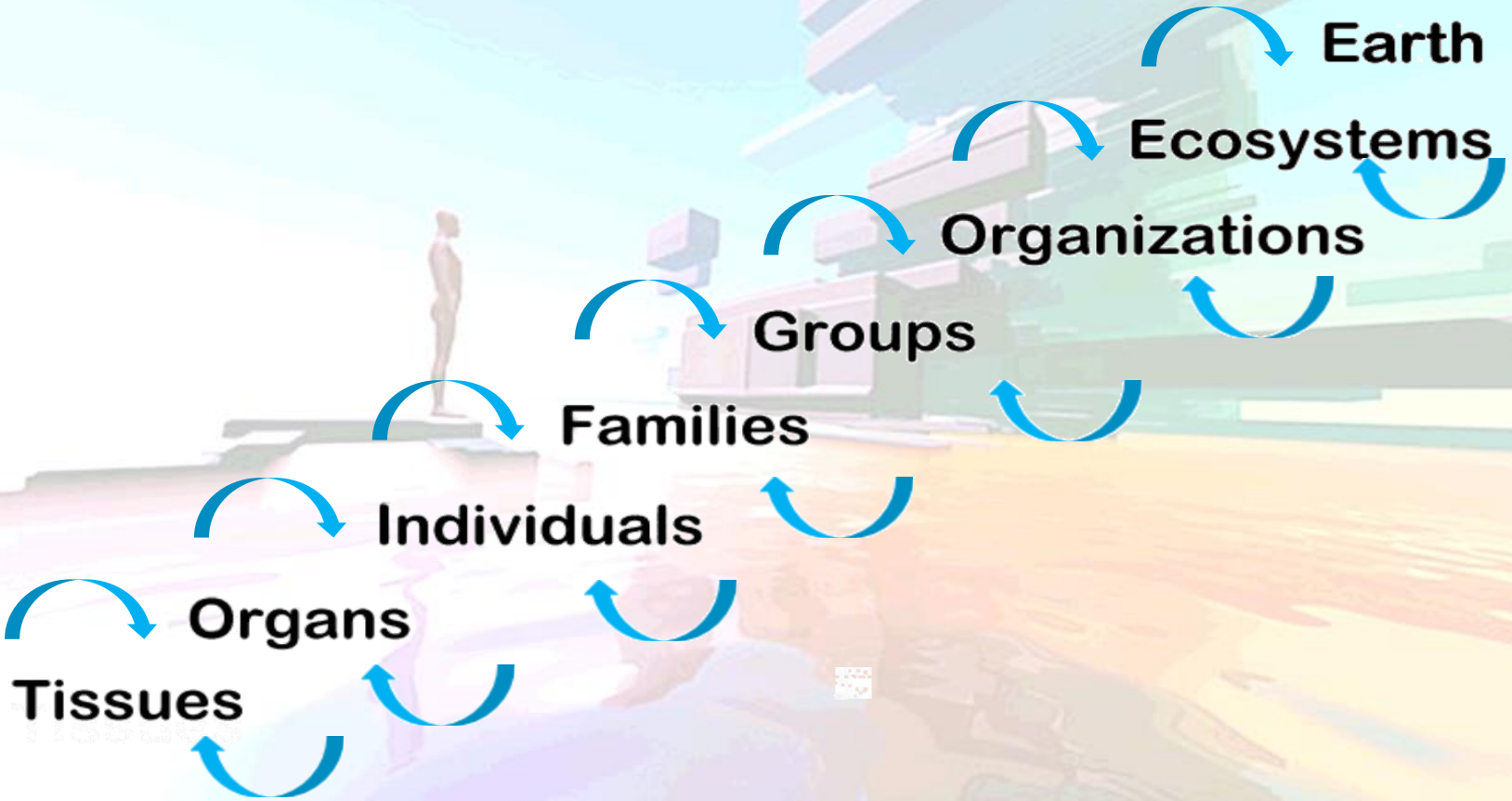
Example of Arbitrary Complex Multiscale System (ACM)



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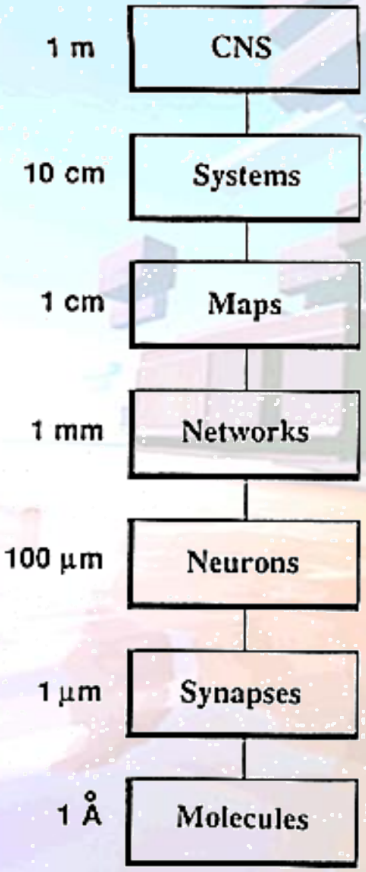
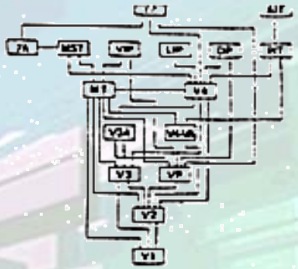
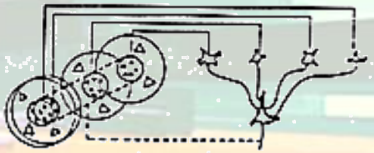
Example of Arbitrary Complex Multiscale System (ACM)







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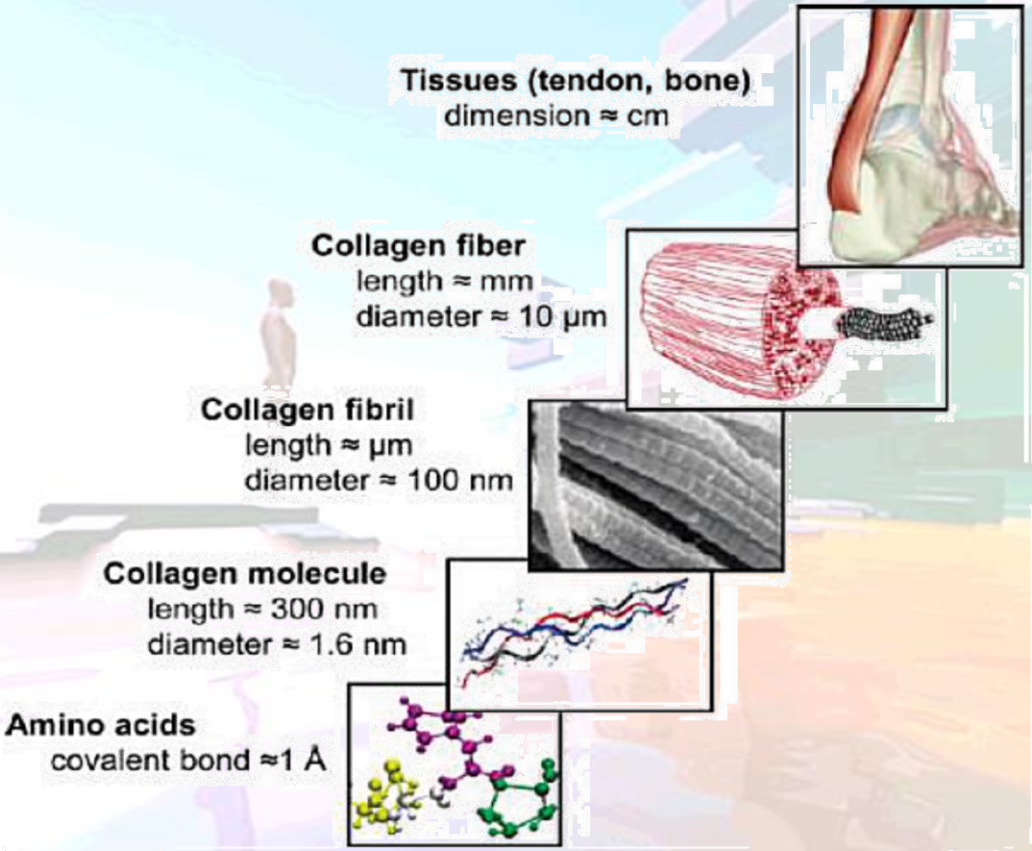
Example of Arbitrary Complex Multiscale System (ACM)



(R.A. Fiorini, 2015)

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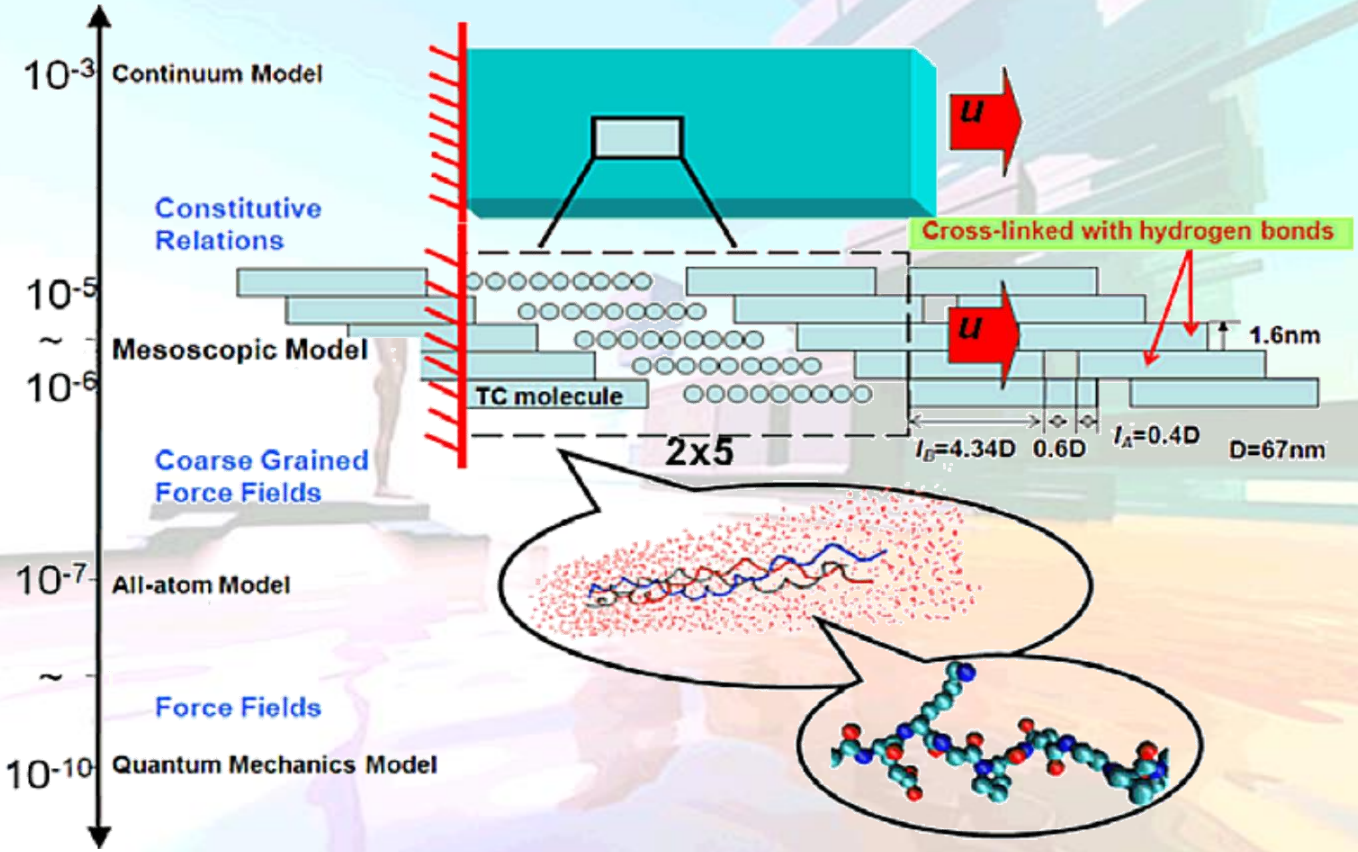
Current Multiscale System Modeling



(R.A. Fiorini, 2015)

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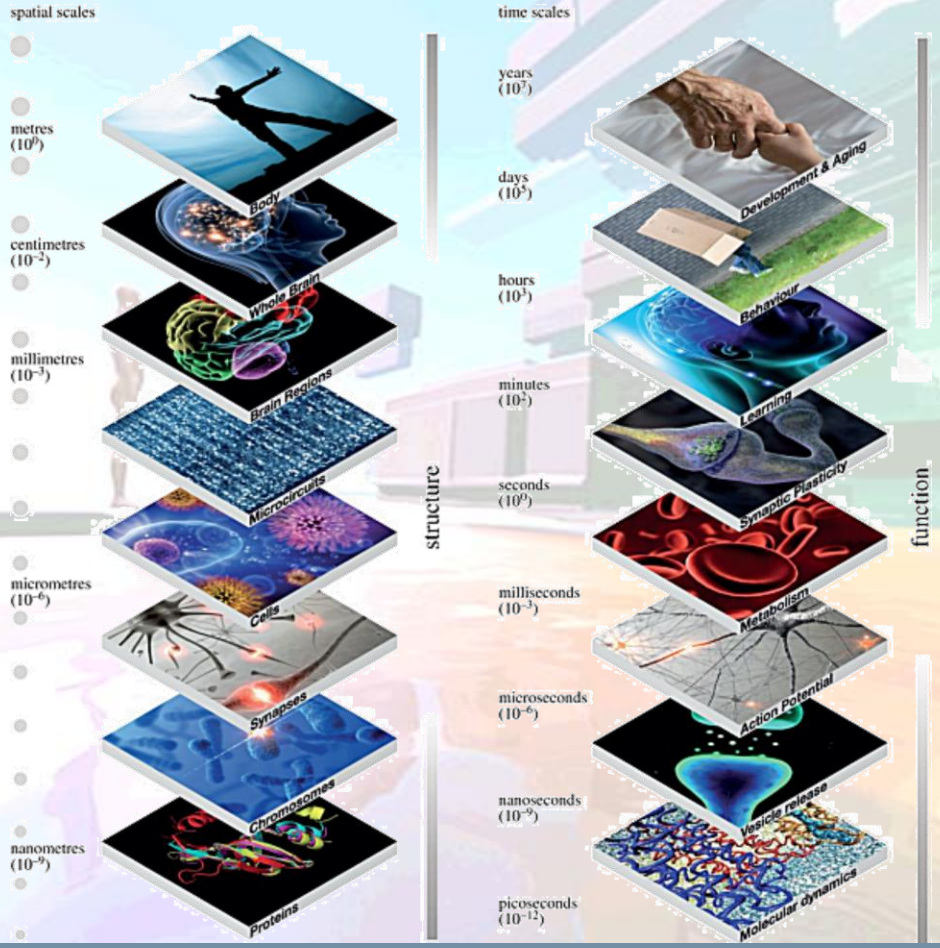
Current Scientific Approach



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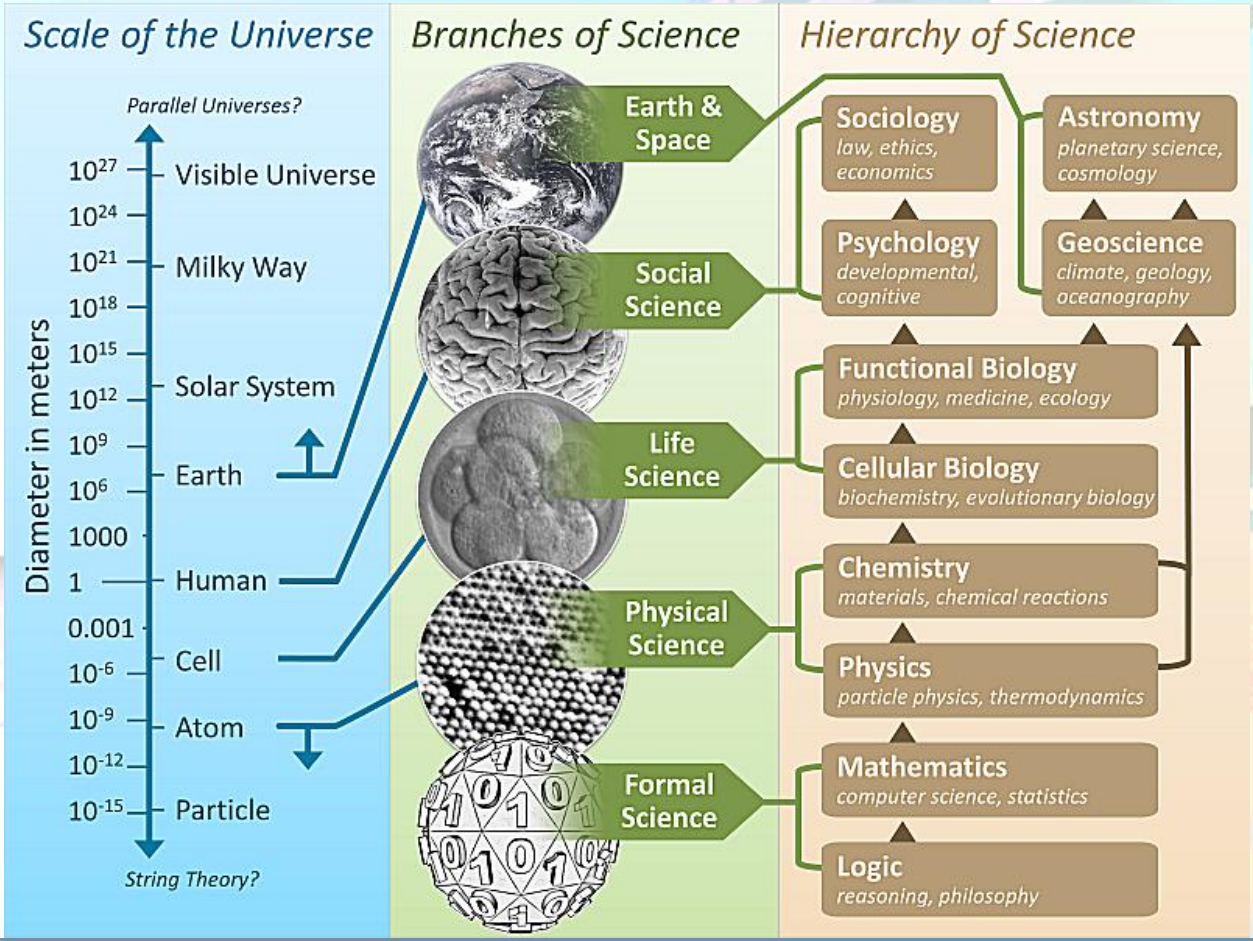
Current Scientific Approach



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Current Scientific Approach

Mankind's best conceivable **worldview** is **at most a partial picture of the real world**, a picture, a representation centered on man. We inevitably see the universe from **a human point of view** and communicate in terms shaped by the exigencies of human life in a natural uncertain environment.

We were able in the past to generate mechanisms to reduce uncertainty by proposing order and classifying reality.

Although there are many sources of uncertainty, two basic areas of uncertainty that are fundamentally different from each other were recognized as traditional reference knowledge: **natural or intrinsic** and **epistemic uncertainty**.

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Current Scientific Approach

Intrinsic randomness of a phenomenon (e.g. throwing a dice) or **natural uncertainty cannot be reduced** by the collection of additional data and it stems from variability of the underlying stochastic process (if any).

Unlike natural uncertainty, **epistemic uncertainty can be reduced** by the collection of additional data. Statistical and applied probabilistic theory is the core of traditional scientific knowledge; it is **the logic of "Science 1.0"**; it is **the traditional instrument of risk-taking**.

Main epistemic uncertainty sources can be referred to **three core conceptual areas**: **a)** Entropy Generation (Clausius-Boltzmann), **b)** Heisenberg Uncertainty Principle and **c)** Gödel Incompleteness Theorems.

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Current Scientific Approach

•**Entropy Generation (Clausius-Boltzmann):** The term entropy was coined in **1865** by Rudolf Clausius based on the Greek "εντροπία" (entropía), meaning "turning toward." There are two physical related definitions of entropy: the thermodynamic definition (Clausius, in the 1850s) and the statistical mechanics definition (Boltzmann, in the 1870s). In **Quantum Statistical Mechanics** (QSM), the concept of entropy was developed by Hungarian-American mathematician and polymath **John von Neumann** (1903–1957) and is generally referred to as "von Neumann entropy". In **classic Information Theory**, entropy is the measure of the amount of information that is missing before message reception and is sometimes referred to as "Shannon entropy." The concept was introduced by **Claude E. Shannon** in his **1948** paper "A Mathematical Theory of Communication". The link between thermodynamic and information entropy was developed in a series of papers by American physicist **Edwin Thompson Jaynes** (1922–1998), beginning in 1957.

•**Heisenberg Uncertainty Principle:** The more precisely the position of some particle is determined, the less precisely its momentum can be known, and vice-versa.(Elion et al., 1994) The original heuristic argument that such a limit should exist was given by German theoretical physicist **Werner Karl Heisenberg** (1901–1976) in **1927**, after whom it is sometimes named, as the "Heisenberg principle."

•**Gödel Incompleteness Theorems:** Gödel's incompleteness theorems are two theorems of mathematical logic that establish inherent limitations of all but the most trivial axiomatic systems capable of doing arithmetic. The theorems, proven by Austrian American logician, mathematician, and philosopher **Kurt Friedrich Gödel** (1906–1978) in **1931**, are important both in mathematical logic and in the philosophy of mathematics. They prove **the open logic approach of Mathematics**. (Licata, 2008)

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Current Scientific Approach

Unfortunately, **epistemic uncertainty sources are still treated with the traditional approach of risk analysis**, which provides an acceptable cost/benefit ratio to producer/manufacturer, but in some cases **it may not represent an optimal solution to end user**. In fact, **deep epistemic limitations** reside in some parts of the areas covered in **decision making**.

More generally, **decision theory**, **based on a "fixed universe"** or a model of possible outcomes, **ignores and minimizes** the effect of events that are **"outside model"**. In fact, **contemporary human made systems can be quite fragile** to **unexpected perturbation** because **Statistics can fool you,** unfortunately.

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Statistics can fool you, unfortunately

APPLICATION / DOMAIN	Simple payoffs	Complex payoffs
Distribution 1 ("thin tailed")	Extremely robust to Black Swans	Quite robust to Black Swans
Distribution 2 ("heavy" and/or unknown tails, no or unknown characteristic scale)	Quite robust to Black Swans	**LIMITS of Statistics – extreme fragility to Black Swans**

(N. Taleb, 2014)

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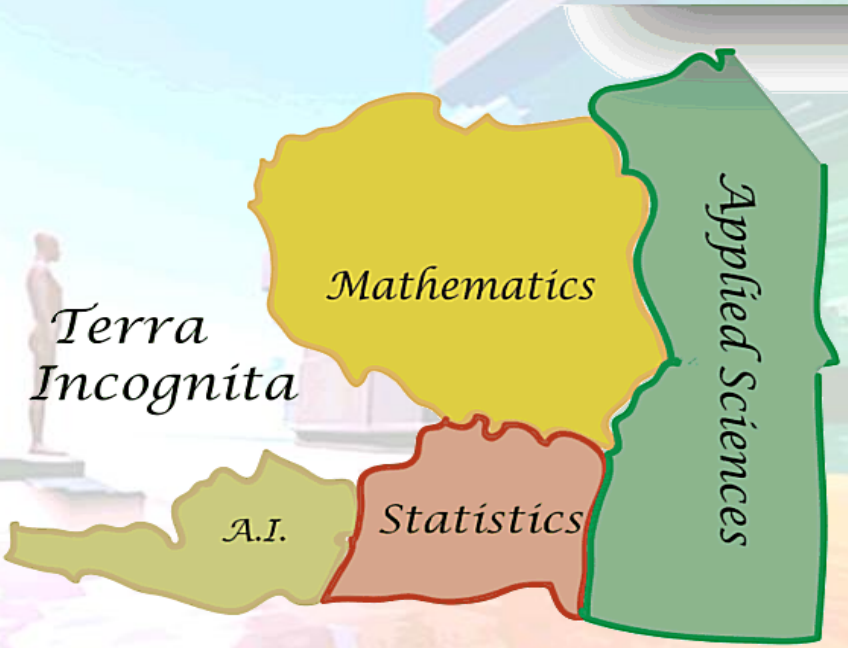
Terra Incognita



Positioning of **the unknown** that is certainly **out of reach for any type of knowledge**, which includes Bayesian inference.

(Bradley Efron, (2013), Bayes' theorem in the 21st century. Science, 340(6137):1177–1178.)

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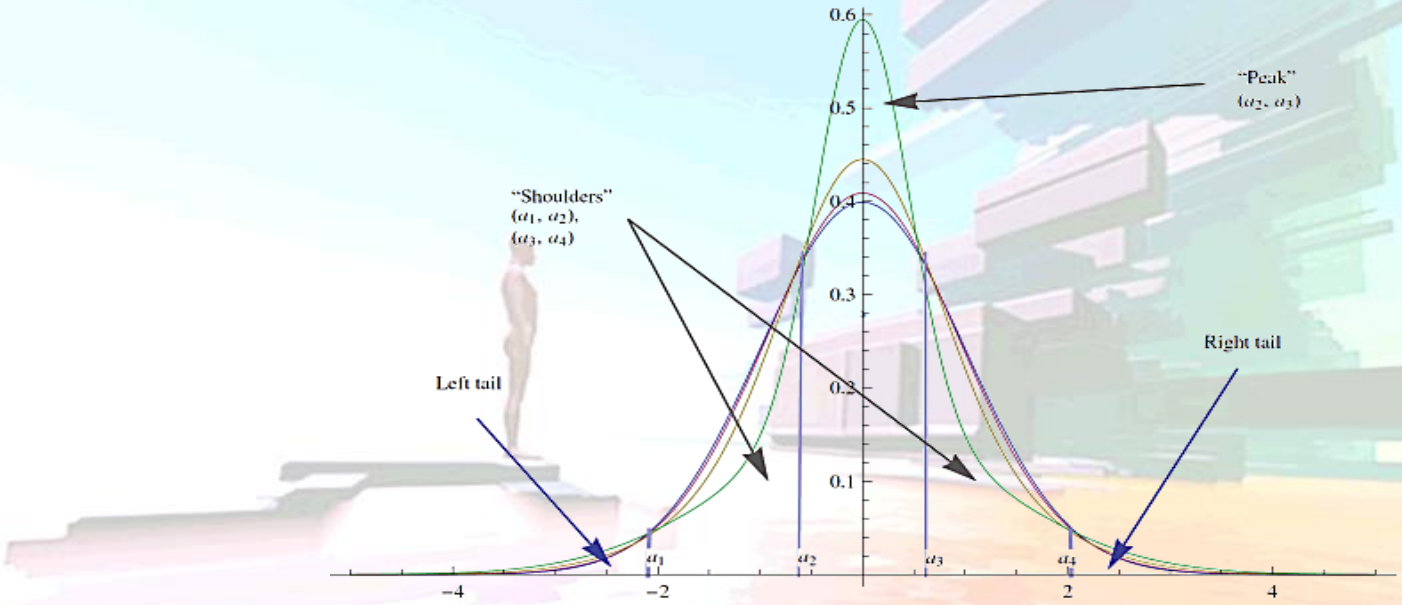
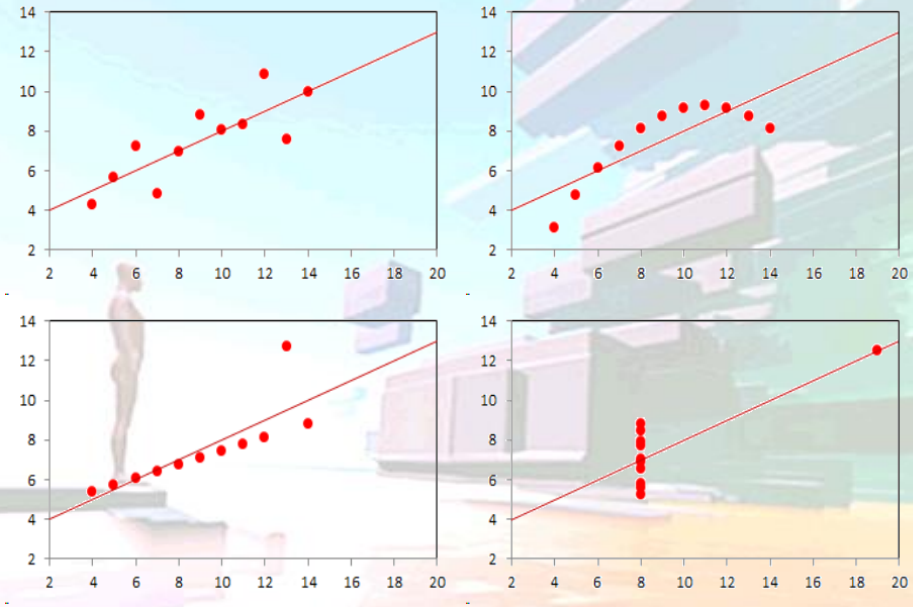
The Body, The Shoulders, and The Tails



Fatter and Fatter Tails through perturbation of σ. Distributions called "bell shape" have a convex-concave-convex shape (or quasi-concave shape). The point is that **events in the tails** of the distributions play the major role **and** their probabilities are not computable, not reliable for any effective use. The implication is that Black Swans do not necessarily come from fat tails; the **main problem** can result **from an incomplete assessment** of tail events.(N.Taleb, 2014)

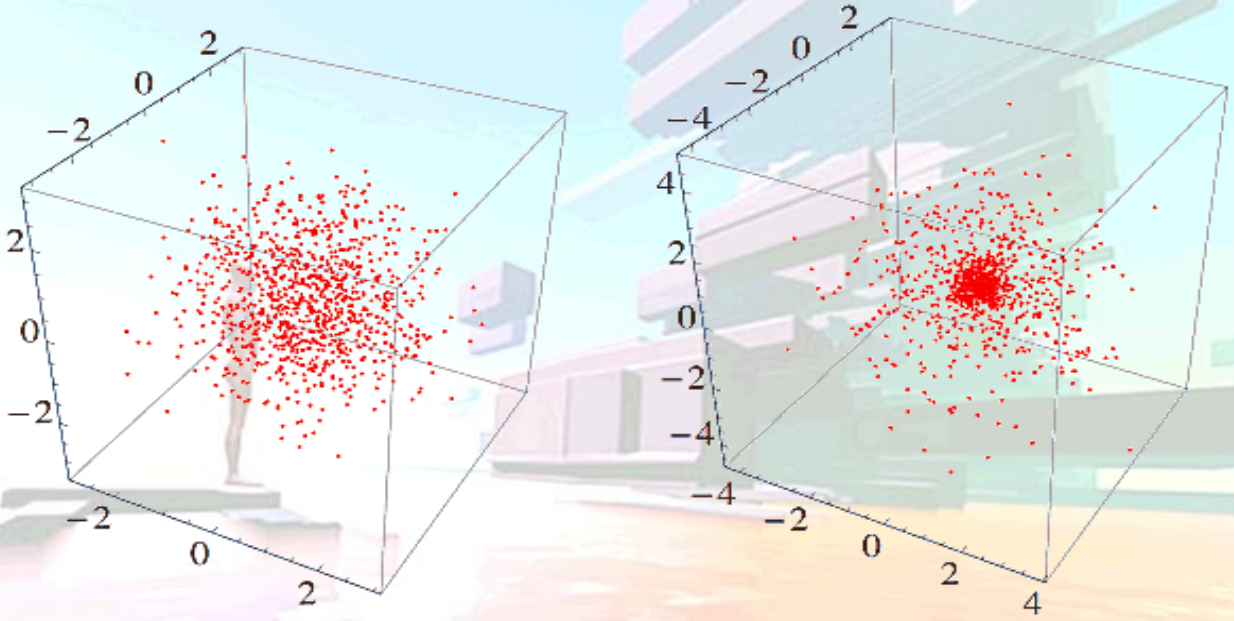
Statistics can fool you, unfortunately



Four examples of different distributions of each 11 data pairs that show exactly the same standard statistical values, such as the **same mean values** for x and y (9.0 and 7.5), the **same linear regression line** with the same regression coefficient (y = 3 +0.5x), the **same standard error** of 1.237, and the **same strong Pearson correlation** of 0.816 **at the same confidence level** of 0.95.

(Anscombe, F.J.: 1973, 'Graphs in statistical analysis', The American Statistician, 27, 17-21.)

Multidimensional Fat Tails Effect



For a 3 dimensional vector, **thin tails (left)** and **fat tails (right)** of the same variance. Instead of a bell curve with higher peak (the "tunnel") we see an increased density of points towards the center. (N.Taleb, 2014)

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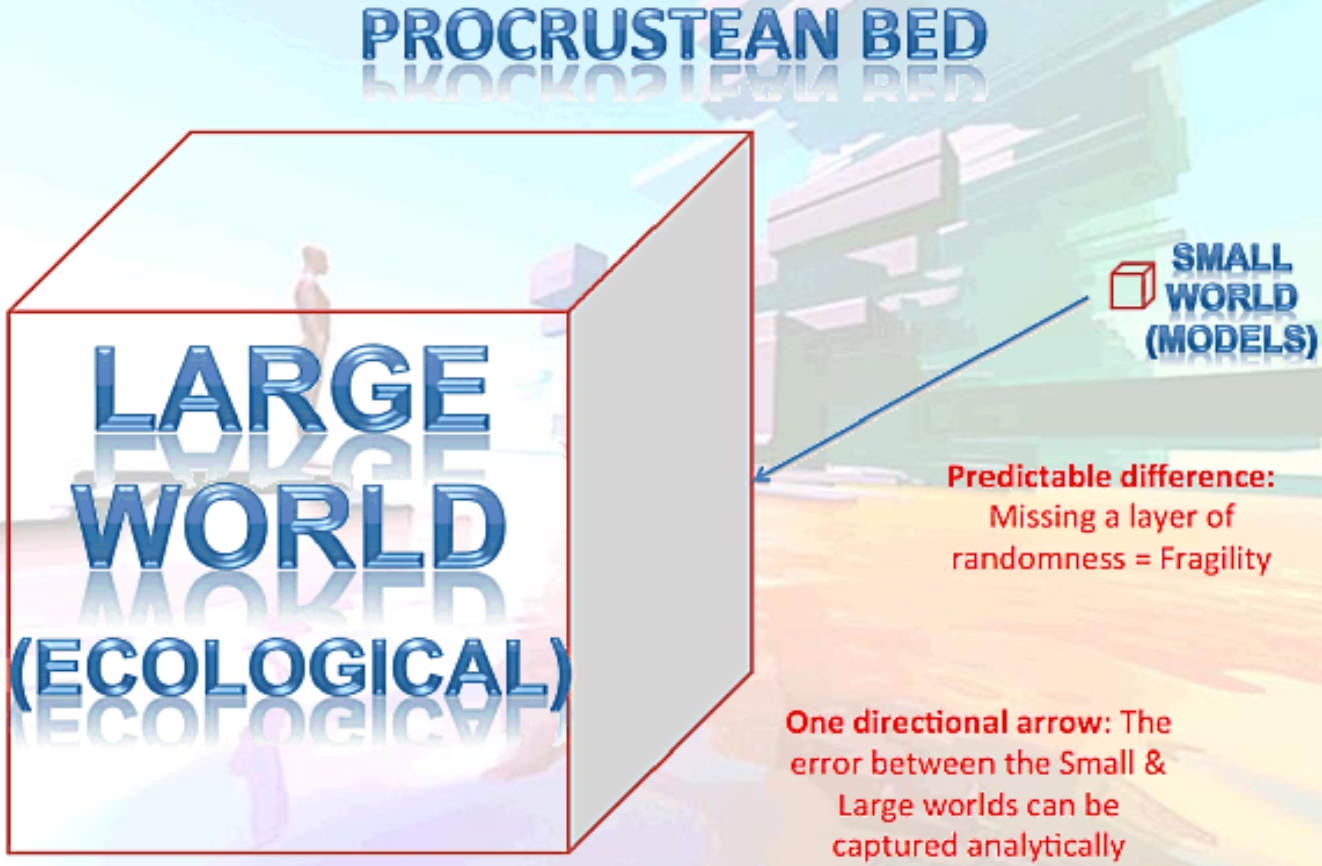
Leonard Savage's Small World/Large World



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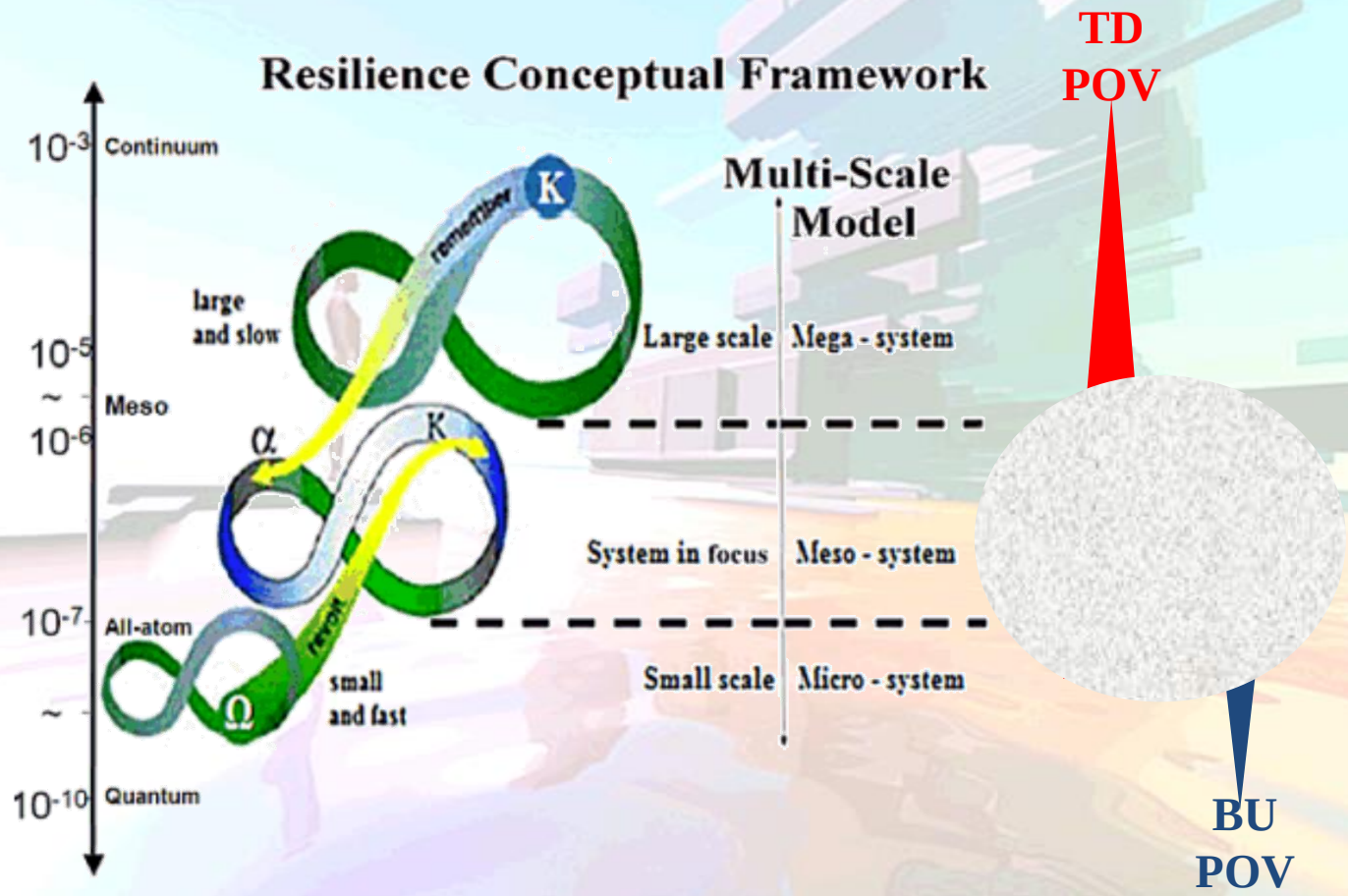
The Root of the Current Problem for ACM System Modeling



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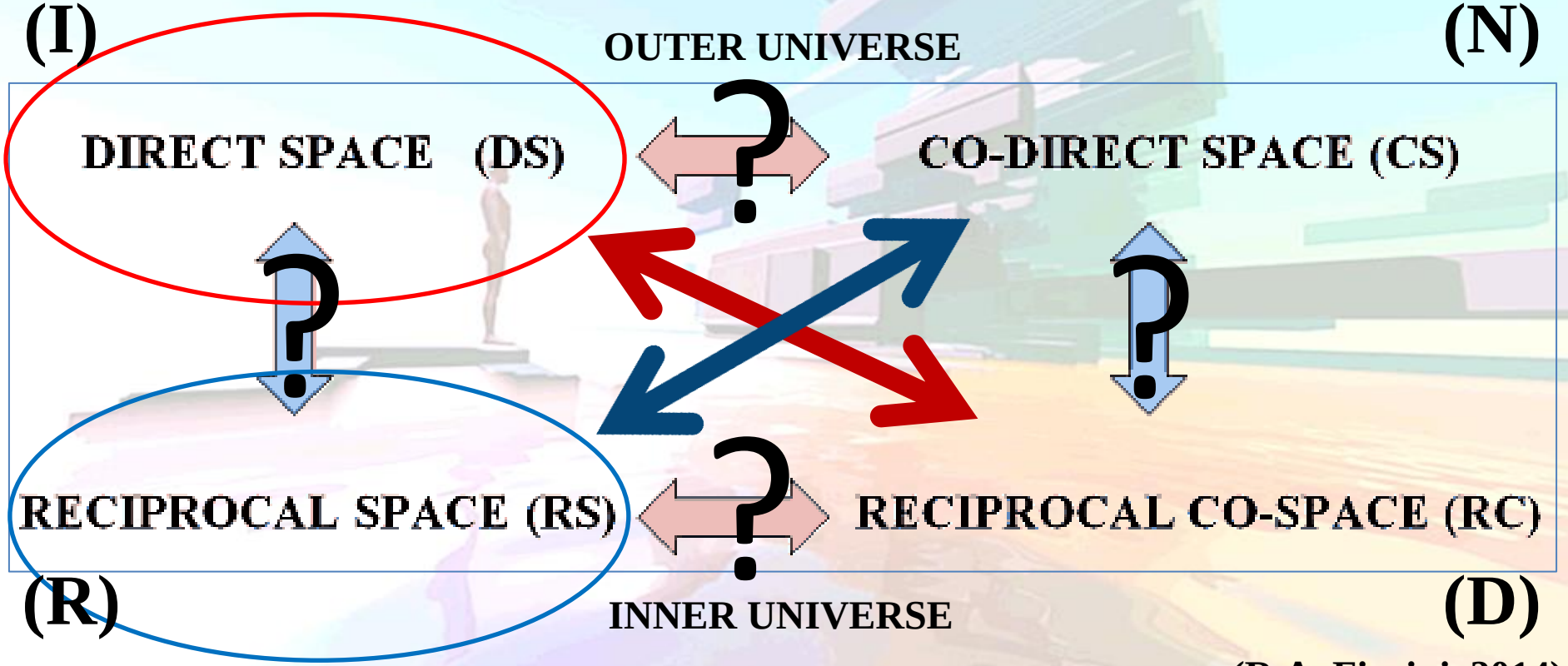
INNER vs. OUTER UNIVERSE (IOU) Mapping By KLEIN Four-Group (CICT)



(R.A. Fiorini, 2014)

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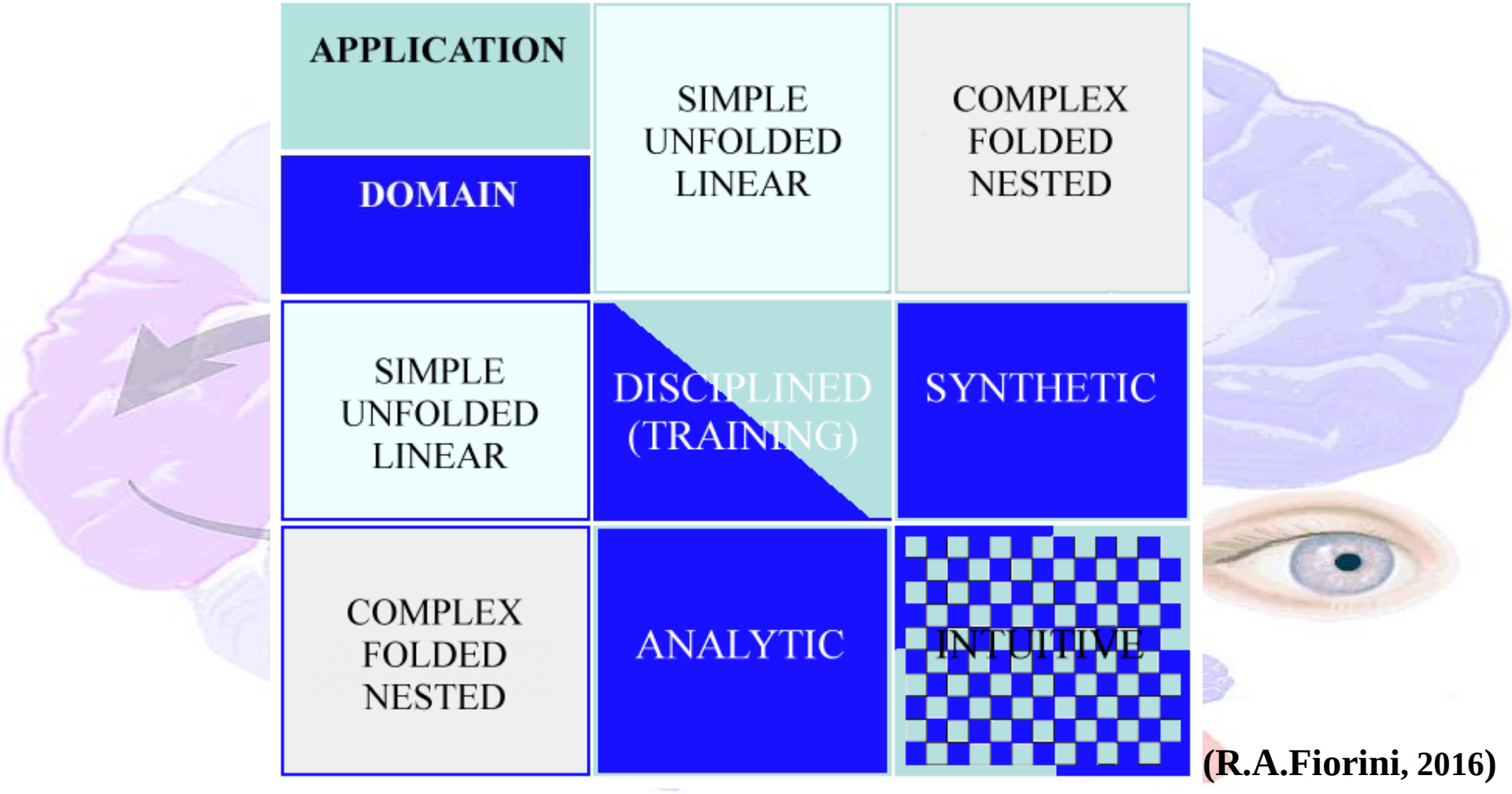

(R.A.Fiorini, 2016)

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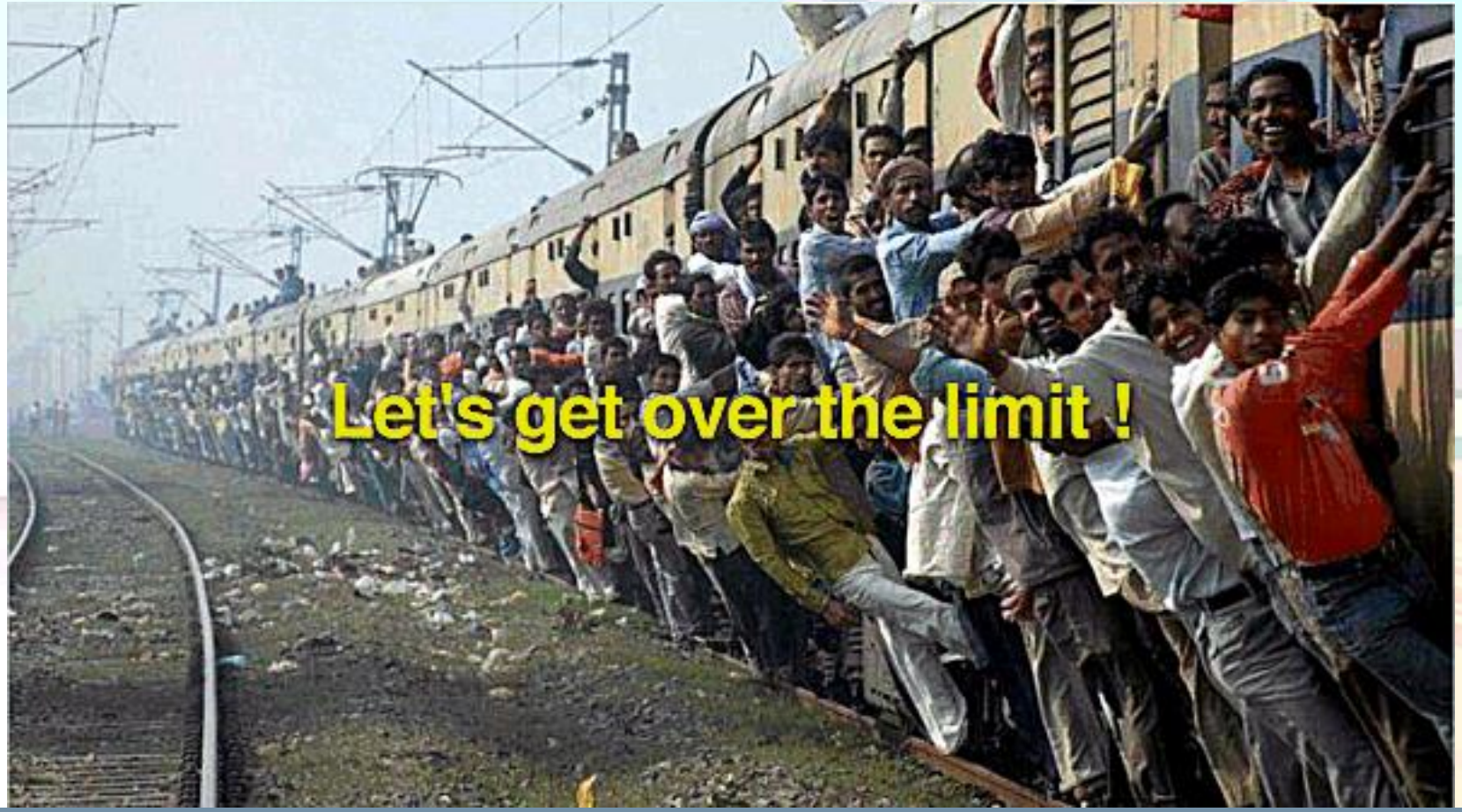
The Challenge of Defining ACM System



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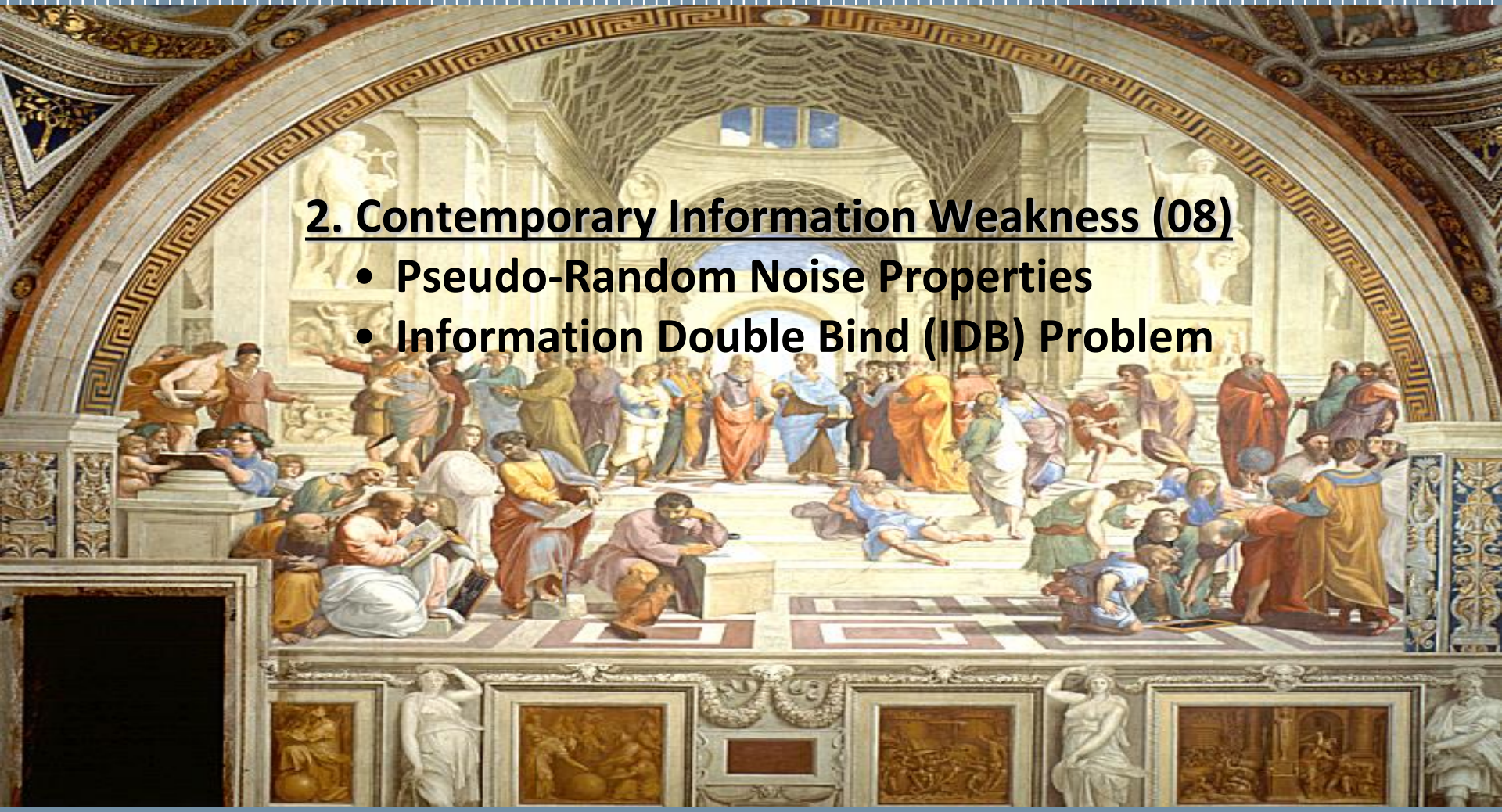

2. Contemporary Information Weakness (08)

- **Pseudo-Random Noise Properties**
- **Information Double Bind (IDB) Problem**

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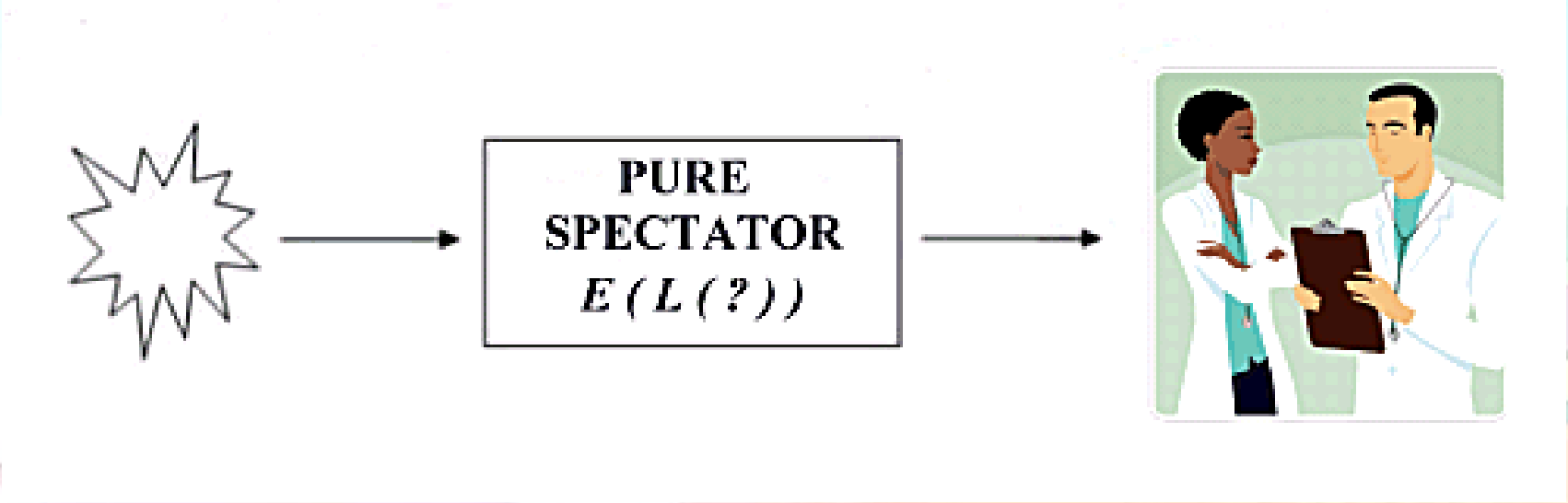
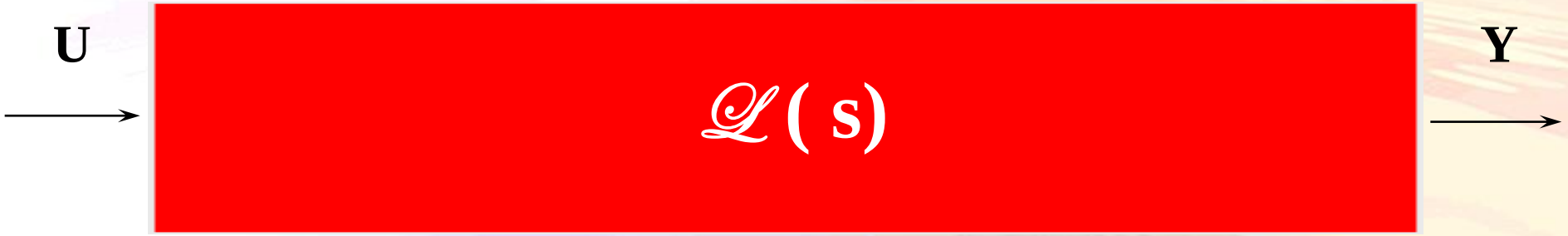
Classic Single Domain Channel Transfer Function Approach (Shannon Passive Information Channel)





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Major Problem with Shannon's Approach

In **2004**, University of Michigan physicist **Mark Newman**, along with biologist **Michael Lachmann** and computer scientist **Cristopher Moore**, applied Shannon's approach to electromagnetic transmission.

Specifically, they show that if electromagnetic radiation is used as a transmission medium, **the most information-efficient encoding format** for a given message is **indistinguishable from blackbody radiation**.

So, paradoxically if you don't know the code used for the message **you can't tell the difference between an information-rich message and a random jumble of letters** (noise as **"unstructured information"** concept).

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Major Problem with Shannon's Approach

As a matter of fact, the **classical instrumentation noise discrimination problem** is still faced by the single domain channel transfer function concept (Shannon's noisy channel), starting from **classic Shannon's information theory** concept, and then applying traditional perturbation computational model **under either additive or multiplicative perturbation hypothesis**.

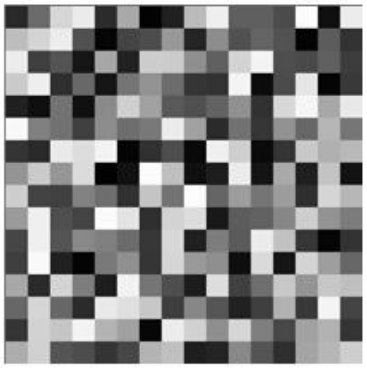
In general, **H(x)**, called **"Shannon entropy,"** is the average unpredictability in a random variable, which is equivalent to its information content. The concept was introduced by Claude E. Shannon in his **1948** paper "A Mathematical Theory of Communication."

Pseudo-Random Noise Properties

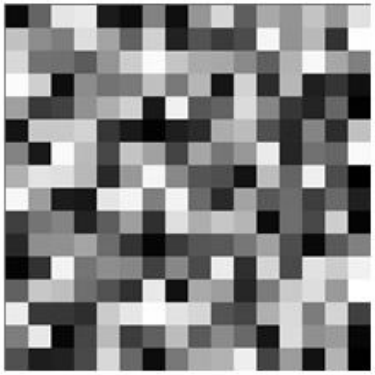
Shannon's entropy provides an **absolute limit on the best possible lossless encoding or compression** of any communication, assuming that the communication may be represented as **a sequence of independent and identically distributed random variables**.

Example: Image Lossless Compression Test

(16 by 16 pixel, 256-shades of gray image)



$H_1(X) = 0.893995$, in single precision arithmetic,
$H_2(X) = 0.893995239236685$, in double precision arithmetic
$H_3(X) =$
0.8939952392366848774964724918765288132199273122746343439319551627, with 64-digit precision arithmetic.



$H_1(X) = 1.000000$, in single precision arithmetic,
$H_2(X) = 1.000000000000000$, in double precision arithmetic
$H_3(X) =$
1.0000000000000000000000000000000000000000000000000000000000000000, with 64-digit precision arithmetic.

(R.A. Fiorini, 2014)

Example: Image Lossless Compression Test

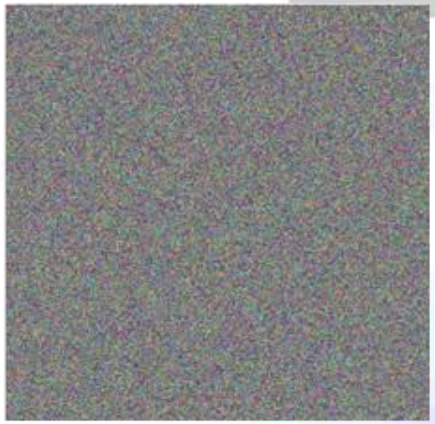
(4,096 by 4,096 pixel, 16,777,216 true color image)

$H_1(X) = 0.999292$ (single precision arithmetic)

$H_2(X) = 0.999292377044885$ (double precision arithmetic)

$H_3(X) =$ 0.9992923770448853118692398478371254320637916484441241727700678337

(64-digit precision arithmetic).



$H_1(X) = 1.000000$ (single precision arithmetic)

$H_2(X) = 0.9999999993863$ (double precision arithmetic)

$H_3(X) =$ 0.9999999993862998327578214706655513480906038553944271528197718 84

(64-digit precision arithmetic).

(R.A. Fiorini, 2014)

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Current Number Theory and modern Numeric Analysis still use LTR (Left-To-Right) mono-directional interpretation only for numeric group generator and relations, so information entropy generation cannot be avoided in current computational algorithm and application.

Furthermore, traditional digital computational resources are unable to capture and to manage not only the full information content of a single Real Number ***R***, but even Rational Number ***Q*** is managed by information dissipation (e.g. finite precision machine, truncating, rounding, etc.).

So, paradoxically if you don't know the code used to communicate a message **you can't tell the difference between an information-rich message and a random jumble of letters.**

This is **the information double-bind (IDB) problem** in contemporary classic information theory and **in current Science** (**nobody likes to talk about it**).

(Fiorini, 2013)

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Contemporary Information Double-Bind (IDB) Problem

Our computational information contemporary classic systemic tools (developed under the positivist reductionist paradigm) are totally unable to capture and to tell the difference between an information-rich message (optimally encoded message) and a random jumble of signs that we call "noise" (they are quite fragile).

It is a distressing dilemma in computational communication…

(and in the overall contemporary scientific community too; just at the origin of human being knowledge extraction and building process from our environment, where we are immersed within.)

How does it come we scientists (statisticians) are still in business without having worked out a definitive solution to the problem of the logical relationship between experience and knowledge?

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3. New Human Awareness (04)

- **Our Intentions Shape Our Future**
- **The New Language for Our Children**

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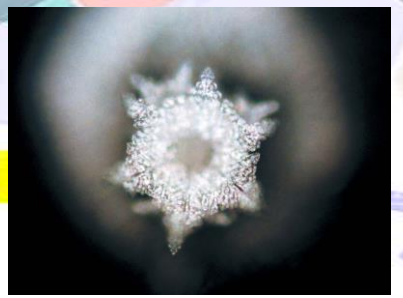
New Human Awareness

The Message from Water

Despair

Hope

War



Peace

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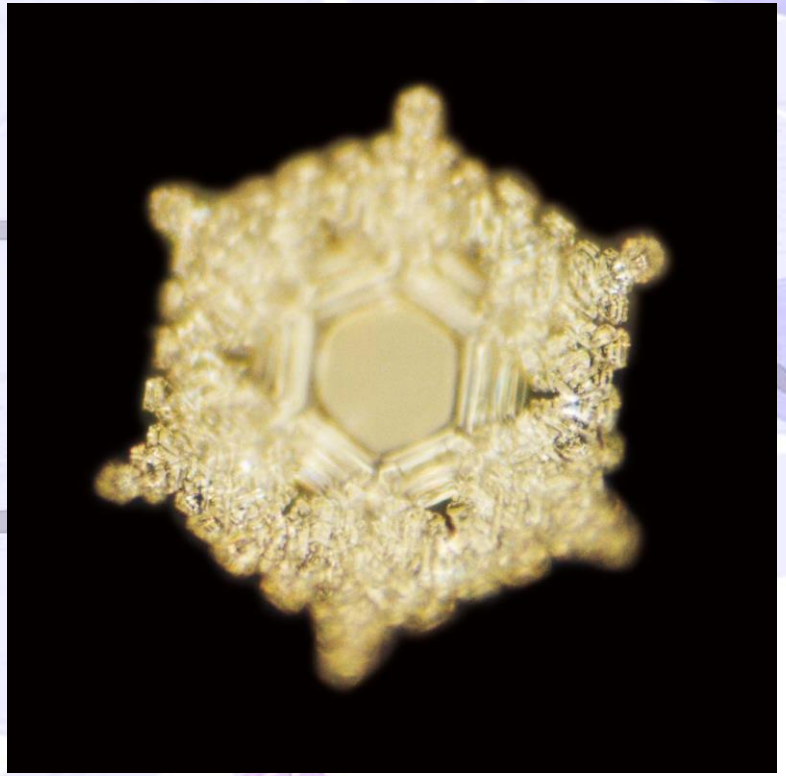
New Human Awareness

Our Intentions Shape Our Future



Love & Gratitude

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New Human Awareness

Our Intentions Shape Our Future

Luc Montagnier, Nobel Prize 2008

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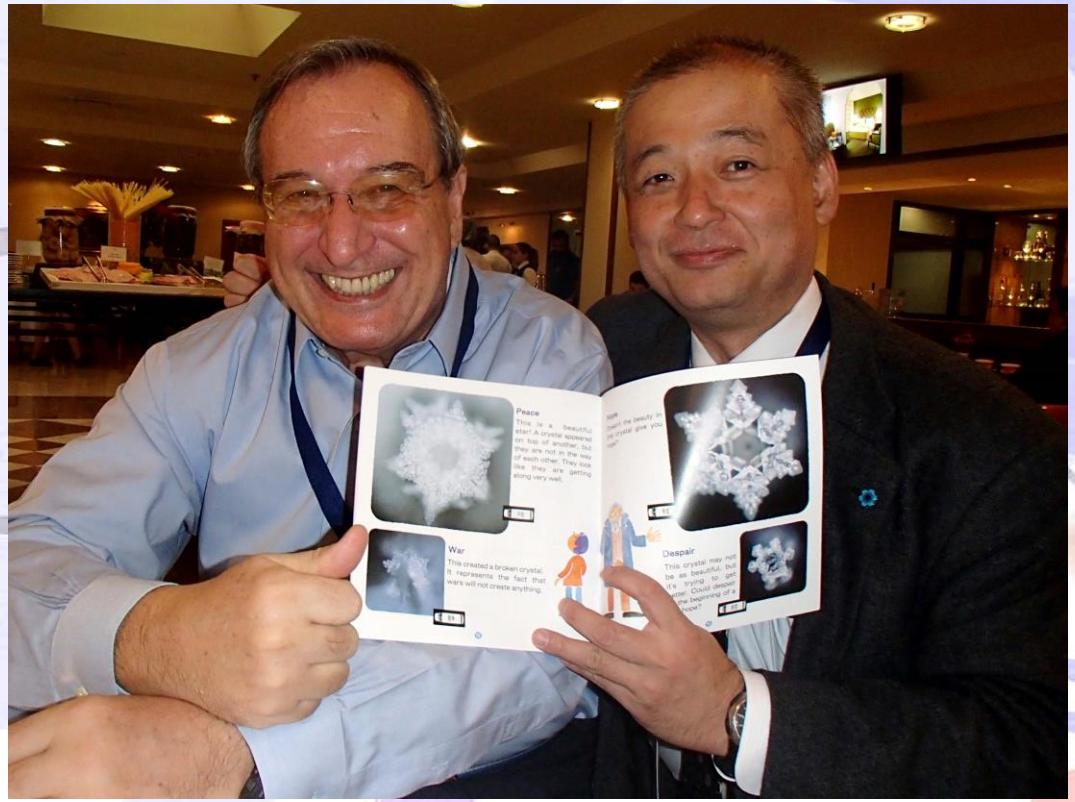
New Human Awareness

The New Language for Our Children



Yasuyuki Nemoto, President of Office Masaru Emoto, LLC, Japan. EMOTO PEACE PROJECT

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Neuralizer Work In Progress

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