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КАФЕДРА ТЕЛЕМАТИКА

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)**

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- 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 ?

Key words of New Era



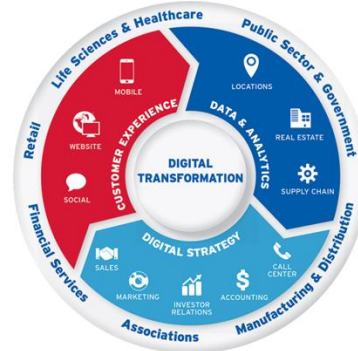
Digital “twin/ashes”



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

Start

1 Alan Turing, 1950
Yes, machines can (or will be able to) think. A computational system can possess all important elements of human thinking or understanding.

I believe that at the end of the century ... one will be able to speak of machines thinking without expecting to be contradicted.



Can computers have emotions?

28 Machines can't have emotions. Machines can never be in emotional states (they can never be angry, joyous, fearful, etc.). Emotions are necessary for thought. Therefore, computers can't think.



can't experience



29 Paul Ziff, 1959
The concept of feeling only applies to living organisms. Because robots are mechanistic artifacts, not organisms, they cannot have feelings.

is disputed by

32 Hilary Putnam, 1964
"Alive" is not definitionally based on structure. Because the definition of "alive" is not based on structure, it allows for nonhuman robot physiologies. Robots made up of cogs and transistors instead of neurons and blood vessels might have feelings

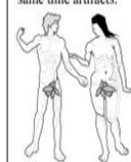
30 J. J. C. Smart, 1964
Having feelings does not logically imply being a living organism. Although we haven't yet come across any nonliving entities with feelings, perhaps in the future we will. There is no logical contradiction in the idea of a nonliving being that has feelings.

Rocks: nonliving and no feelings.
Check!
Salt: nonliving and no feelings.
Check!
Staplers ... check!
Water ... check!
Well, no nonliving things with feelings ... yet.

31 J. J. C. Smart, 1964
We can imagine artifacts that have feelings.

Several cases show that artifacts could have feelings. (1) If the biblical account of creation in Genesis were true, then humans would be both living creatures and artifacts created by God. (2) We could imagine self-replicating mechanisms whose offspring would manifest small random alterations, allowing them to evolve. Such mechanisms might be considered living and at the same time artifacts.

They are artifacts of God as well as living creatures.



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

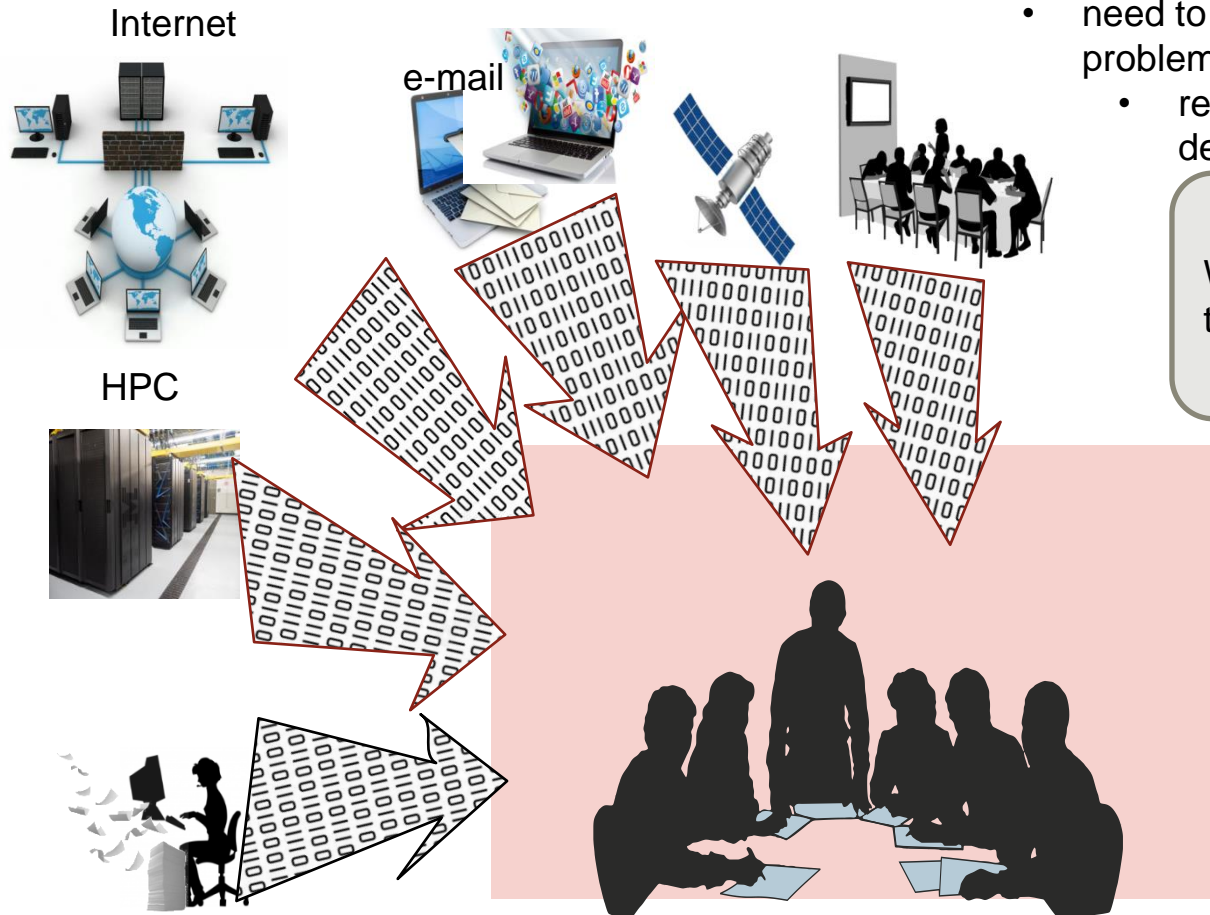
"Eldorado" of the new economy is a space of "big data" from which "digital knowledge" is extracted with the help of «intellectual» technologies

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

Can we swim through the “Digital Flood”

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**



- need to understand the problem
- remember the "correct" decision

What should be done to solve the problem?

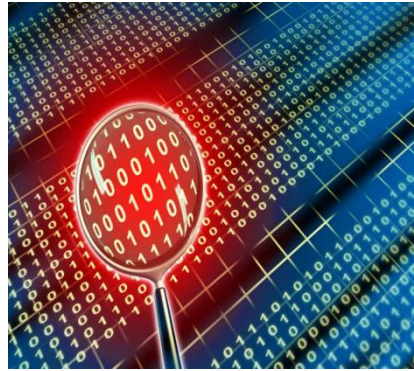


Advance CS platforms should have: **reconfigurable** heterogeneous processing field, deep **storage** class memory, and **distributed** (collaborative) architecture

From **direct calculation** to solve inverse tasks – find algorithm or code for **solving the problem**

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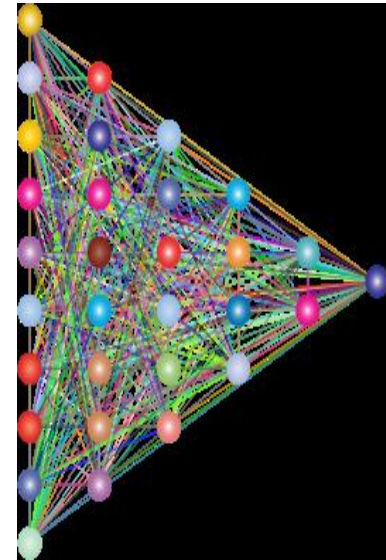
The classic goal of computer science:
automation of solving "direct problems":
finding numerical solutions of equations using algorithms and programs



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 А при условии наступления события В (т. н. условная вероятность).

$P(A)$ — вероятность события А (**априорная** оценка);

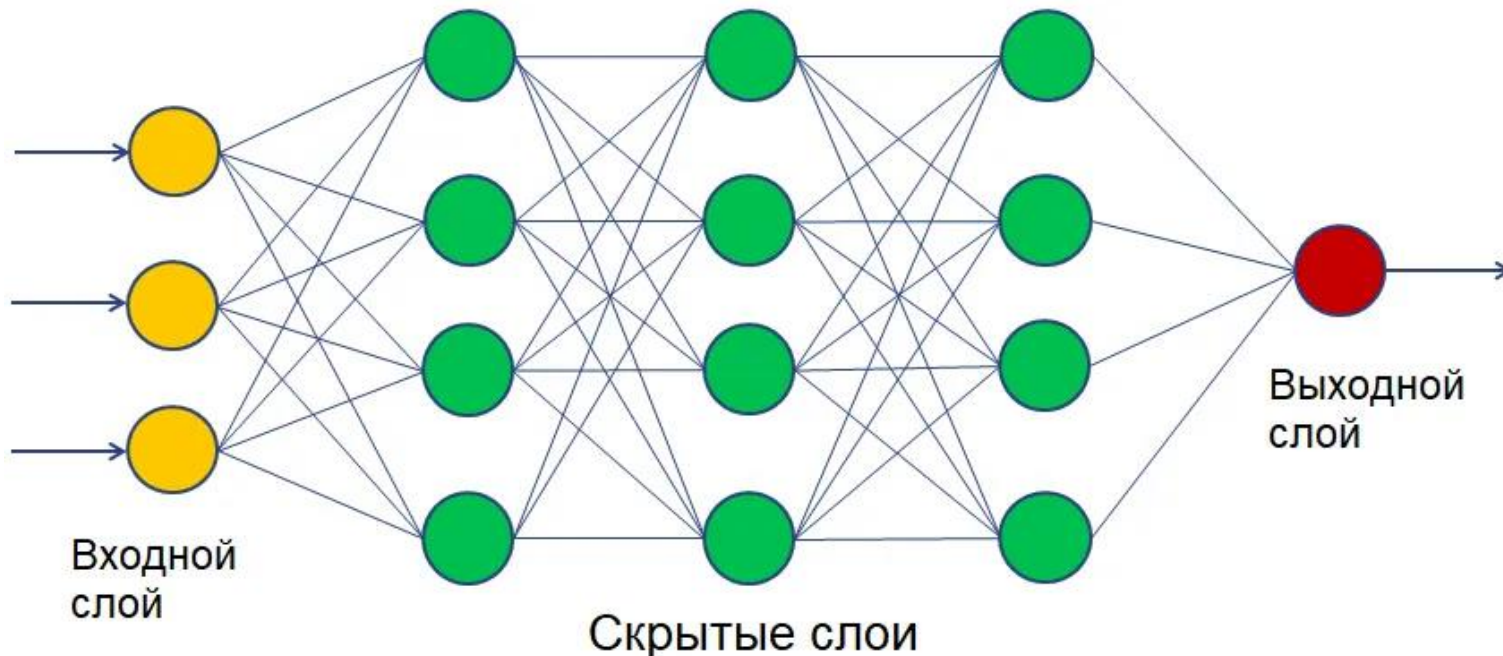
$P(B|A)$ — вероятность (также условная), которую мы получаем из наших данных;

$P(B)$ — 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)

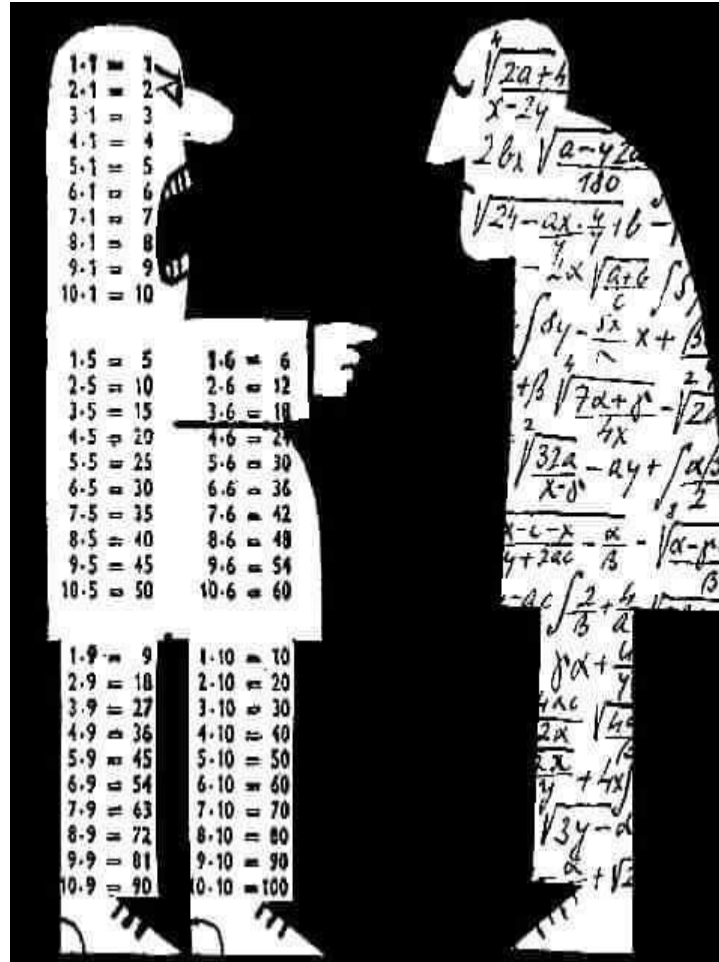


to use such solutions, we must "trust" the tool. So, in addition to the solution itself, it is necessary to "calculate" an **explanation** of how this solution was obtained.

Conclusion : intelligent does not mean digital

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)