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КАФЕДРА
ТЕЛЕМАТИКА

Семинар по специальности на английском языке
(Workshop in English)

тема
A Search for the Missing Science of Consciousness

занятие 8

23 марта
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Что было на прошлой лекции

Вычисления - это процесс, который реализует отображение между некоторыми символическими структурами (доменами). Реализованное отображение может иметь форму

function,

operator,

algorithms

or …. specific

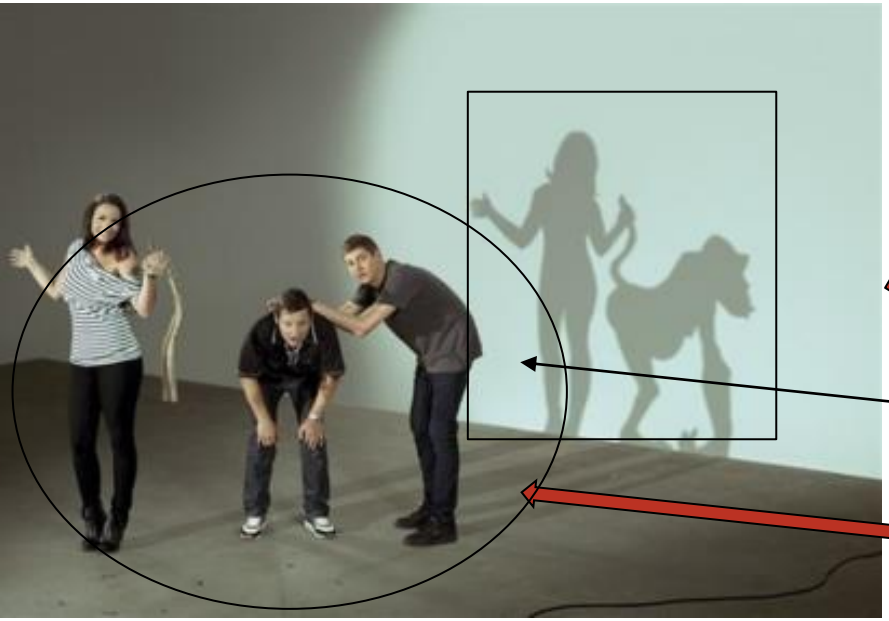
relationship.

Any symbolic structure may be

- **numbers**: 3 + 2 equals 5,
  or may not.

All depends from от наличия механизмов, которые аналогичны процессам вычислений

Symbols vs of with physical reality

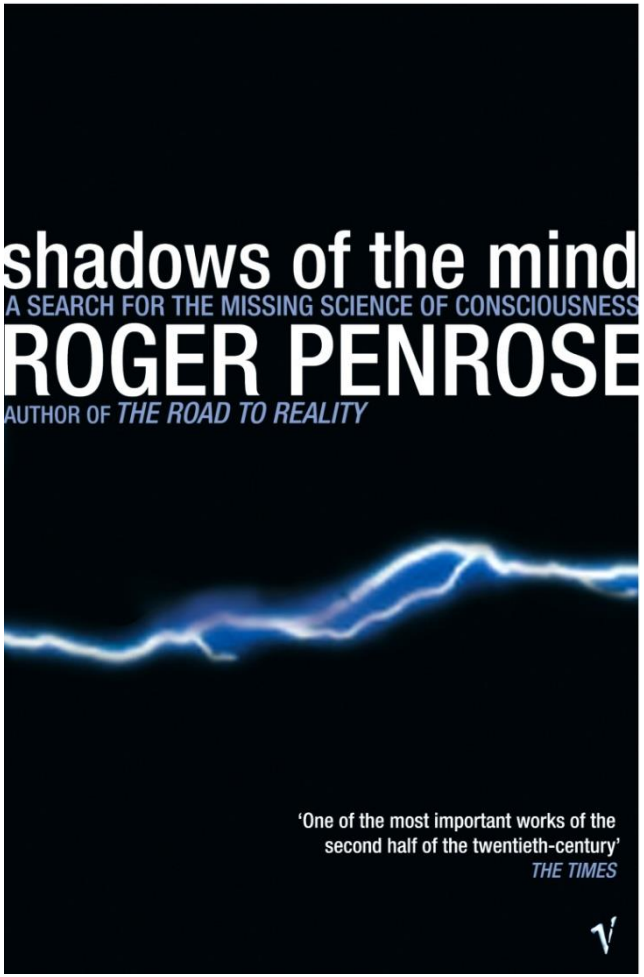


В науке давно известна физическая невычислимость «прошлых» состояний термодинамических процессов, и полная обратимость во времени и изотропность в пространстве фундаментальных законов…..

It has long been known in science physical incalculability of "past" states of thermodynamic processes, and complete reversibility in time and isotropy in space of fundamental laws

но до сих пор нет ясности как эти ограничения преодолеваются при функционировании мозга

О чем лекция: Computer science vs science of Consciousness



quod sentimus loquamur
мы чувствуем, что говорим

quod loquimur sentiamus
мы представляем этот опыт

математика и компьютерные науки тесно связаны с передним краем физических исследований
Р. Пенроуз

. ВЫЧИСЛЕНИЯ – это работа с числами
СОЗНАНИЕ – это обработка информации

Is there and what is the fundamental difference between the "processing" of numbers or calculations and the processing of information or consciousness?

AI vs symbolic processing in computers

Nowadays there are 2 major approaches to AI:

- statistical machine learning (learning from the data, e.g. learning to differentiate cats from dogs by looking at the pixels of many labeled photos)
- symbolic AI / logical reasoning / computer algebra (e.g. manipulate 2y=x into y=0.5x or deduce from “all men are mortal” and “John is a man” that “John is mortal.”)

Humans mind use some form of both of the above. Only using one of the above would be insufficient to explain the intelligence humans have demonstrated.

1. Statistical machine learning is nowadays often implemented via neural networks which are “formal” inspired by the human brain.
2. As for symbolic AI, is apparently similar to algebraic manipulations with “numbers” or make logical deductions ….. pretty quickly.

Fundamental question is, how exactly do we combine #1 and #2 ?
There are many possible approaches.

The are no hard problems to provide real calculation , but only problems that are hard to certain level of understanding how to use the obtain results ….

theses.

- Intelligent computation vs pure digital computation - manipulation of physical entities whose properties are related to energy and matter like as abstract symbols.
- "Inputs" of intelligent computing come in the form of representations of physical entities (action), and the output can be either been as abstract symbol or physical action or even both of two.
- Computational theory of mind should has a specific language describing the process of reducing the entropy of environments by process of explanation.

What is the nature of “mental number" that involved in intelligent calculations

- Humans develop a mental model of the world based on what they are able to perceive with their limited senses or …by unlimited resource of exailtellectual calculate ability
- Understanding the mechanism of brain calculation ability is perhaps the most fundamental challenge for modern scientists.

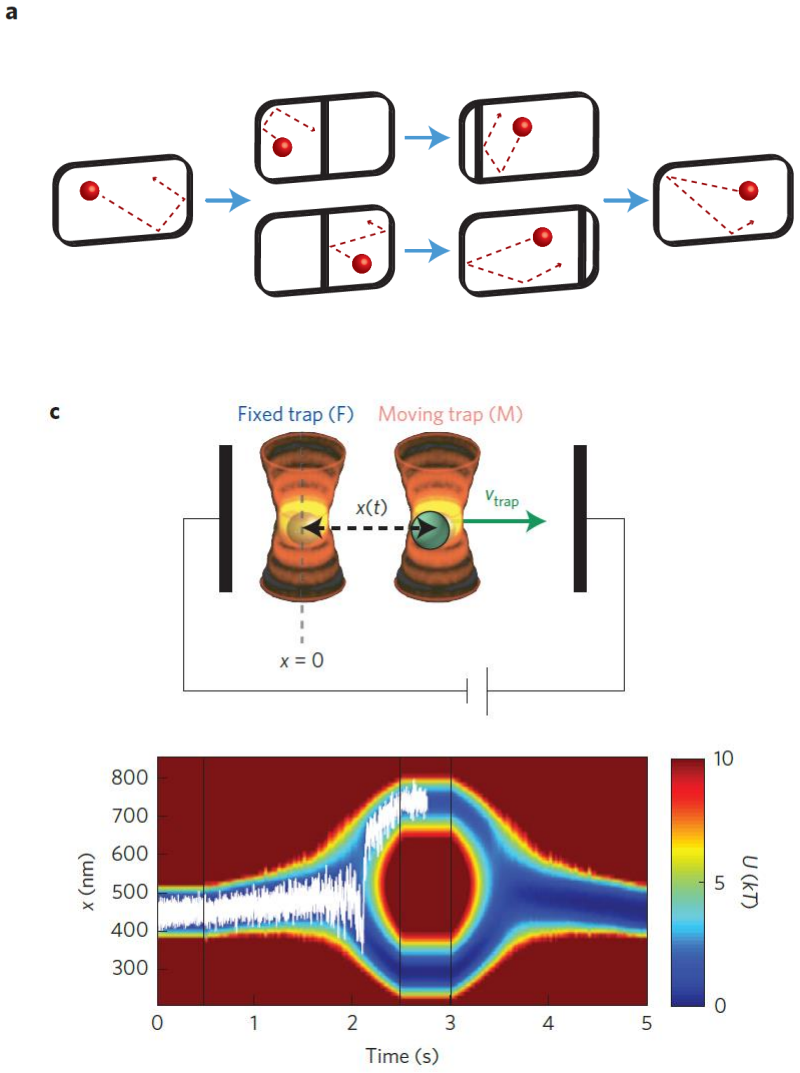
Mental model of reality:

- The image of the world around us is just a model of our mind.

- Nobody in his head imagines all the world, only selected concepts, and relationships between symbol form of knowledge and natural system

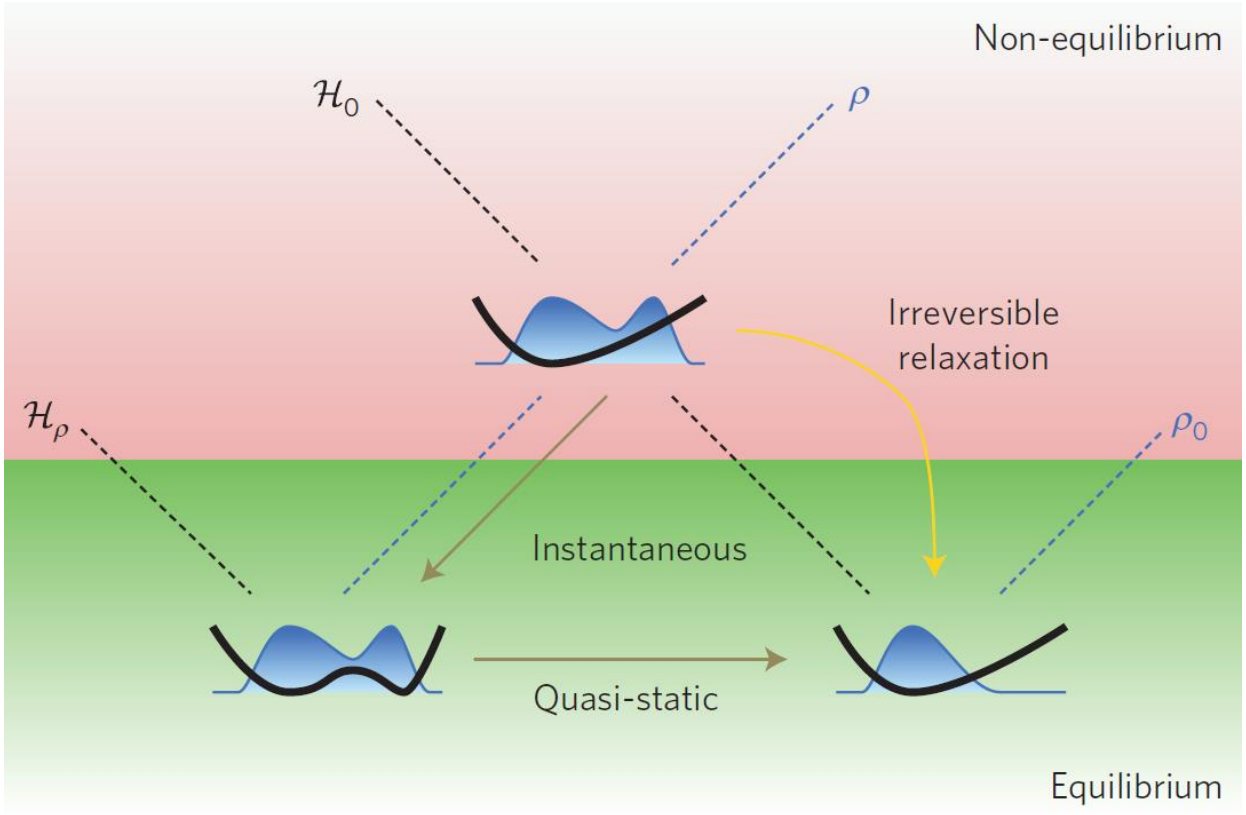
What is Physical representation of numbers ???

Experimental realizations: Szilárd engine - partition is inserted into a box containing a single molecule and surrounded by a thermal reservoir - созданию технологии охлаждения без движущихся частей механизма



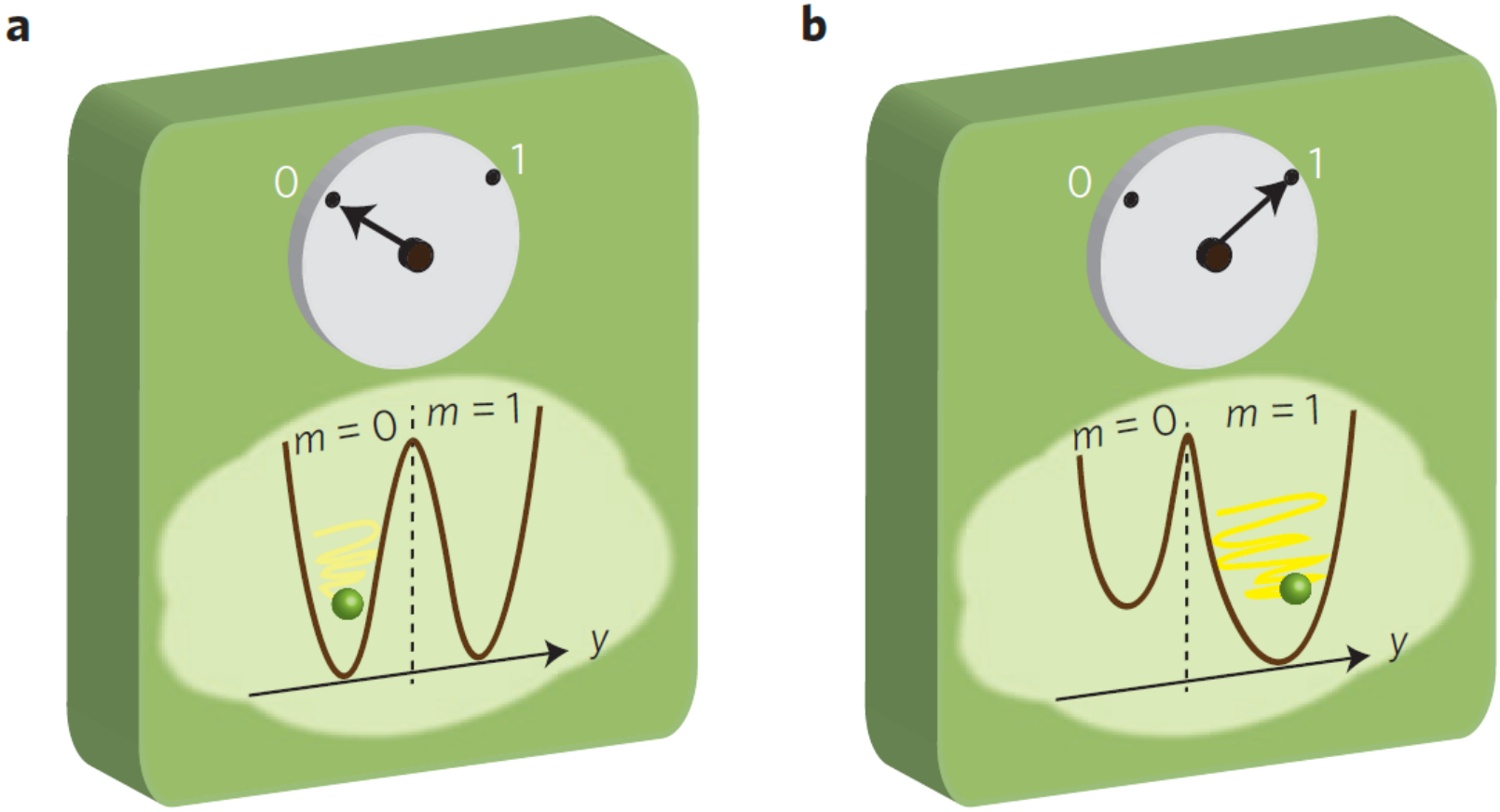
Если у вас есть 1 бит, с которым можно “поиграть”, то его энтропия пропорциональна логарифму двух, поскольку бит имеет два возможных состояния

Information and the second law: Non-equilibrium free energy

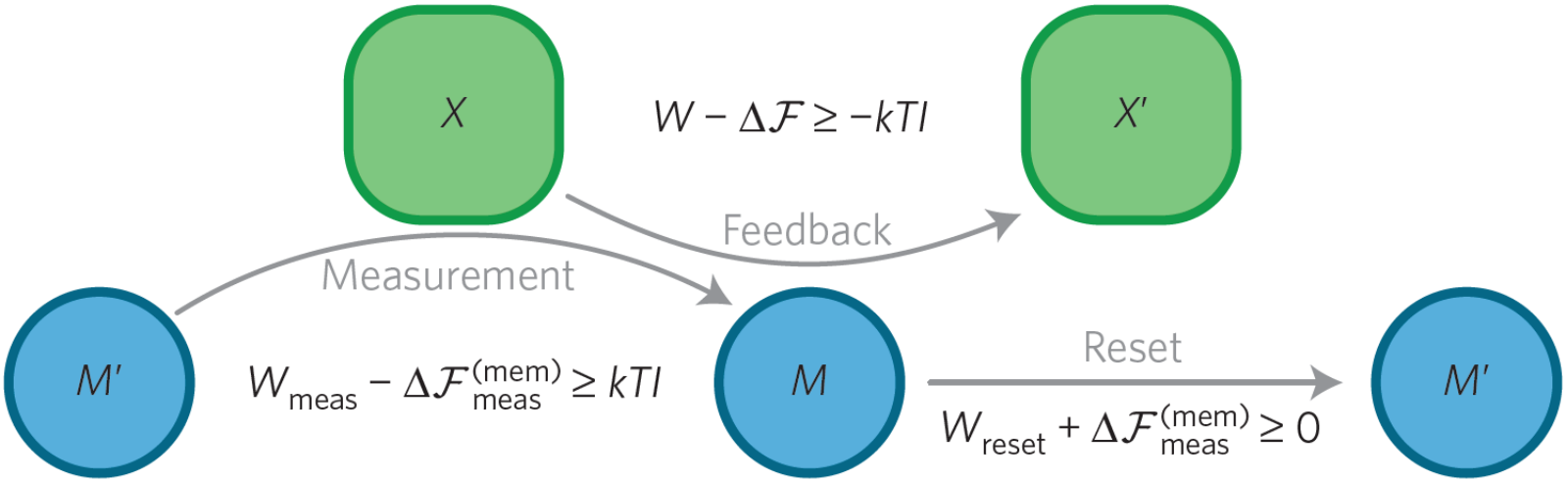


physical meaning of the non-equilibrium free energy:
How to drive the system from the non-equilibrium state to the equilibrium state…
.
Shannon entropy coincides with the equilibrium entropy for canonical equilibrium states

Toy model of a memory- memory can either be symmetric or asymmetric



A measurement is a thermodynamic process in which we vary the memory from M^0 -> M to develop information I about the system X.



new theoretical framework: information reservoirs, are treated on an equal footing to other thermodynamic reservoirs, such as thermal or chemical baths

Resume

- Fundamental questions about information and thermodynamics are under debate, such as the coincidence between the thermodynamic and psychological arrows of time

- Understanding the subjectivity of entropy sheds light on the foundations of the general physical theory of information

- Interesting thermodynamic phenomena, such as the emergence of entropic forces that are related to the accuracy of computers feature – one of priority challenge of science