Introduction to AI – an eventful journey

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Popular definitions

- Wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence.
- Any system that **perceives** its environment and takes actions that **maximize** its chance of achieving its **goals**.
- ***Simulation*** of human intelligence processes by machines, especially computer systems.
- ***Ability*** of a digital computer or computer-controlled robot to perform tasks commonly associated with **intelligent beings**.
- Computerized system that ***exhibits behavior*** that is commonly thought of as requiring intelligence.
- ***Science*** of making machines do things that would require intelligence if done by man.
- ***Science and engineering*** of making intelligent machines, especially intelligent computer programs.
- Makes it possible for machines to **learn from experience, adjust to new inputs** and perform human-like tasks

Types of AI

The emergence of artificial superintelligence will change humanity, but it's not happening soon. Here are the types of AI leading up that new reality.

Reactive AI

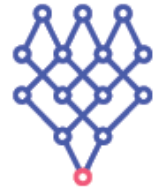
- Good for simple classification and pattern recognition tasks
- Great for scenarios where all parameters are known; can beat humans because it can make calculations much faster
- Incapable of dealing with scenarios including imperfect information or requiring historical understanding

Limited memory

- Can handle complex classification tasks
- Able to use historical data to make predictions
- Capable of complex tasks such as self-driving cars, but still vulnerable to outliers or adversarial examples
- This is the current state of AI, and some say we have hit a wall

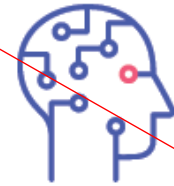
Theory of mind

- Able to understand human motives and reasoning. Can deliver personal experience to everyone based on their motives and needs.
- Able to learn with fewer examples because it understands motive and intent
- Considered the next milestone for AI's evolution



Self-aware

- Human-level intelligence that can bypass our intelligence, too



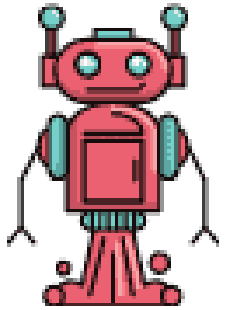
SOURCE: DAVID PETERSSON; ICONS: MIAKIEVY/GETTY IMAGES

Auto-...

- **Automation** describes a wide range of technologies that reduce human intervention in processes. Human intervention is reduced by predetermining decision criteria, subprocess relationships, and related actions — and embodying those predeterminations in machines.
- **Autonomy** means independence of control. This characterization implies that autonomy is a property of the relation between two agents, in the case of robotics, of the relations between the designer and the autonomous robot. Self-sufficiency, situatedness, learning or development, and evolution increase an agent's degree of autonomy, within the strict confines of their direct environment

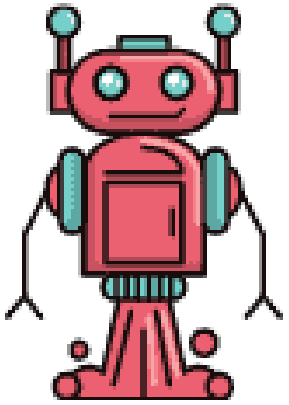
NARROW AI

Weak AI refers is AI that focuses on doing one task really well.



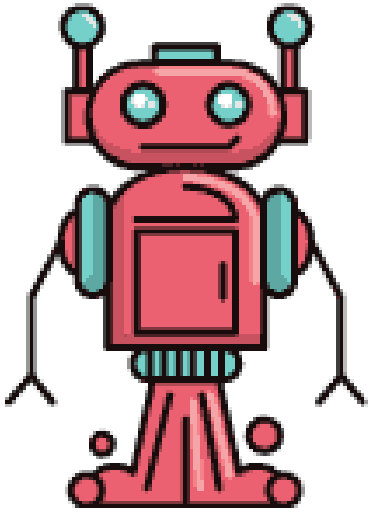
GENERAL AI

Strong AI refers to AI that exhibits human-level intelligence.



SUPER AI

Super AI is AI that surpasses human intelligence and ability.



ARTIFICIAL INTELLIGENCE ZONE

Use computers for...

1. Posing the right questions

2. Real world $\longrightarrow$ math formulation

3. Computation

4. Math formulation $\longrightarrow$ real world, verification

Goals of AI research

- calculation-reaction,
- decision-making / reasoning under risk & uncertainty,
- prioritize and plan,
- process (symbolic) knowledge (NLP),
- learning (from experience / by simulation / by example),
- pattern recognition,
- Perception (data fusion),
- ability manipulate objects.
- ----------
- the ability to solve an arbitrary problem (General intelligence)
- creativeness & Heuristics,
- consciousness.

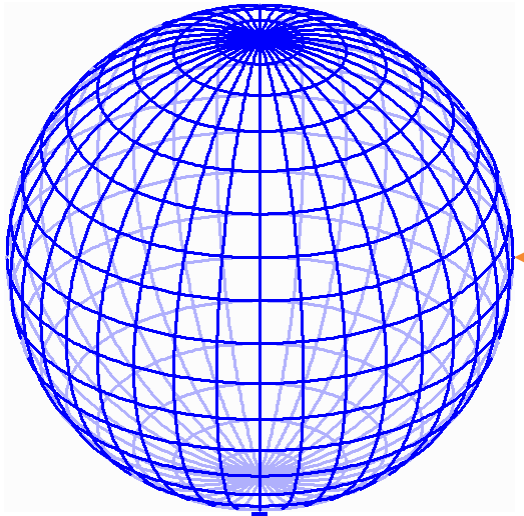
epistemology

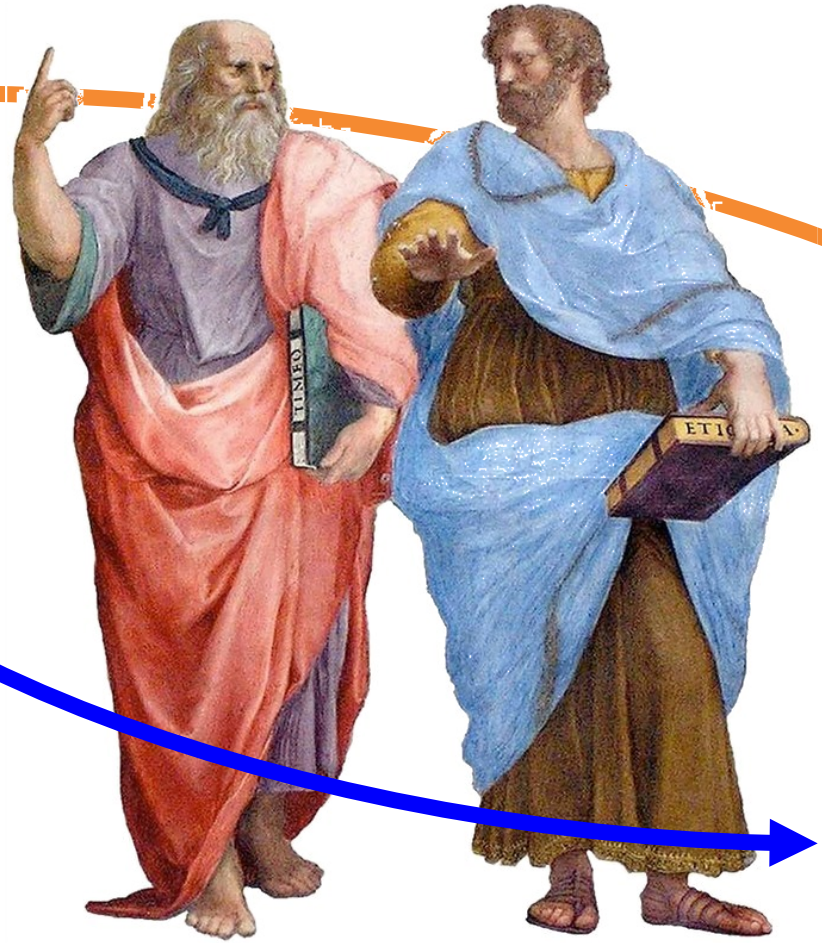
/ɪˌpɪstɪˈmɒlədʒi,ɛˌpɪstɪˈmɒlədʒi/

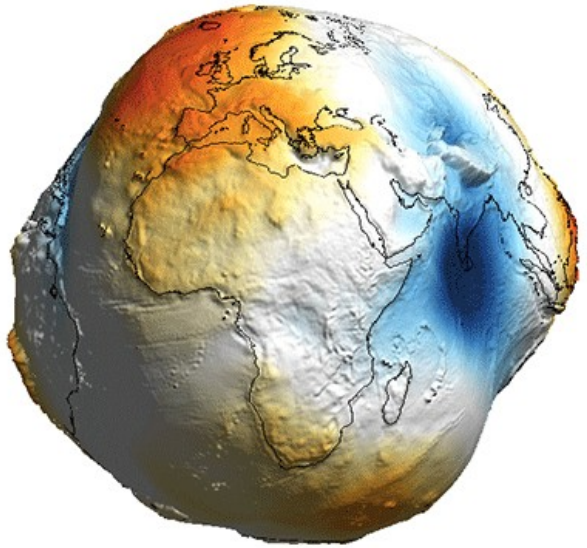
noun **PHILOSOPHY**

the theory of knowledge, especially with regard to its methods, validity, and scope, and the distinction between justified belief and opinion.

Induction/Deduction







Universality / specialization

Стохастичен или детерминиран Свят?

- ТЕЗА: „Няма нищо случайно на този свят. Случайността се дължи на непознаване на съответните причинно-следствени връзки. Детерминираността или случайността на едно събитие се свежда до **познавателните способности на човека**“ (класическа физика, математика)
- АНТИТЕЗА: „Според **принципа за неопределеност** на Хайзенберг съществуват събития, причинно следствените връзки на които не могат да бъдат определени в рамките на смислено за настъпването на събитието време. Този принцип означава, че съществуват събития, които не могат да бъдат направени детерминирани, в следствие на което те са непрогнозируеми. “ (квантова физика, инженерни науки)

Проф. Георги Чобанов, VSIM:16, Равда, Септември 2016

Стохастичен или детерминиран Свят?

- СИНТЕЗА (Марчев, мл.):

1)Или съществуват недетерминирани събития, при които причинно-следствени връзки няма;

2)Или познавателната способност на човека е незначимо малка в сравнение с всеобхватната Вселена/Вселени.

3)И в двата случая за използването на по-добрия (или единствения възможен) вероятностен математически апарат е предпочитано.

4)Особено валидно е за явленията със социално-психологически характер, които много повече се доближават до квантовата механика (принцип на наблюдателя, случайност (или необхватна сложност) на поведението на обектите, неопределеност на средата, непълна информация, нестационарност и пр.). Едновременно това е и по-прагматичния подход, при който винаги може да се разчита на конкретни числени резултати.“

Standing on the shoulders of giants

Nanos gigantum humeris insidentes

"*What Descartes did was a good step. You have added much several ways, and especially in taking the colors of thin plates into philosophical consideration. If I have seen a little further, it is by standing on the shoulders of Giants.*" (Newton, Isaac. 1675, “Letter from Sir Isaac Newton to Robert Hooke“)

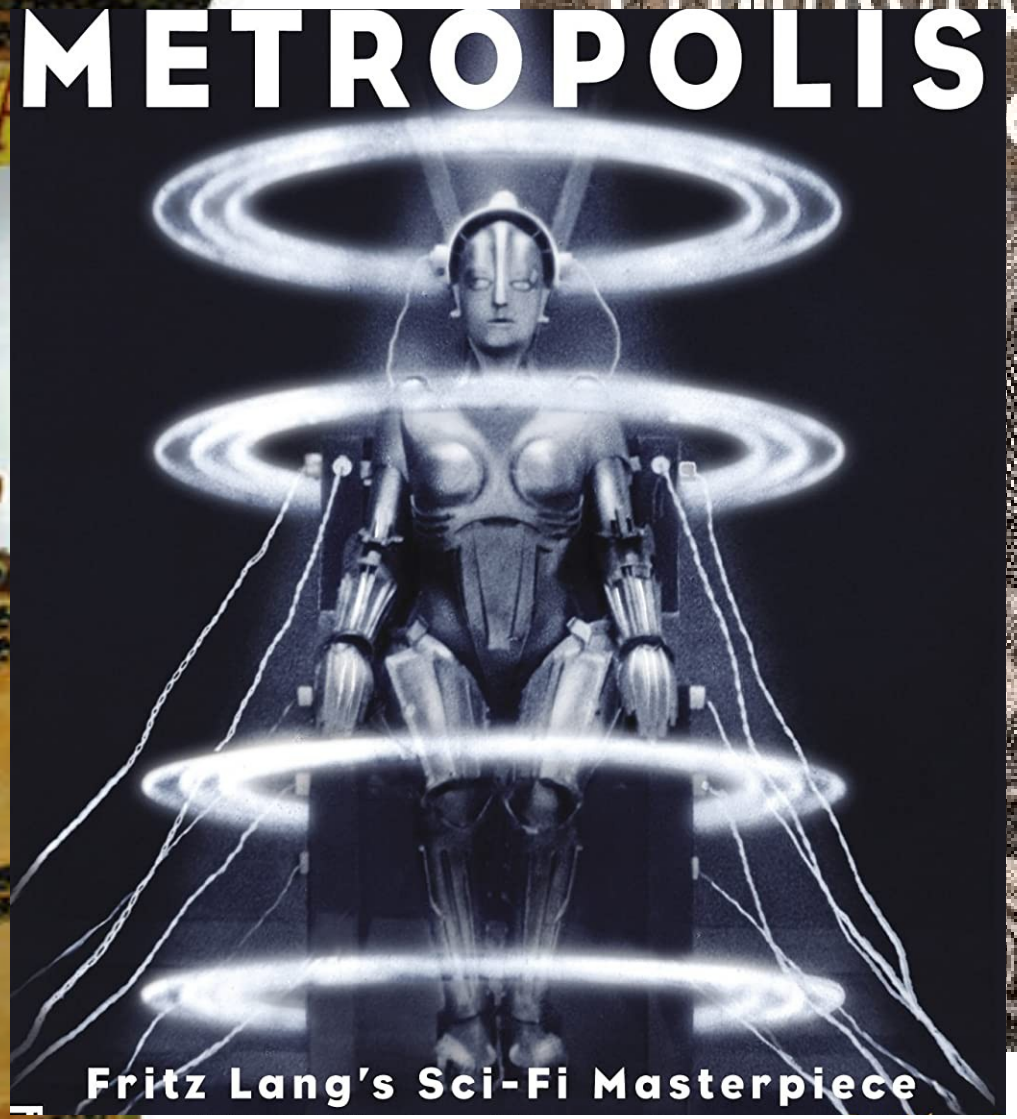
“We are like dwarfs sitting on the shoulders of giants. We see more, and things that are more distant, than they did, not because our sight is superior or because we are taller than they, but because they raise us up, and by their great stature add to ours.“ (John of Salisbury, 1159, Metalogicon)

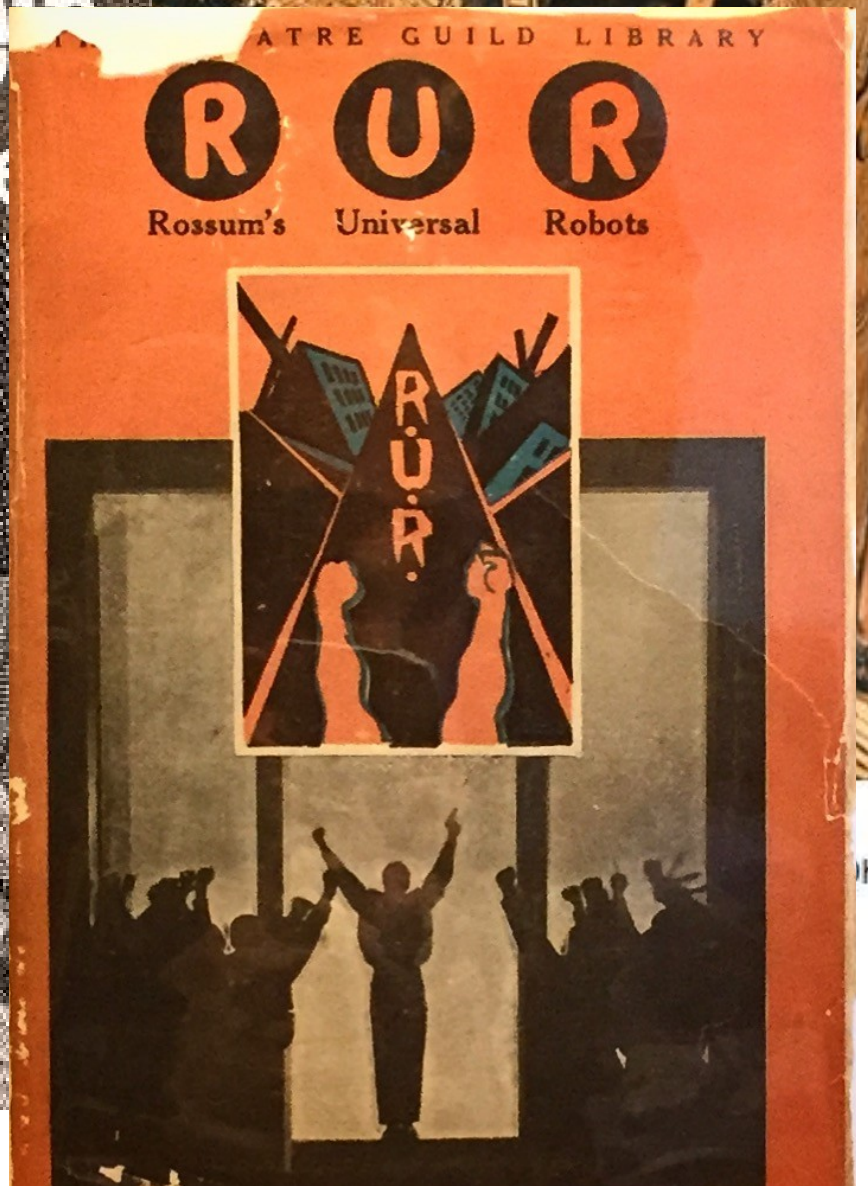
Greek mythology: the blind giant Orion carried his servant Cedalion on his shoulders to act as the giant's eyes.

Phases

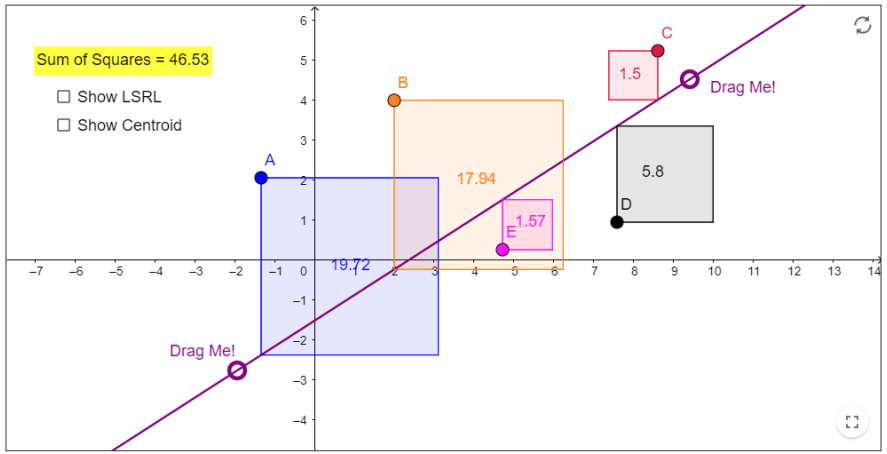
- Imitation (through art)
- Analytical parametric methods (solving hard problems)
- Iterative computation methods for state search
- Adaptive computation methods

Imitation / Deus Ex





Parametric identification in linear systems
Least Squares Method



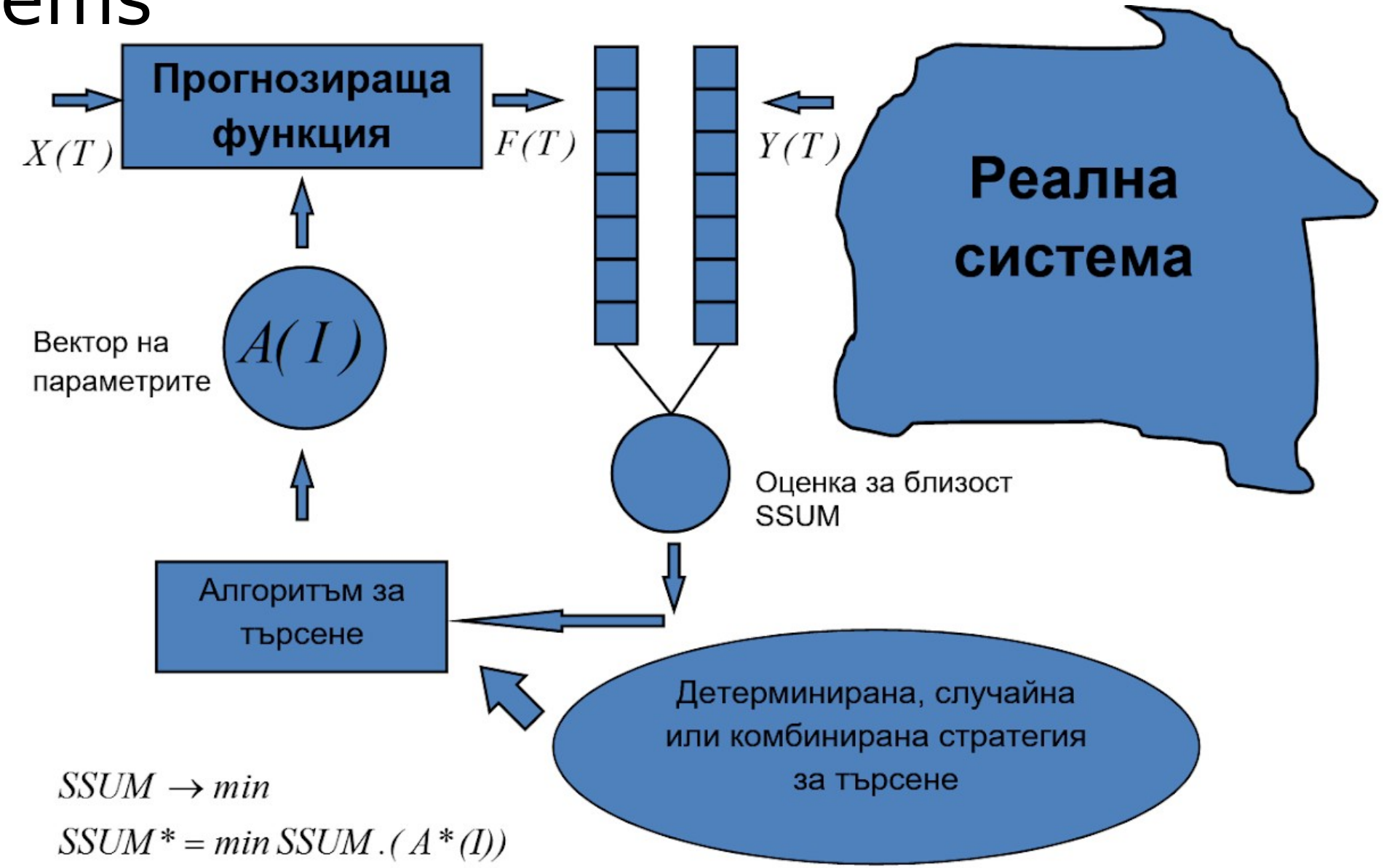
Carl Friedrich Gauss

- Linear regression-ish
  - linear $Y = a_0 + a_1 . X$
  - logarithmic $Y = a_0 + a_1 . \ln X$ $Z = \ln X$ $Y = a_0 + a_1 . Z$
  - exponential $Y = e^{a_0 + a_1 . X}$ $Q = \ln Y$ $Q = a_0 + a_1 . X$
  - power $Y = a_0 . X^{a_1}$ $Q = a_0 + a_1 . Z$
  - reciprocal $Y = a_0 + \frac{a_1}{X}$ $Z = \frac{1}{X}$ $Y = a_0 + a_1 . Z$
  - reverse reciprocal $Y = \frac{1}{a_0 + a_1 . X}$ $Q = \frac{1}{Y}$ $Q = a_0 + a_1 . X$
  - quadratic sum $Y = (a_0 + a_1 . X)^2$ $Q = \sqrt[2]{Y}$ $Q = a_0 + a_1 . X$
  - sine $Y = a_0 + a_1 . \sin X$ $Y = a_0 + a_1 . Z$

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

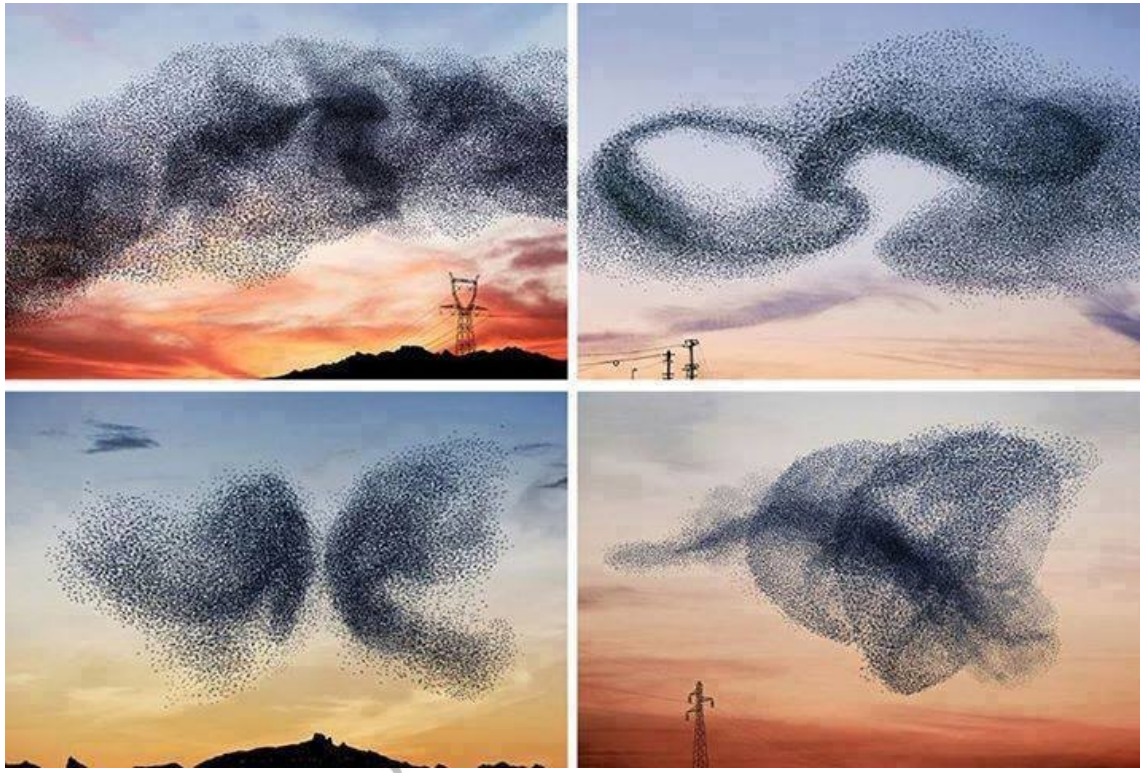
$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

Parametric identification in non-linear systems



Self-organization

- Structure (incl. features, models) and parametric identification



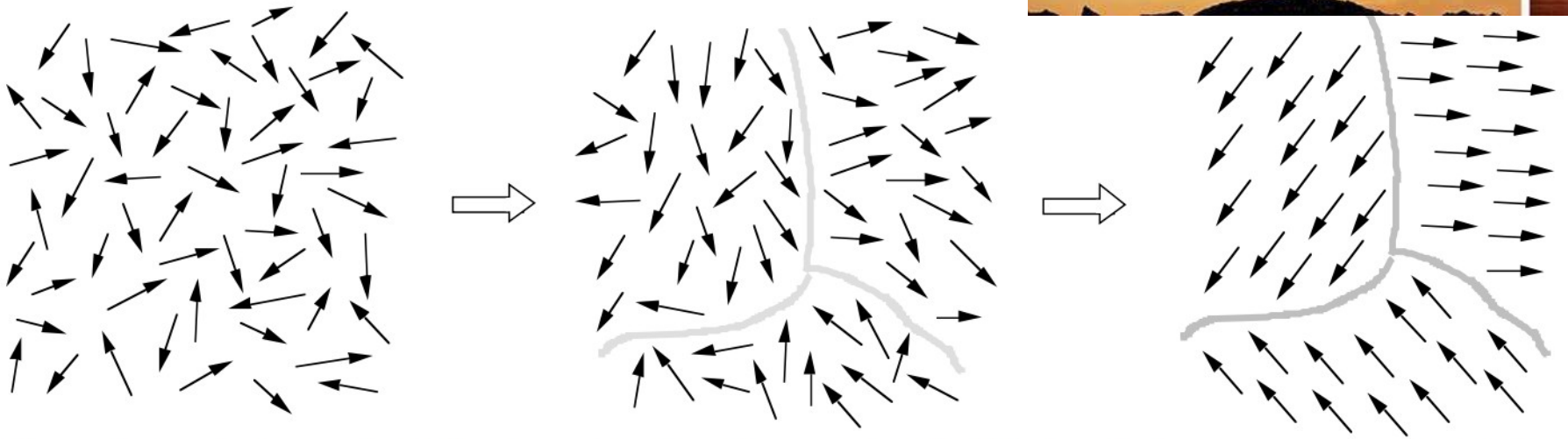
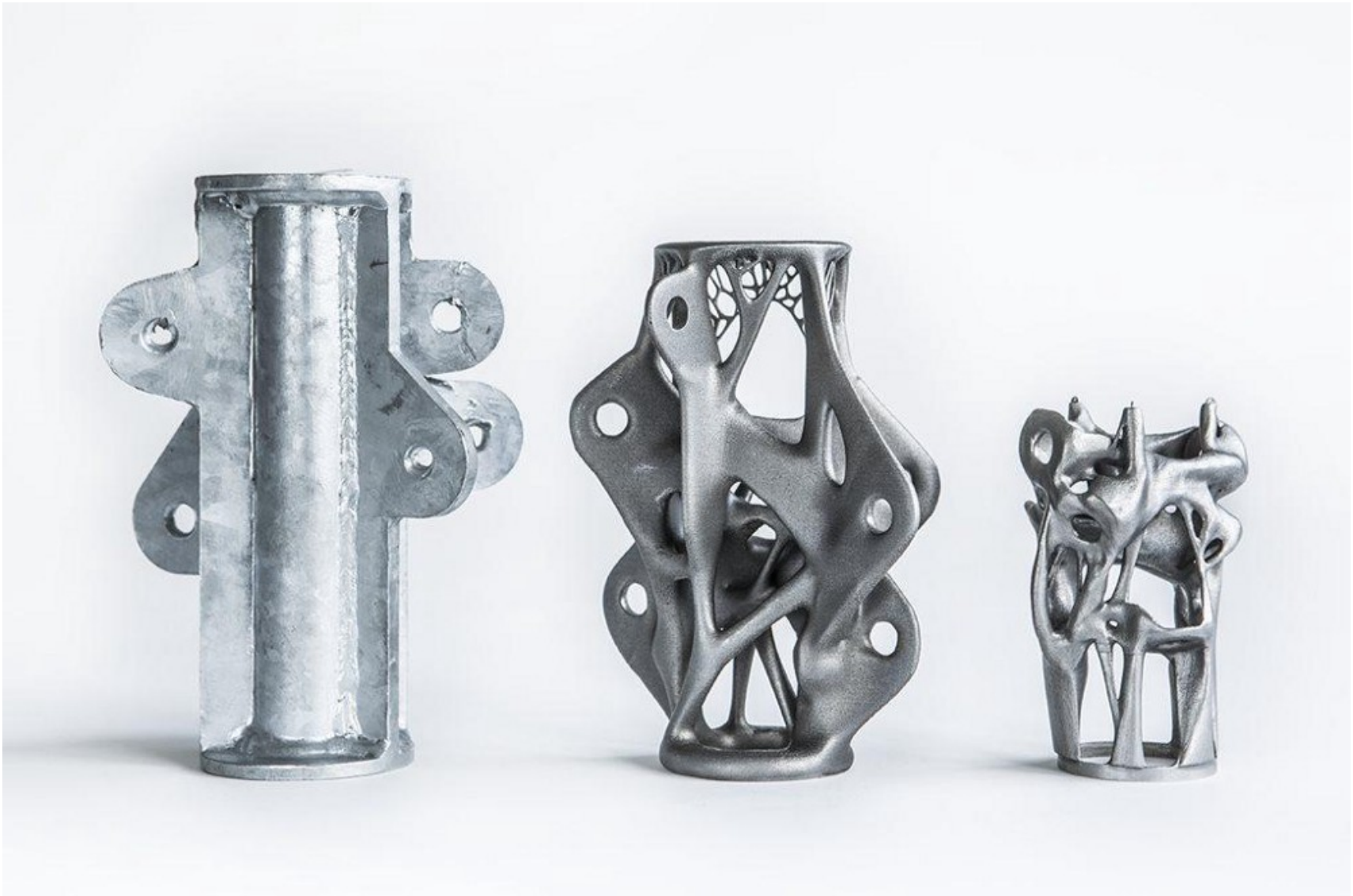
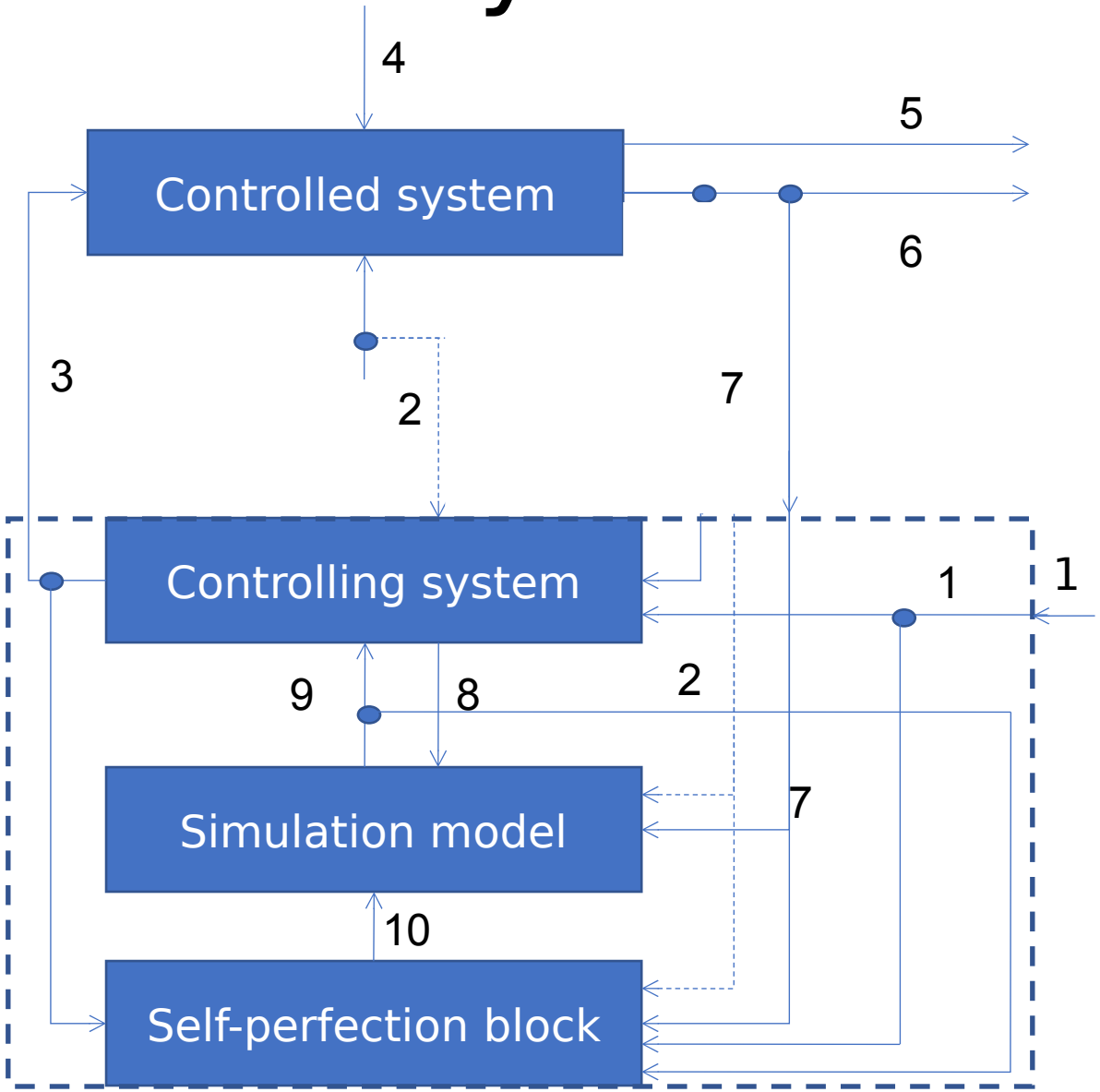


Figure 2: local alignment of directions of action, from random (left) to locally homogeneous, but globally heterogeneous (right)



Control system



1. Goals
2. Observed influences from the environment (market factors)
3. Controlling influences
4. Unobserved influences from the environment
5. Insignificant variables (?)
6. Significant variables
7. Feedback
8. Task for the simulation model
9. Proposed controlled influences
10. Adjusting the internal structure and/or the values of the variables of the simulation model

- *Systematic approach*
- *Inductive reasoning & Empirism*
- *Heuristics & Interdisciplinary nature*
- *Complexity emulation*
- ***Self-perfection (Self-learning and/or Self-organization)***

What is a model?

?

Simulation model definition

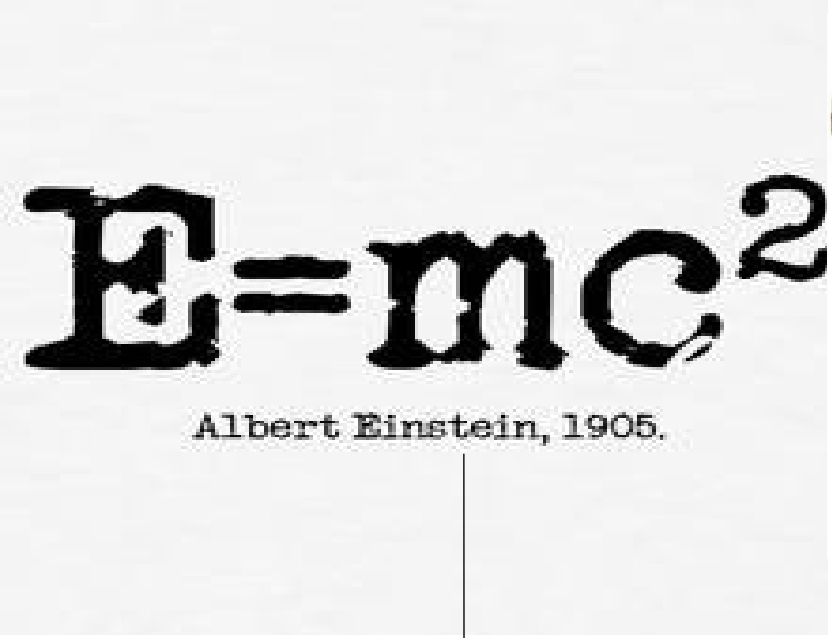
Purposefully created artificial system,

which:

1. Reflects the most significant features of the modeled system:
   - ►*Describes the most significant (for the purpose of the research) components and connections of the modeled system;*
   - ►*Has behavior close enough (for the purpose of the research) to the behavior of the modeled system.*

2. Provides gathering of new information about the modeled system:
   - ►*By simulating the behavior of the modeled in convenient granularity scale (incl. convenient time);*
   - ►*By replacing to some extend (for the purpose of the research) the modeled system*
   - ►*By experiments with the model instead of the real system (“what... if...?”).*

Analytical or Simulation model



Година		2012									2013					
Тримесечие		II			III			IV			I			II		
Период (t)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Месец		Апр.	Май	Юни	Юли	Авг.	Септ.	Окт.	Ноем.	Дек.	Ян-ри	Февр.	Март	Апр.	Май	Юни
ОПТ																
1.Печалба преди лихви и данъци	лв.	710	-15	-15	630	-1	1	1248	-19	-19	3565	4	4	665	14	17
Изменение в оборотния капитал	лв.	-4920.7	314.85	330.08	-4481	713.4	773.8	-4626	1258	1330	-3862	1782	1821	-3535	1805	1842
Платени данъци	лв.	0	0	0	0	0	0	0	0	0	0	0	0	-128.2	0	0
2.Паричен поток от оперативна дейност	0	-4211	300	315	-3852	713	775	-3379	1239	1311	-297	1786	1825	-2999	1820	1859
Постъпления/Плащания от лихви	лв.	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5	-137.5
Постъпления/Плащания от главници	лв.	11000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.Паричен поток от финансова дейност	лв.	6652	162	178	-3989	575	637	-3516	1102	1174	-434	1648	1688	-3136	1682	1722
Увеличение на капитал	лв.	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Паричен поток след отчитане движението на капитала	лв.	7252	162	178	-3989	575	637	-3516	1102	1174	-434	1648	1688	-3136	1682	1722
5.Паричен поток в началото на отчетния период	лв.	0	7252	7414	7592	3603	4178	4815	1299	2401	3574	3140	4788	6476	3340	5022
6.Кумулативен паричен поток	0	7252	7414	7592	3603	4178	4815	1299	2401	3574	3140	4788	6476	3340	5022	6743
7.Кумулативен ПП от оперативна дейност	0	-4211	-3911	-3595	-7447	-6734	-5960	-9338	-8099	-6788	-7085	-5299	-3474	-6473	-4653	-2794
Нетна настояща стойност NPV																
Дисконтирани парични потоци по месеци		7165	159	172	-3801	541	593	-3231	1000	1053	-385	1443	1460	-2680	1420	1436
Година	лв.	2012	2013	2014												
Дисконтирани парични потоци по години	-11600	3650	3487	5300												
Дисконтирана стойност на КМА към момента на отчитане				7434												
Нетна настояща стойност NPV	8271															
Процент на дисконтиране D	14.59%															
Вътрешна норма на възвращаемост	39.5%	2012	2013	2014												
Парични потоци по години	-11600	3574	4278	18564												
Средна претеглена цена на капитала																
Източник	Размер	Дял	Цена	Тегло												
Собствен капитал	600	5%	7%	0.36%												
Дългосрочни задължения	11000	95%	15%	14.2%												
Общо	11600	100%		14.59%												

Towards simplification of modeled system for generalization of principles and relationships

Towards emulating (imitating) complexity to extract particular results (values) for decision making