4 SUMMIT VIENNA 2015 IS4IS

Extended Abstract

What Is Information? Why Is It Relativistic and What Is Its Relationship to Materiality, Meaning and Organization

Robert K. Logan

Department of Physics – University of Toronto - 60 St George St. Toronto ON M5S 1A7 Canada

logan@physics.utoronto.ca tel: 1-416-361-5928

Accepted: 29 March 2015

Extended Abstract

We are swimming in a sea of information but do we really understand what is information. A project that I engaged in with a number of systems biologists provided an interesting perspective on this question. In a paper entitled Propagating Organization: An Enquiry by Stuart Kauffman, Robert K. Logan, Robert Este, Randy Goebel, David Hobill and Ilya Shmulevich that appeared in Biology & Philosophy 23: 27-45 we wrote,
"Our broad aim was to understand propagating organization as exemplified by the vast organization of the coevolving biosphere."

The cell operates as an information processing unit, receiving information from its environment, propagating that information through complex molecular networks, and using the information stored in its DNA and cell-molecular systems to mount appropriate responses. We argue that Shannon information does not apply to the evolution of the biosphere because one cannot prestate all possible Darwinian preadaptations or the ensemble of possibilities and hence their entropy cannot be calculated.

According to the Shannon definition of information a structured set of numbers like the set of even numbers has less information than a set of random numbers because one can predict the sequence of even numbers. By this argument a random soup of organic chemicals would have more information that a structured biotic autonomous agent.

The biotic agent has more meaning than the soup, however. The living organism with more structure and more organization has less Shannon information. This is counterintuitive to a

biologist's understanding of a living organism. We therefore conclude that the use of Shannon information to describe a biotic system would not be valid. Shannon information for a biotic system is simply a category error.

A living organism has meaning because it is an autonomous agent acting on its own behalf. A random soup of organic chemicals has no meaning and no organization. We may therefore conclude the meaning of life is organization—organization that propagates.

The Relativity of Information

You may legitimately ask the question "isn't information just information?", i.e., an invariant like the speed of light. Our response to this question is no, it is relative.
Instructional or biotic information is a useful definition for biotic systems just as Shannon information was useful for telecommunication channel engineering.

Thus we identify the information in living organisms with the organization of constraints that allow an organism to capture energy from the environment for their growth and replication. A living organism propagates its organization, which constitutes its information.

We therefore conclude that constraints are information and information is constraints, which we term as instructional information because this is its function and we want to distinguish it from Shannon information. The constraints are the organization of the living organism and therefore the organization is the information and vice versa.

We next note that biotic information is not symbolic but is embedded in the biomoleules of which the living organism is composed. Biotic information cannot be separated from the medium in which it is instantiated. DNA does not symbolize RNA but rather catalyzes its creation.

And likewise RNA does not symbolize proteins but rather catalyzes its creation.
And the same with proteins they are not symbols but enzymes.

One of the characteristics of biotic information is that it is instantiated materially whereas symbolic information and Shannon info can move from one medium to another. For biotic information the medium is the message in the McLuhan sense and it is also the content. The medium is the content and the content is the medium. Whereas for symbolic info the medium and its content are separate.

We humans deal with 3 kinds of information: genetic, percepts , and concepts (symbolic)