13908 Experimental Techniques in Physics Supported with AI/ML

Lecture 1: Introduction

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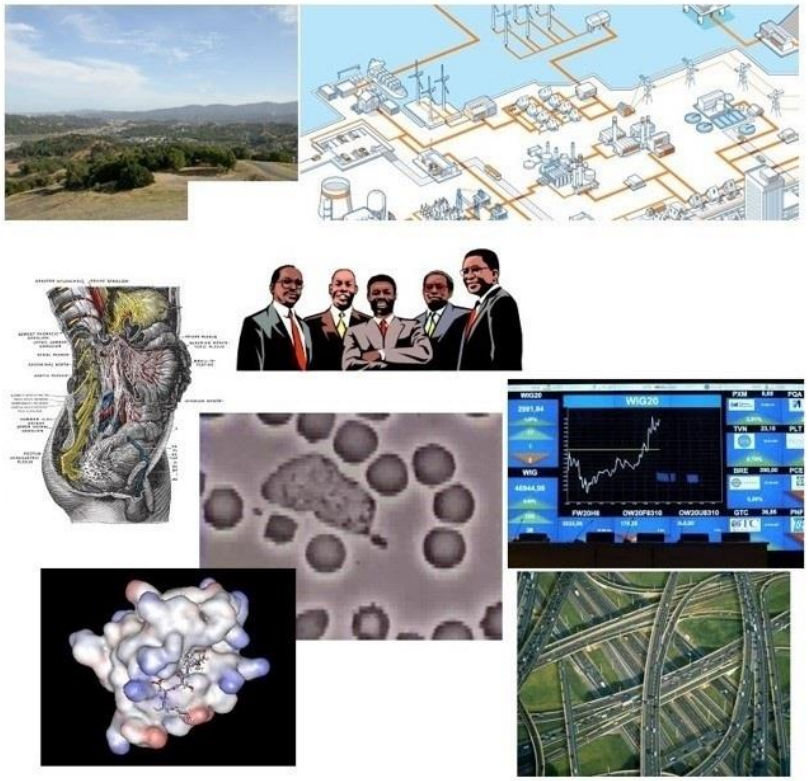
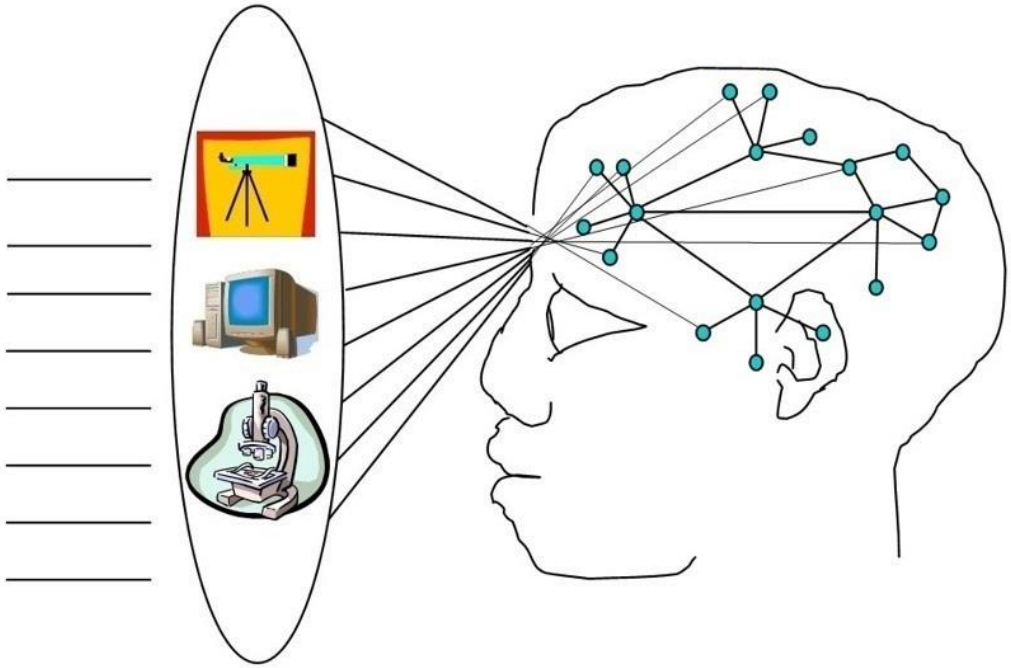
LECTURE 1

Observation, experimentation, analysis, cognition



Evolving, objective world



Interface of interaction: perception and analysis (also evolving)

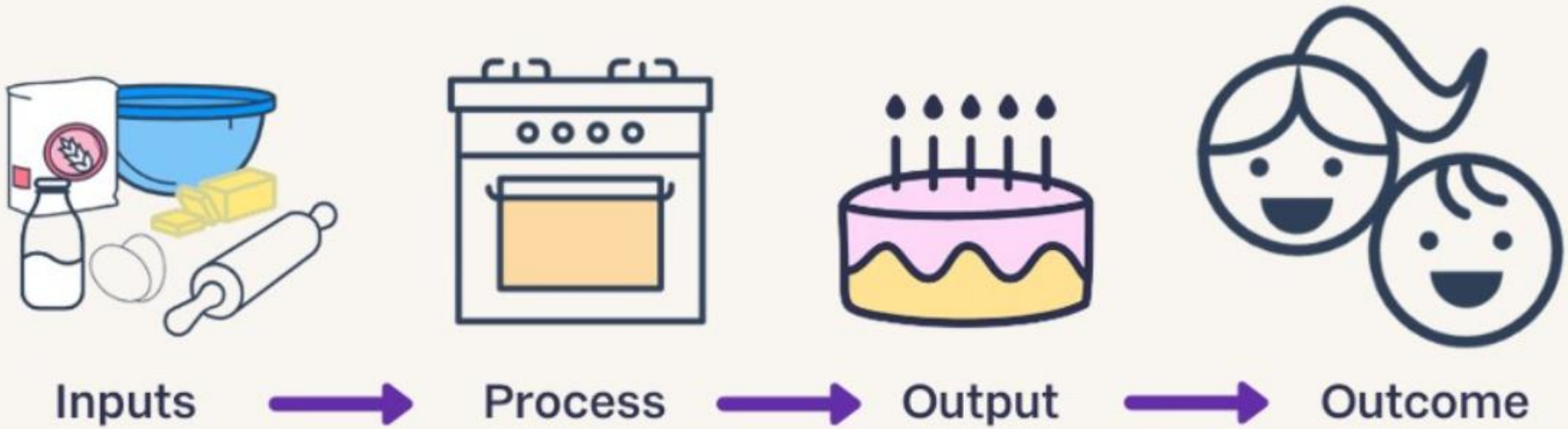
Evolving cognition

Evolving scheme of obtained knowledge

Complex processes and systems are difficult to design and control

What are outcomes?

Outcomes are commonly defined as the end result of an intervention



Factors affecting system (cake) and its observation

Complex processes and systems are difficult to design and control

Functions – Cake Example

Sugar Water Flour Eggs

INPUT

Function

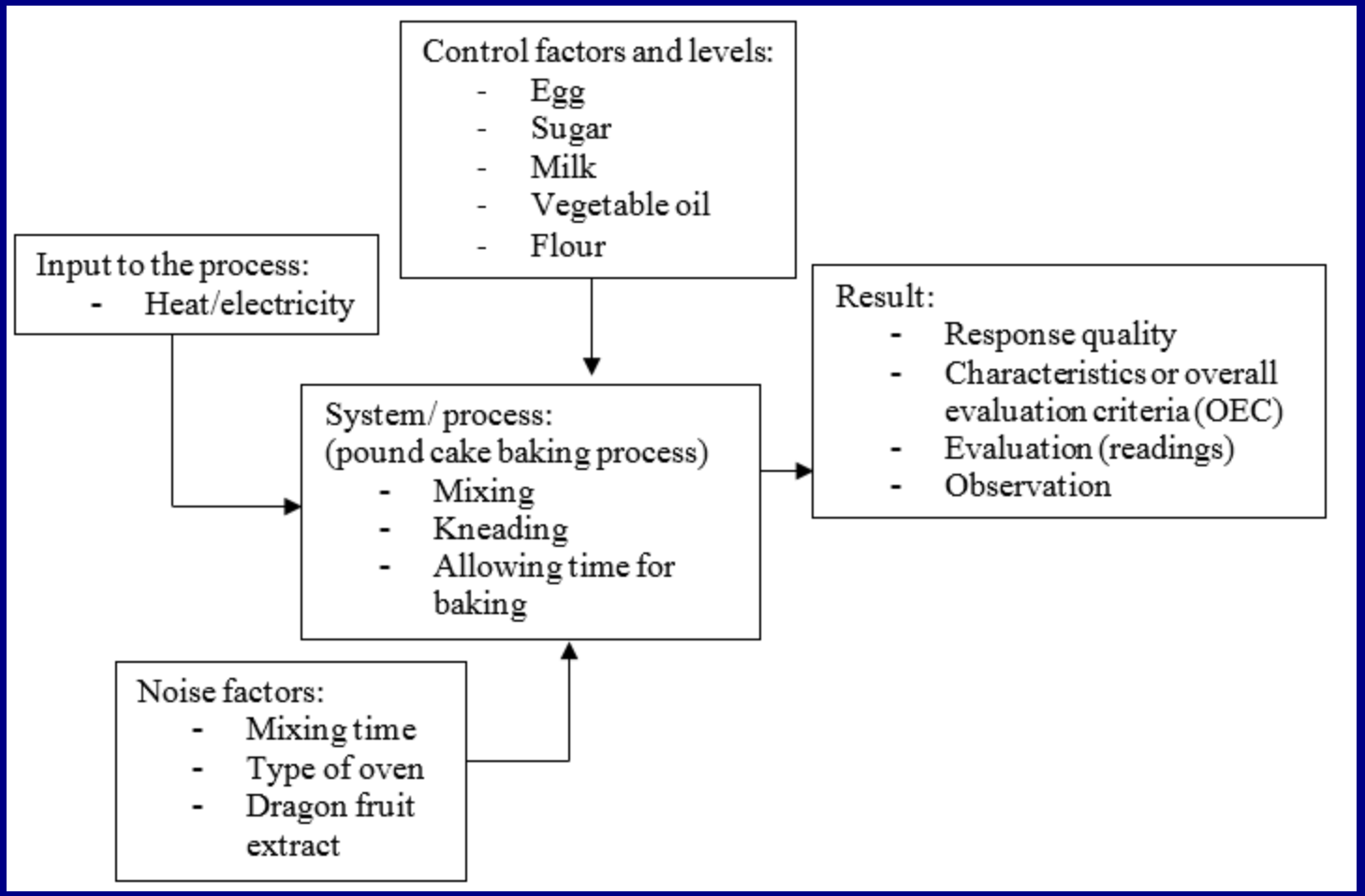
OUTPUT

Each input only has one output – if you put these eggs in the oven, you will never get a soda. The only possible output is cake.

Complex processes and systems are difficult to design and control

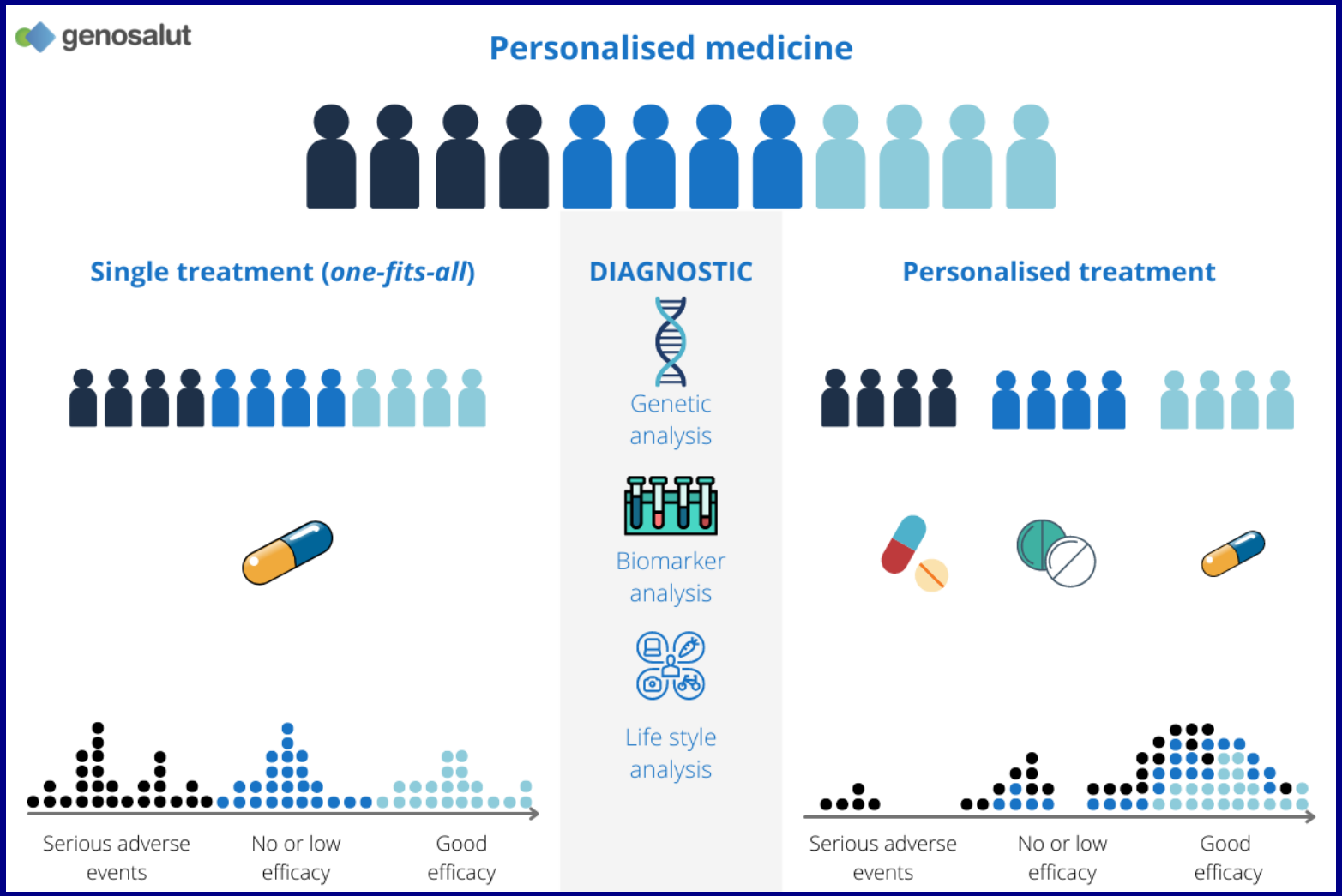
Can I change the order of operations?

Complex processes and systems are difficult to design and control



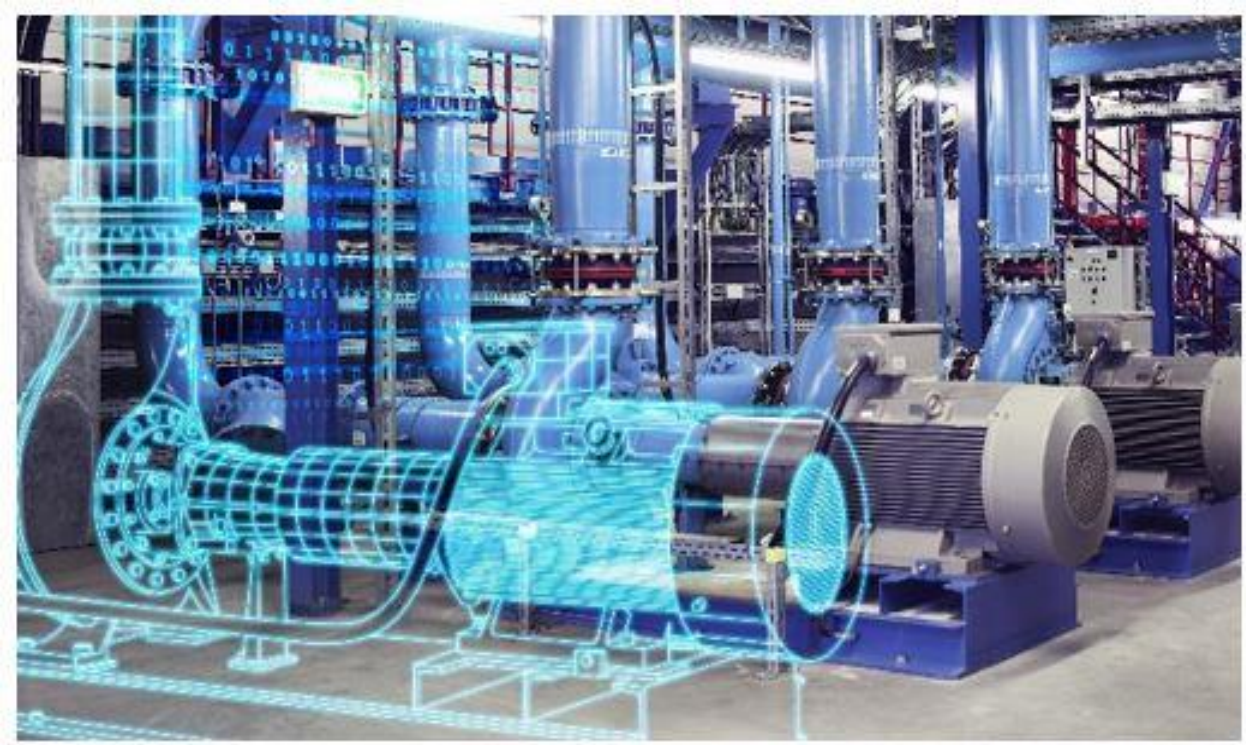
Factors affecting system (cake) and its observation

Complex processes and systems are difficult to monitoring and management



How to realize the paradigm of personalized medicine?

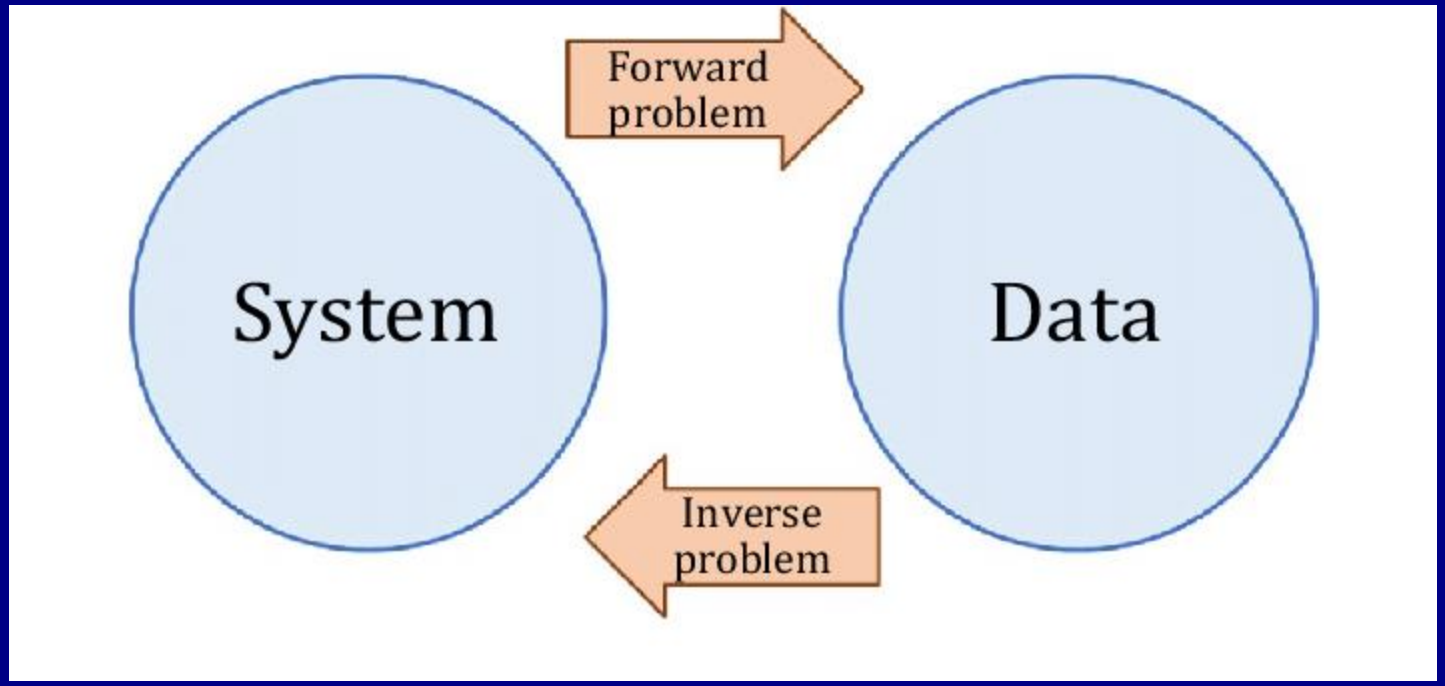
Digital twin for inference personalization



Augmented Reality for Maintenance

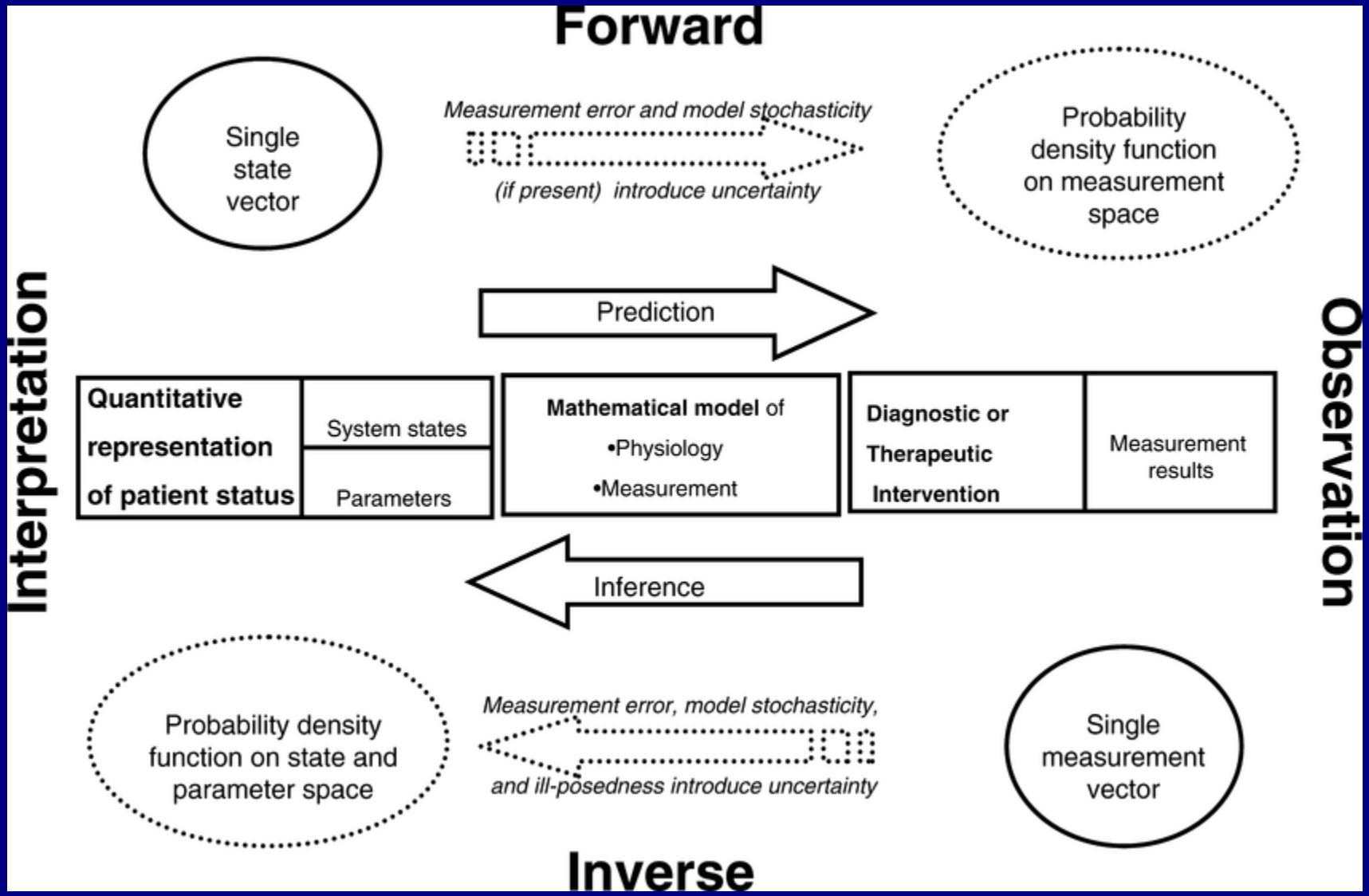
Where and what is the space for experimentation?
What technique should be used to obtain reliable observation(s)?
How the AI/ML can be used to suport experimentation?

Forward and inverse problem in physics



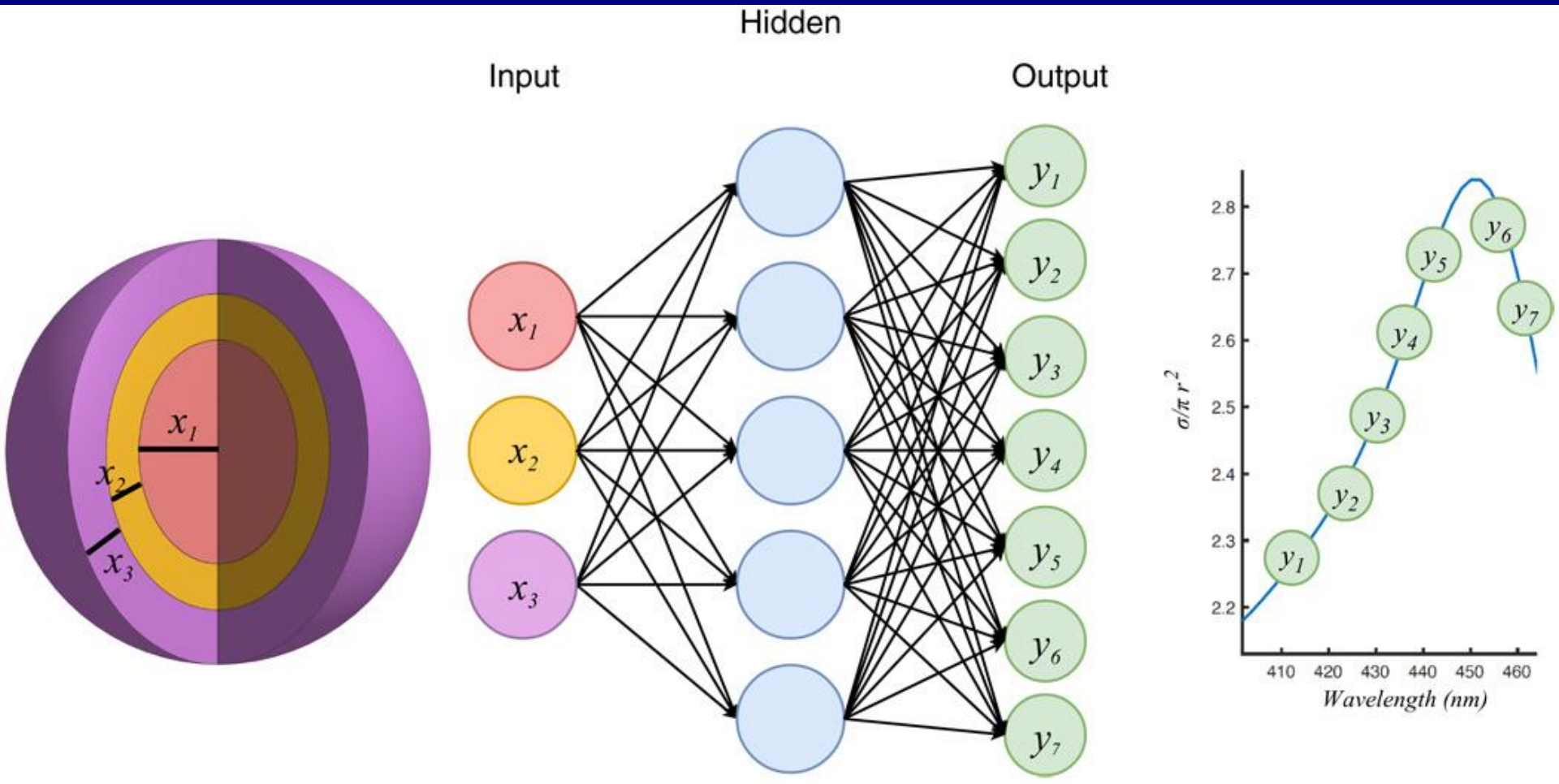
E.g., how to conclude about the system with measured data?

Forward and inverse problem in physics



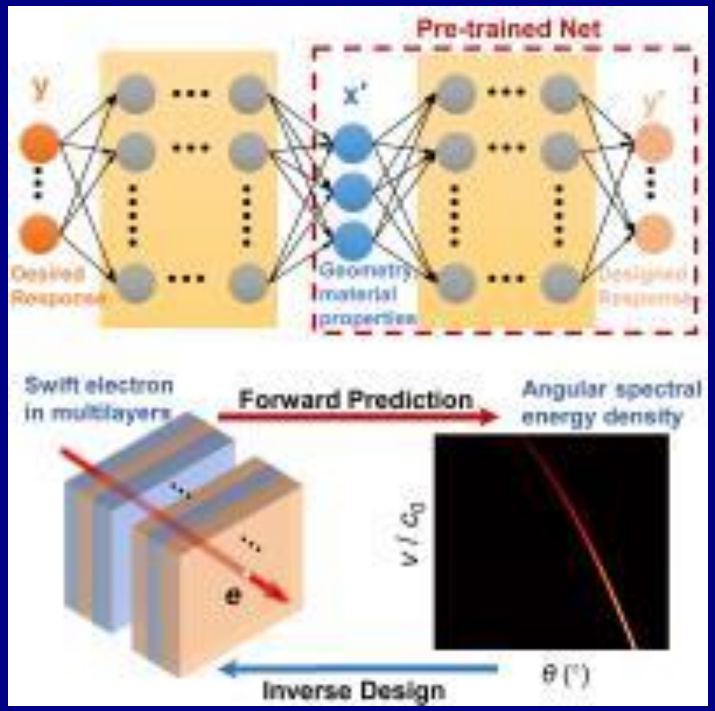
What is the role of measurement in physics?

Simultaneous inverse design of materials and structures via deep learning

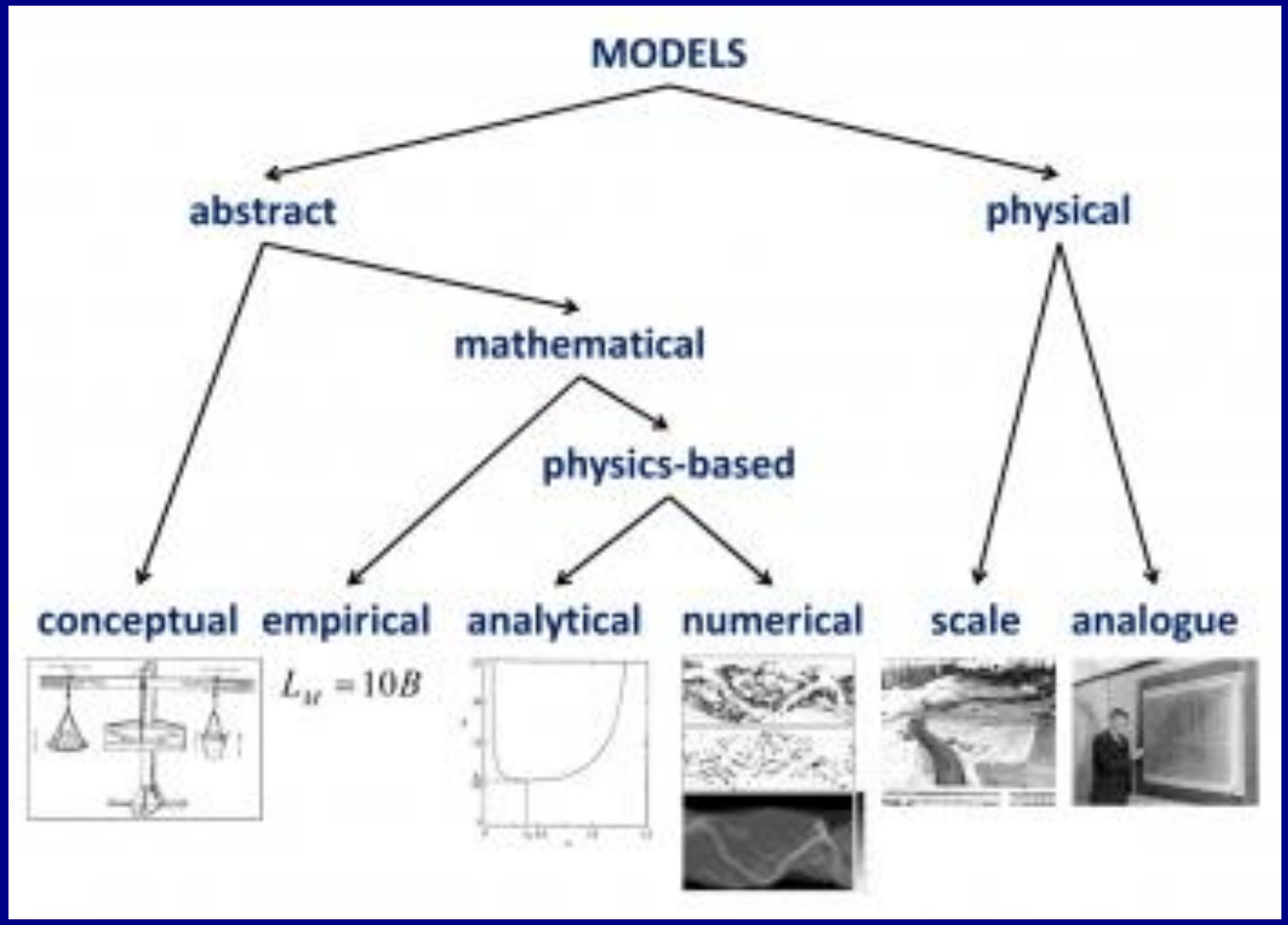


Nanophotonic particle simulation

Analysis and design of transition radiation in layered uniaxial crystals using tandem neural network

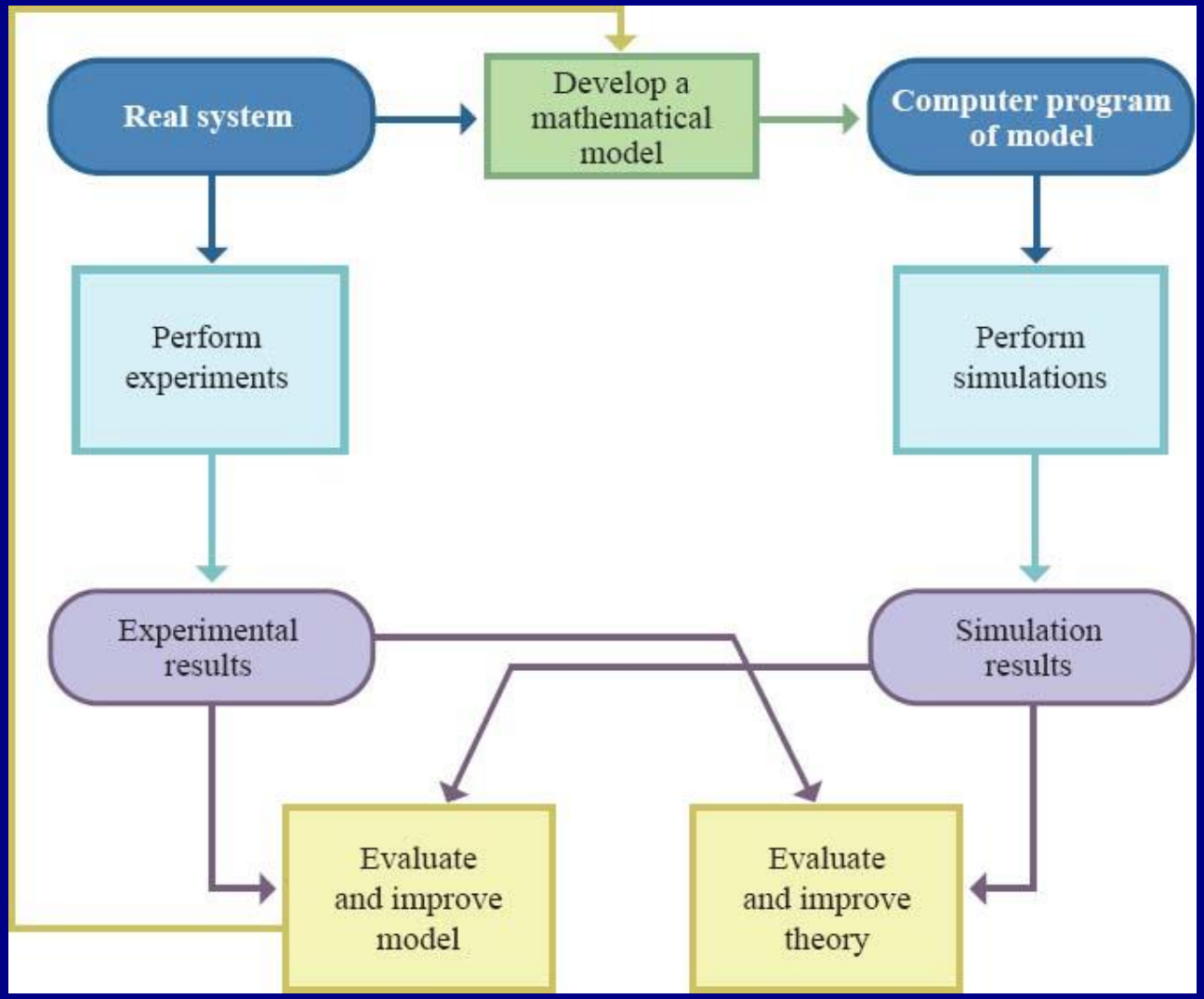


Role of modeling in experimentation



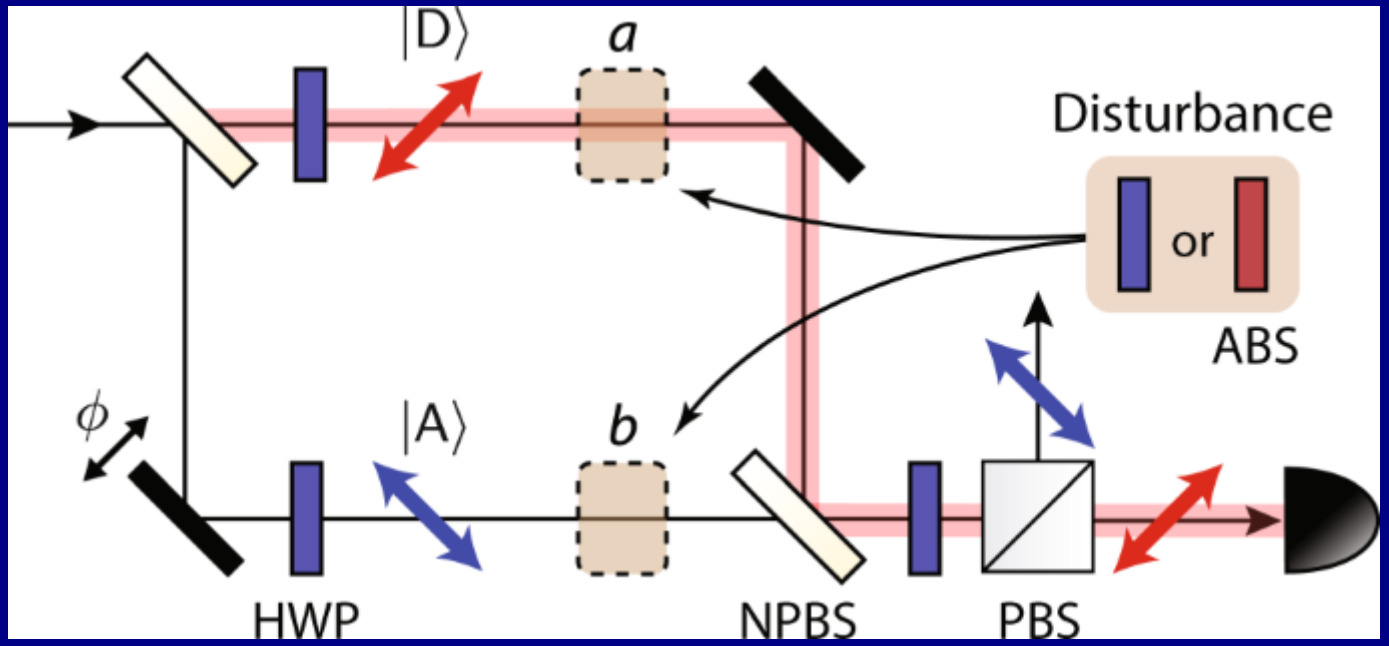
How about other systematics for modeling?

Computer simulations for experimentation



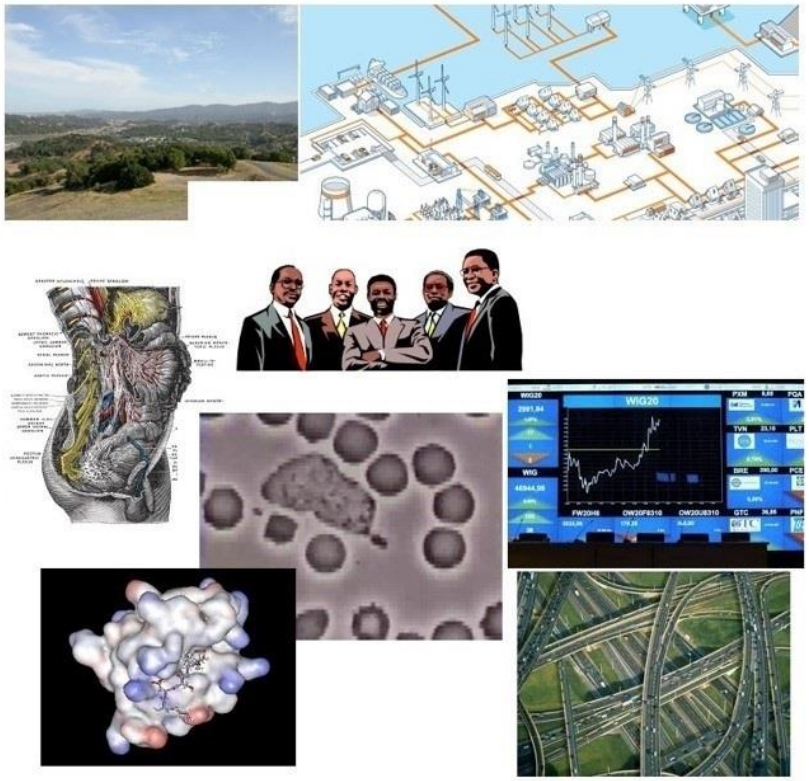
Theory, experimentation and modeling…

The role of measurement path in observation



What is the „true" input for measured output?

Observation, experimentation, analysis, cognition



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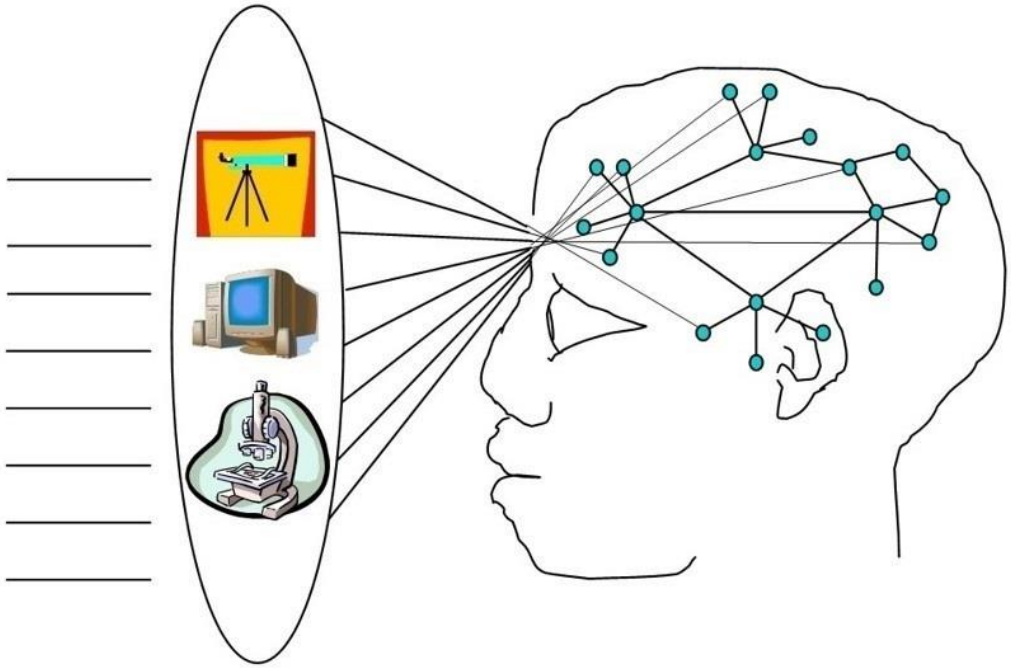
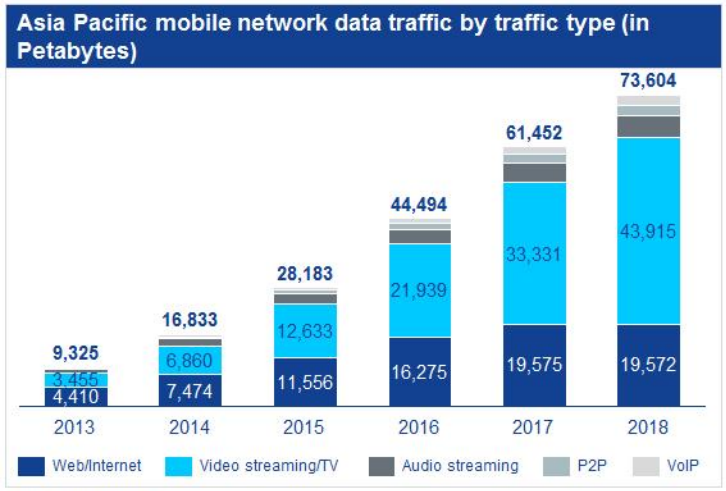


Interface of interaction: perception and analysis (also evolving)

Evolving cognition

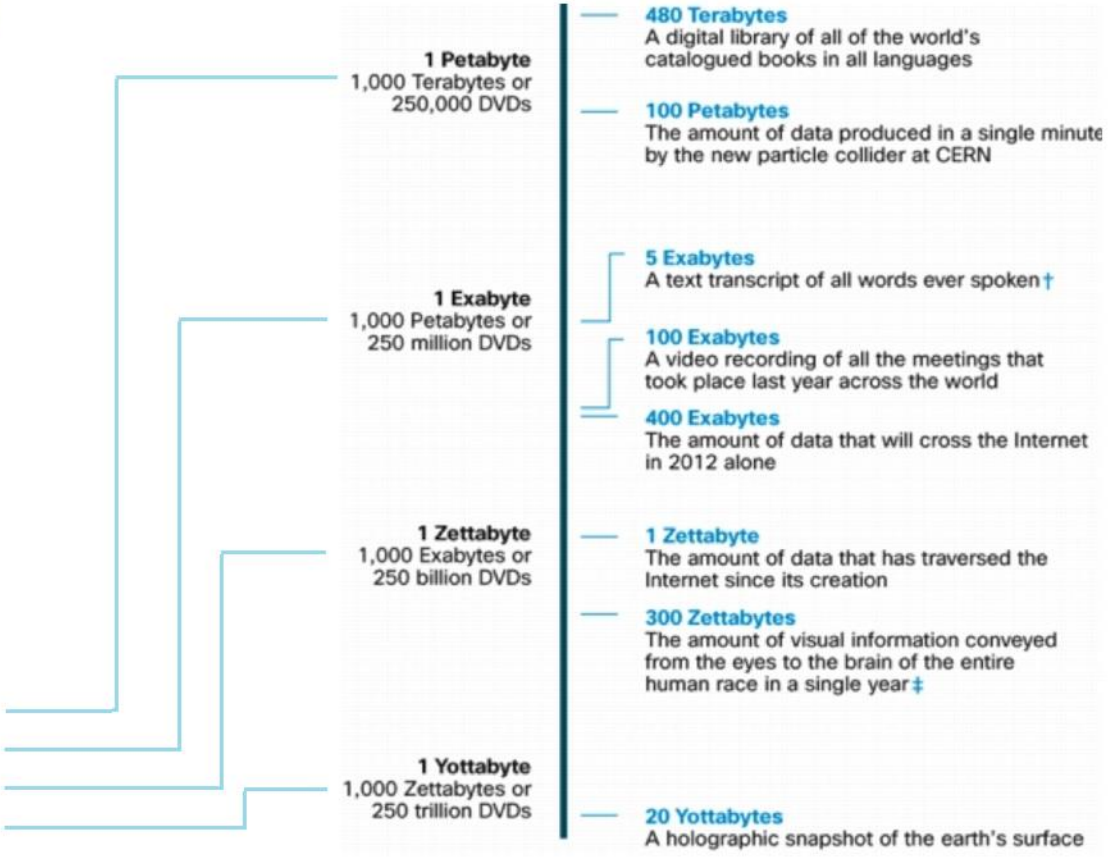
Evolving scheme of obtained knowledge

Data as the carrier of information



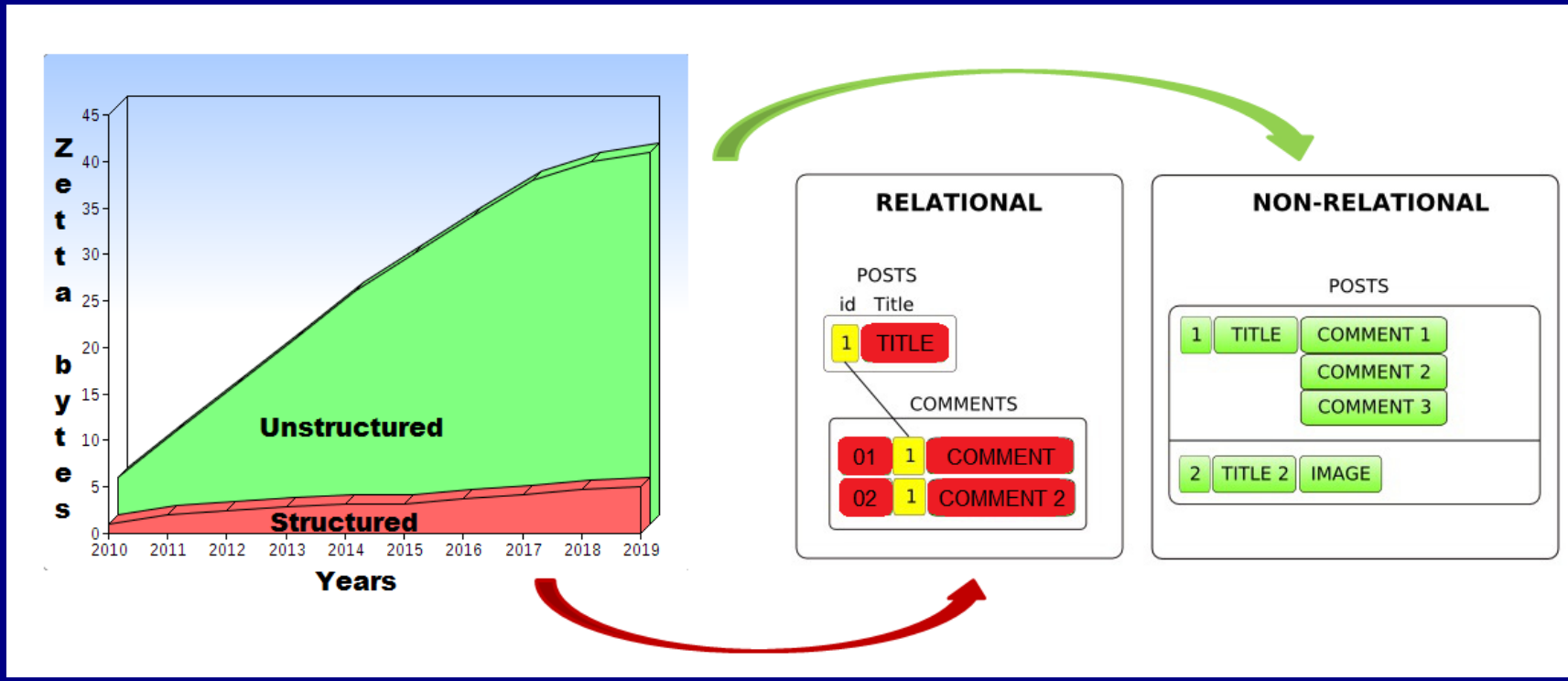
Source: ABI Research

Prefix	Symbol	10^n
kilo	k	10^3
mega	M	10^6
giga	G	10^9
tera	T	10^{12}
peta	P	10^{15}
exa	E	10^{18}
zetta	Z	10^{21}
yotta	Y	10^{24}



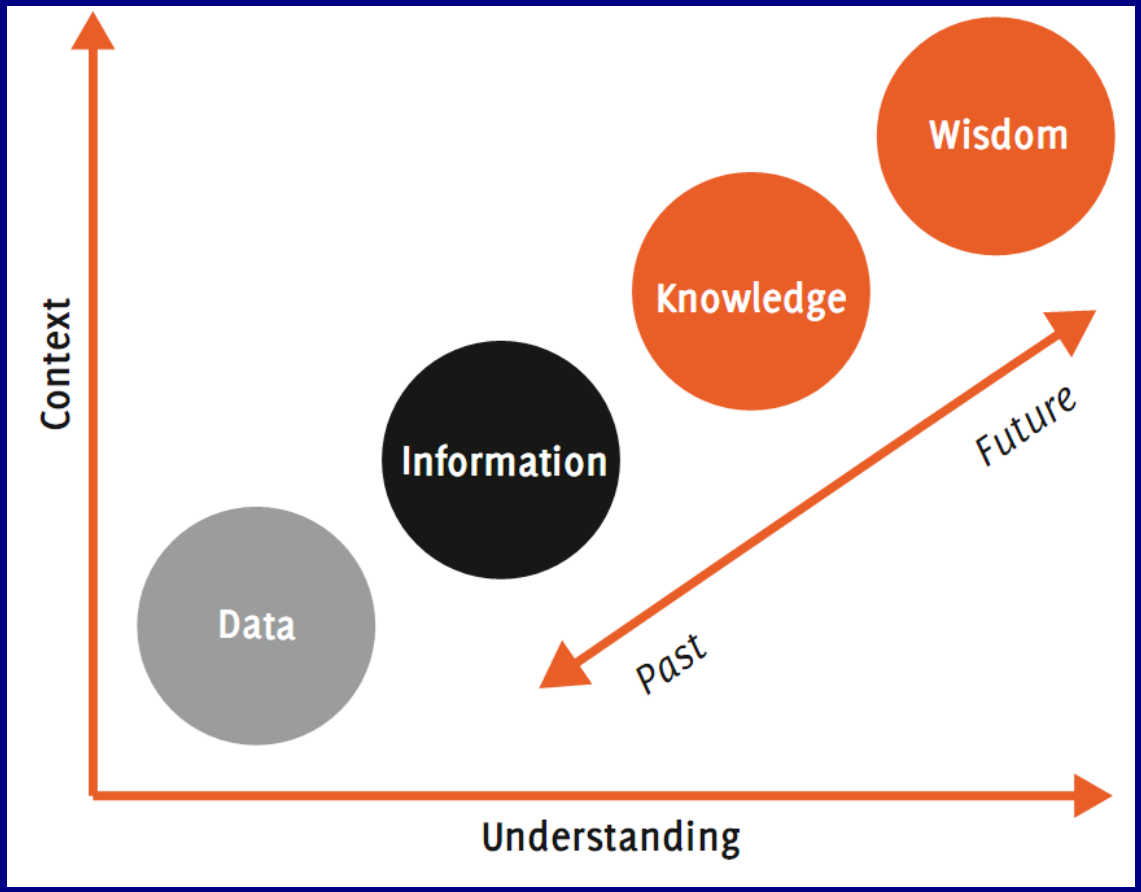
Data volumes characteristic for contemporary systems

Role of data in cognition process



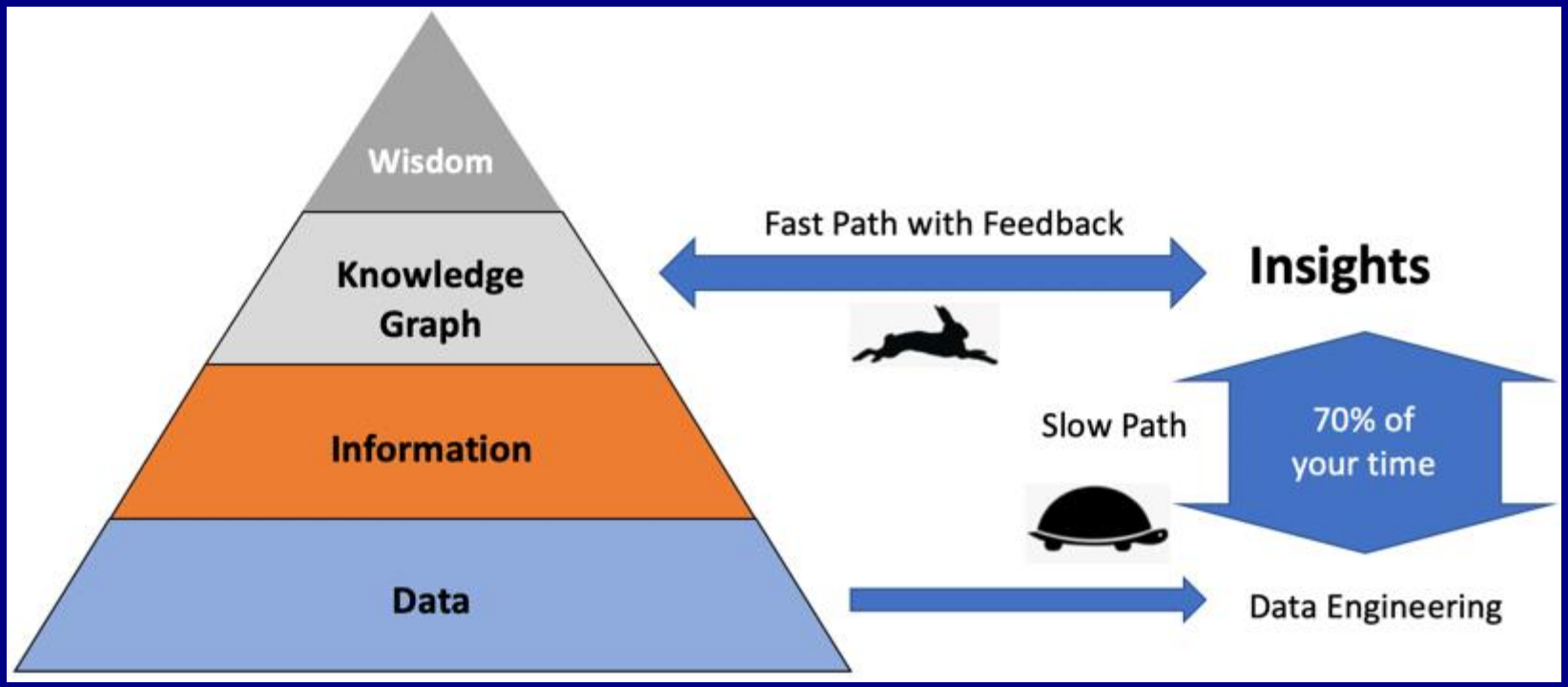
Evolving scheme of obtained knowledge

Role of data in cognition process



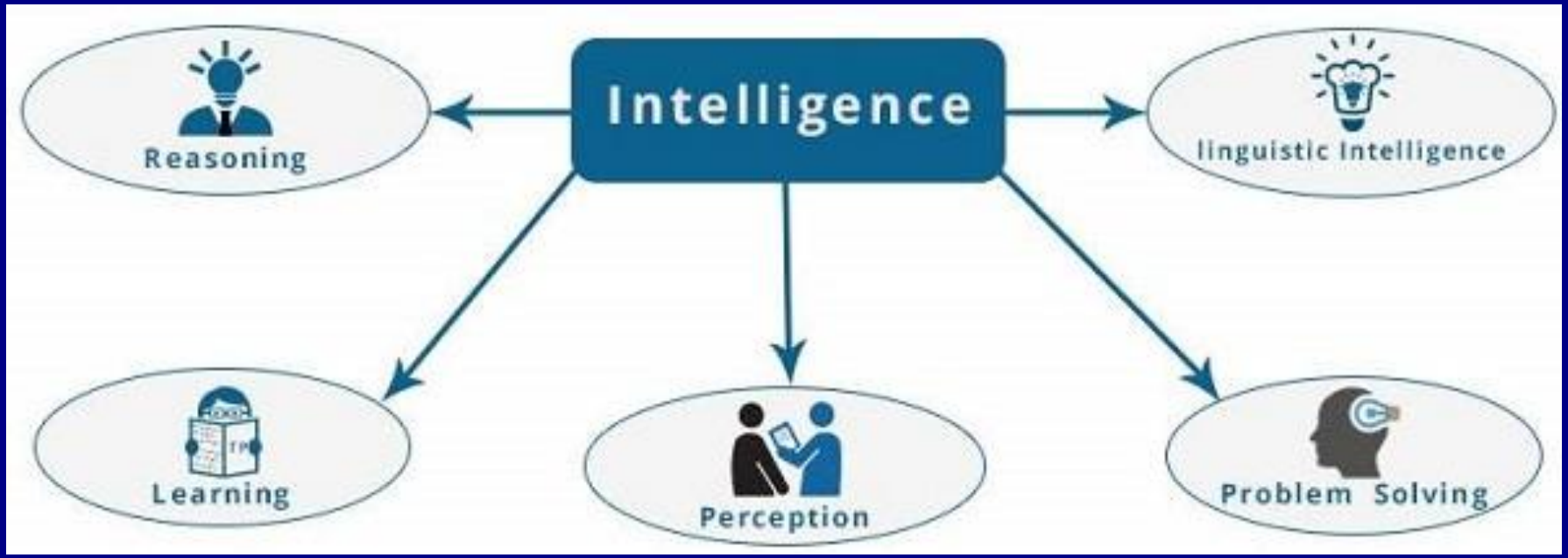
Triangle of knowledge

Role of data in cognition process



Triangle of knowledge

Why do we need an inteligence in experimentation?



What is possible/impossible for the artificial intelligence (AI)?
How to use AI for supporting experimentation?