Санкт-Петербургский
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Семинар по специальности на английском языке

Лекция 4

New Era of Evolution - is current civilization is

phenotype of human gene ?

(**фенотип — совокупность внешних и внутренних признаков организма,**

включая поведение, приобретённые в результате онтогенеза – процесса

индивидуального развития)

September

2020 г.

- Do we have enough knowledge to calculate the trajectory THIS PROCESS ?
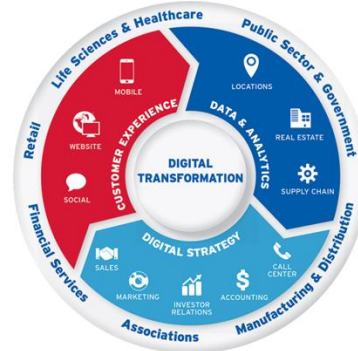- What we need to know and what tool we must have to do this ?

Digital "twin/ashes"

Knowledge transformation – from object to number

Digital distorting mirror

The genetic code is the set of rules used by living cells to translate information encoded within genetic material (DNA or mRNA sequences of nucleotide triplets) into proteins.

- The world (natural and artificial) is continually changing and one of the fundamental drivers of this process – so called digital transformation

- In common since Digital transformation is about computer aided intellectual activities – new way to do what we already do but better (more precisely, faster, etc).

- So, the backbone of the Digital economy provides :
  - **hyper** connectivity **& HPC**
  - **internet** of things (IoT)
  - **Big data** processing of "Digital Flood"

Fundamental issues:
- is the current civilization is phenotype of human gene ?
- does current civilization has its own gene ?

① Can Computers Think?
The History and Status of the Debate — Map 1 of 7
An Issue Map™ Publication

Underlined/emphasized right column:

<u>Fundamental restriction:</u>
Human knowledge and competencies becomes computers resources ONLY <u>if being converted to algorithms or programs.</u>

<u>"Eldorado" of the new economy</u> is a space of "big data" from which "digital knowledge" is extracted with the help of <u>«intellectual» technologies</u>

Cognitive computing - technology that try to mimics the functioning of the human brain by integrate various computing principles:

- "stored" program
- "Neuromorphic" approximation
- regularizing decisions of inverse tasks

Digital flood problem: **no time** to **invent** an algorithm (and delegate the solution to the computer) and create computer program, so decisions are made on the basis of **experience or out of habit**

Internet

e-mail

HPC
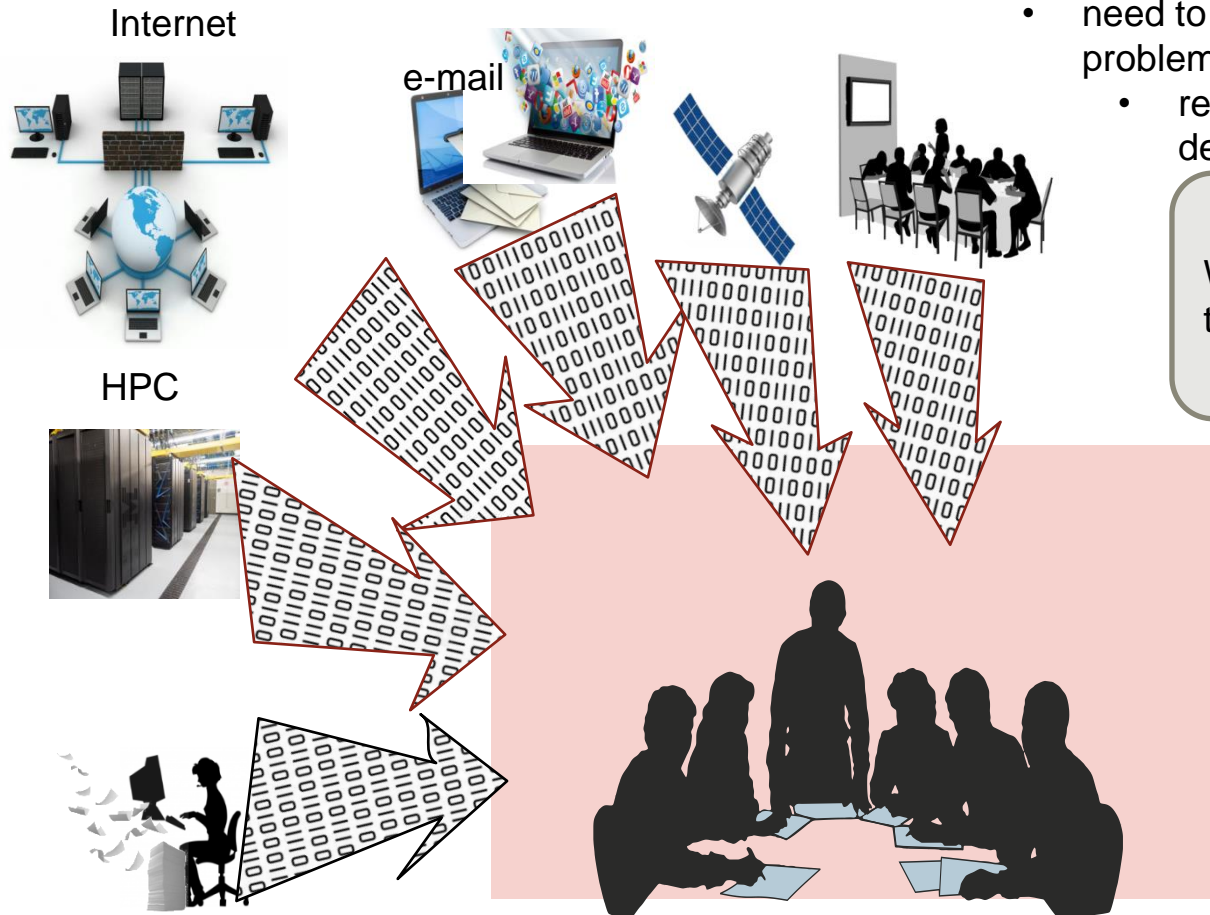
- need to understand the problem
  - remember the "correct" decision
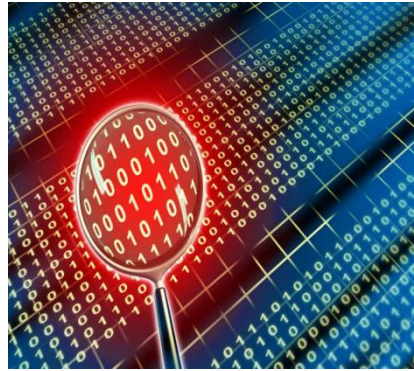
What should be done to solve the problem?

Advance CS platforms should have: **reconfigurable** heterogeneous processing field, deep **storage** class memory, and **distributed** (collaborative) architecture

The classic goal of computer science:
automation of solving "direct problems": finding numerical solutions of equations using algorithms and programs

The principles of "computer science" –
- automata can model automata,
- algorithm can mapping digits to digits,
- "big data" is the hidden bank of algorithms ...

New challenges for computer science:
solving "inverse task problems": find algorithms to solve the task in context of available data and a priori knowledge
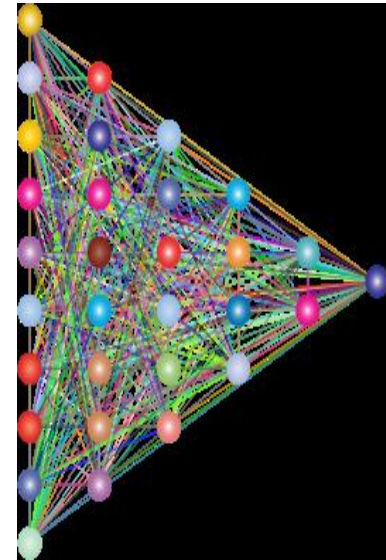
Skolem's paradox : relativity of set-theoretic notions
(non-absoluteness of theoretic notation)

the intuitively expected result can be very different from the Bayesian result

. . .every countable axiomatisation of set theory represented in first-order logic (or by expressions in the form "there exists x such that x is Socrates and x is a man", where "**there exists" is a quantifier**, while **x is a variable**), if it is consistent, has a countable model

Логика первого порядка — формальное исчисление, допускающее высказывания относительно переменных, фиксированных функций и предикатов. Расширяет

логику высказываний (.

New Math - or how to extract knowledge from the surrounding data

Conventional computers are good at calculating, but they are poor at some tasks that are easy for humans. Basic idea - update probability as new data becomes available

$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)}$$

Левая часть уравнения — апостериорная оценка вероятности события A при условии наступления события B (т. н. условная вероятность).

  P(A) — вероятность события A (априорная оценка);

  P(B|A) — вероятность (также условная), которую мы получаем из наших данных;

   P(B) — константа нормировки, которая ограничивает вероятность значением 1.

Neural network as a tool for solving the problem

… fast solving the problem without an explicit description of the algorithm but … but based on experience. (the solution "extracts" from a large data set)
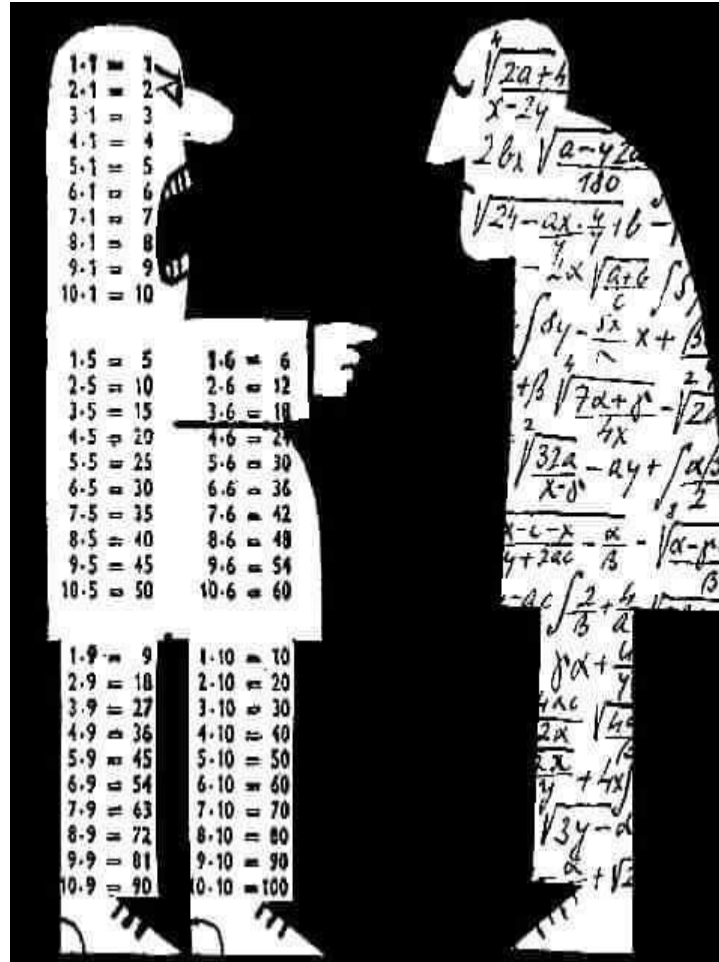

Входной слой

Скрытые слои

Выходной слой
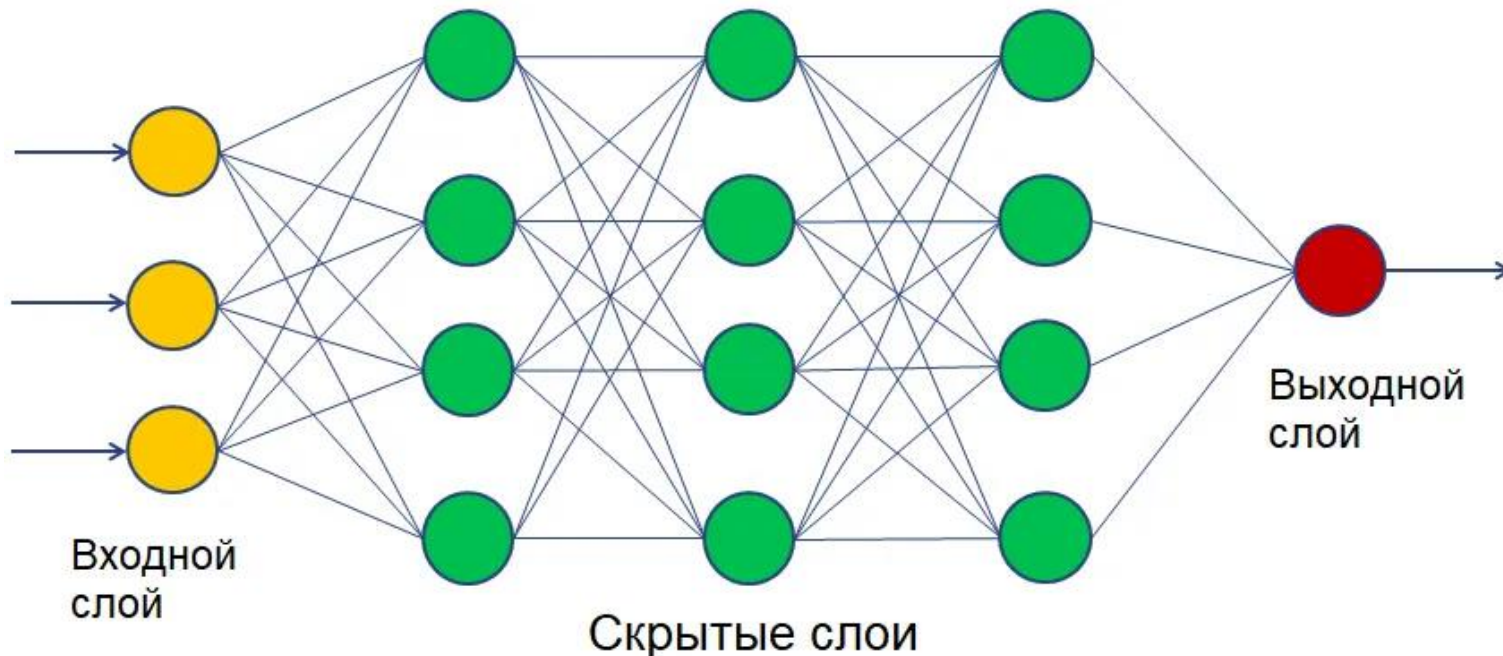
to use such solutions, we must "trust" the tool. So, in addition to the solution itself, it is necessary to "calculate" an explanation of how this solution was obtained.

digital phenotype
- we wanted the best, but it
turned out as always:

Metaphors for the issue under discussion

Мышление есть лишь расчет.

Томас Гоббс (1588-1679)

Не будем спорить — давайте посчитаем.

Жозеф Лагранж **(1736-1813)**