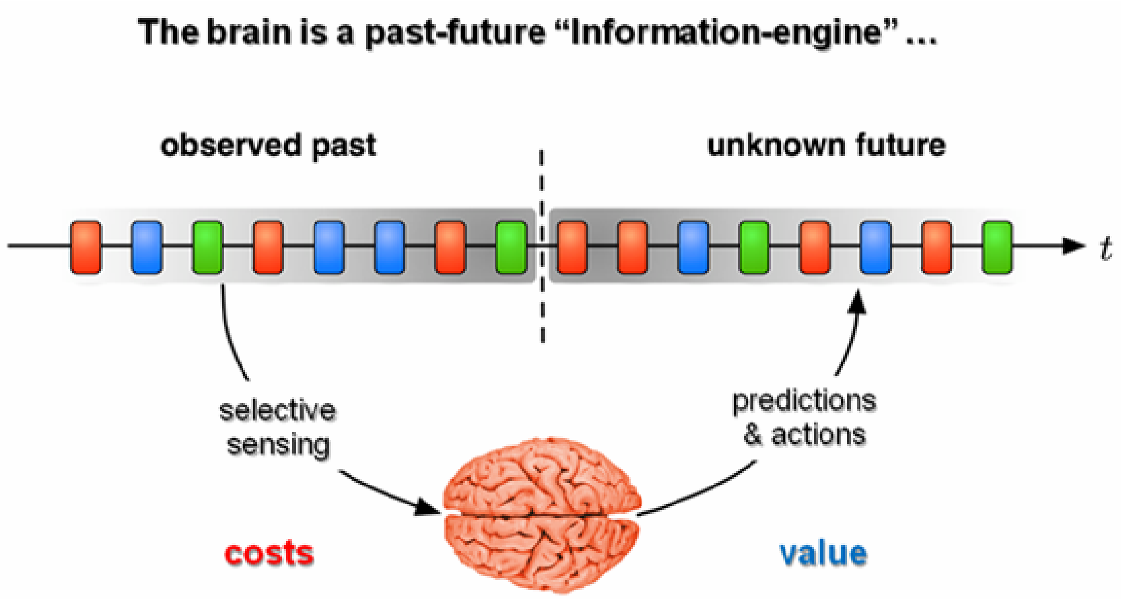
The information-dynamics of life

One of the most distinctive characteristics of living organisms is their individual or collective ability to process and exploit information. This ability is best manifested in the - so called - perception-action cycle. This cycle was described by the neuroscientist JM Fuster as *the circular flow of information that takes place between an organism and its environment in the course of a sensory-guided sequence of behavior towards a goal*. In a well defined sense, this cycle of information is for life what the Carnot cycle was for thermodynamics – it allows us to discover fundamental quantitative limits on the interaction of organisms with their environments.
When the environment is approximately stationary, the efficiency of the perception-action cycle is determined by the ability of the organism to extract and represent information from the past that is biologically valuable for its future, on multiple time scales. This observation suggests an intriguing analogy between the combined perception and action, and Shannon's classical model of communication. I will present this analogy and discuss some of its consequences for optimal biological adaptation and performance. In addition, I will describe recent applications of this new theoretical framework to auditory perception and optimal decision making.



Dr. Naftali Tishby is a professor of computer science and a founding member of the Interdisciplinary Center for Neural Computation (ICNC) at the Hebrew University of Jerusalem since 1992. He is considered one of the leaders of machine learning research and computational neuroscience in Israel. He received his PhD in theoretical physics from the Hebrew university in 1985 and was a research staff member at MIT and Bell Labs from 1985 and 1991. Prof. Tishby was also a visiting professor at Princeton University, U of Pennsylvania, UCSB, and IBM research.
His current research is at the interface between computer science, statistical physics, and computational neuroscience. He pioneered various applications of statistical physics and information theory in computational learning theory. More recently he has been working on the foundations of biological information processing and the connections between dynamics and information. He has introduced with his colleagues new theoretical frameworks for optimal adaptation and efficient information representation in biology, such as the Information Bottleneck method and the Minimum Information principle for neural coding.

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