

General System Theory Chapter 2.

The Meaning of General System Theory

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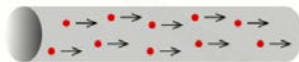
The Modern Theory of Communication

Information

- Another example of general system theory is theory of communication
 - New branch of physics
 - Due to development of radio, radar, calculating machine, and etc.
- Information is general notion in communication theory
- In many cases, the flow of information corresponds to a flow of energy
- However, information, in general, cannot be expressed in terms of energy



Direct current



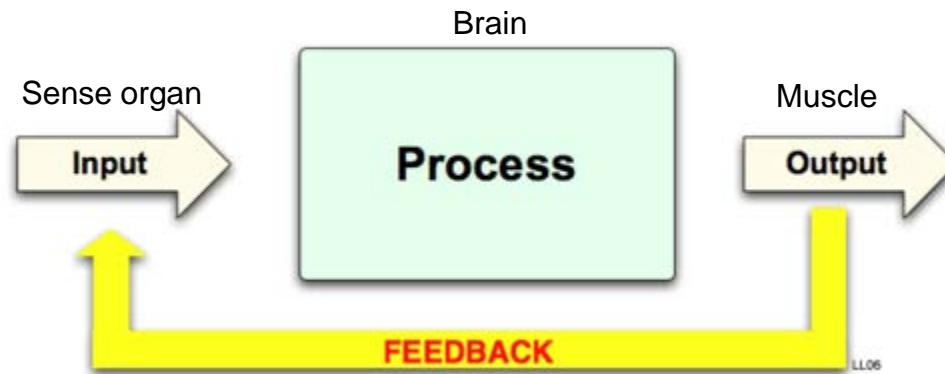
Opposite to the flow of energy



Without a flow of energy or matter

Feedback

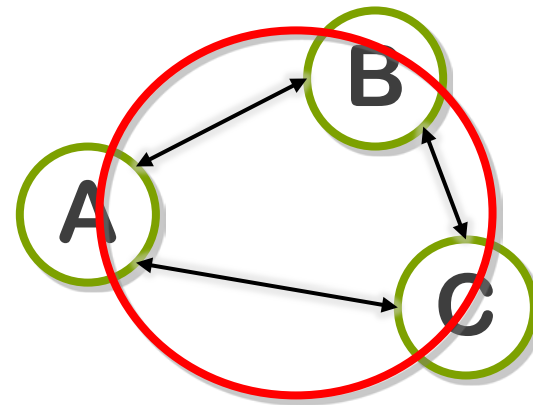
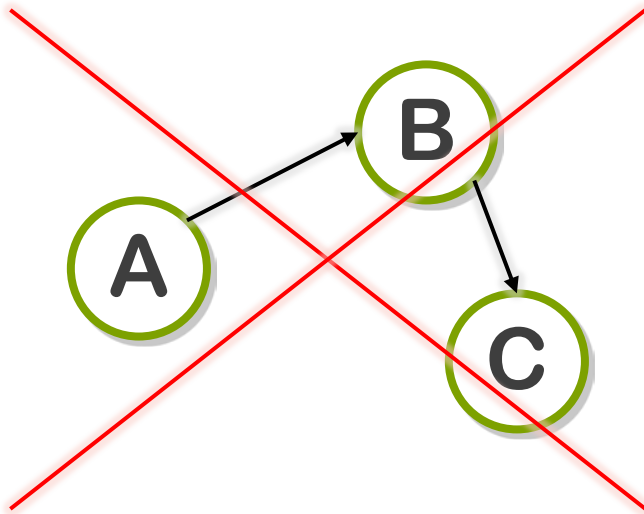
- Feedback is a second central concept of the theory of communication
 - Widely used in modern technology and biological phenomena
 - Self-propelled missiles, ship-steering system, cooling of blood
 - Also, cybernetics tries to show that mechanisms of a feedback nature are the base of teleological or purposeful behavior in man-made machines as well as in living organisms, and in social systems



Causality and Teleology

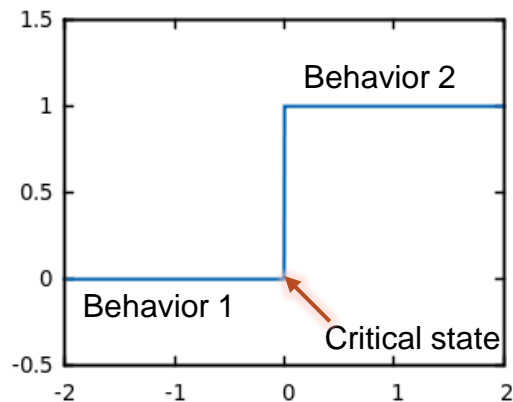
Causality

- In the world view called mechanistic, the aimless play of the atoms produced all phenomena in the world
 - Governed by the inexorable laws of causality
 - Isolation of individual causal train
- However, in modern science, the one-way causality is insufficient
 - Wholeness, holistic, etc. are needed
 - Also, we must think in terms of systems of elements in mutual interaction

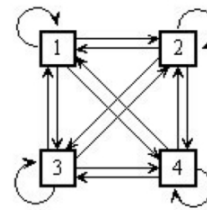


Teleology

- We cannot conceive of a living organism without notion of teleology
- Equifinality and feedback are also well explained with the teleology
 - Equifinality: steady state
 - Feedback: goal to be reached
- A model for adaptive behavior also used the concept of teleology
 - Use step function
 - Pass critical state => start off in a new way of behavior
 - Could be called as trial and error
 - Tries different ways and means until there is no conflict with critical values of the environment



I.I Homeostat



$$Output_{i(t+1)} = \sum_{j \in c} Output_{j(t)} \times Weight_{ij(t)}$$

where c is the set of connected units, with $i \in c$

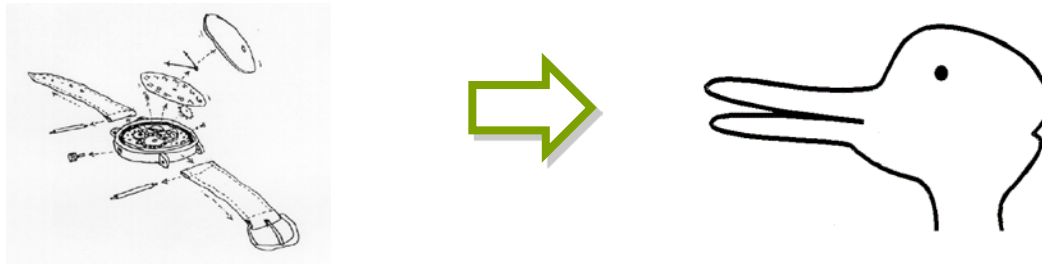
Figure i. Schematic of 4 unit homeostat and update equations (right)

What is Organization?

- Organization did not appear in classical physics, but is different in modern physics
 - An atom, a crystal, or a molecule are organizations
 - In biology, organisms are organized things
- Characteristic of organization is a notion like wholeness
 - Such notions do not appear in conventional physics
 - System theory is well capable of dealing with these matters
- At the Boulding`s book, general model of organization appeared
 - *The Organizational Revolution (1953, Kenneth E. Boulding)*
 - Application of general system theory to human society
 - Malthusian law of population
 - Also, there is a law of optimum size of organizations
- The number of such general theorems for organization can easily be enlarged

General System Theory and the Unity of Science

- So far, the unification of science has been seen in the reduction of all science to physics
- But, isomorphy of laws in different fields is needed
 - Not reductionism, but perspectivism
 - We cannot reduce the biological or social level to the lowest level
 - We can find constructs and possibly laws within the individual level



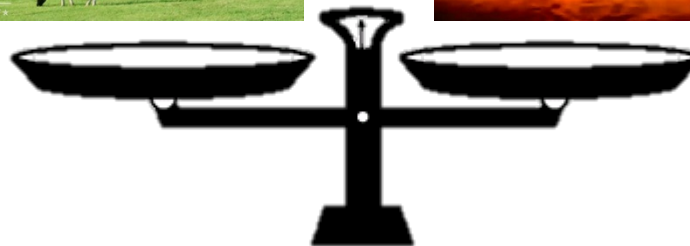
- So, the unifying principle is that we find organization at all levels
- Possibly the model of the world as a great organization can help to reinforce the sense of reverence for the living

General System Theory in Education: The Production of Scientific Generalists

- We make examples of why scientific generalists is needed
 - *The Education of Scientific Generalists* – Bode *et al.*, 1949
 - One man can no longer cover a broad enough field
 - System problems arise whenever parts are made into a balanced whole
 - We need a simpler, more unified approach to scientific problems
 - *Integrative Studies for General Education* – Mather, 1951
 - Similar general concepts have been independently developed from widely different fields
 - Thus, integrative studies would prove to be an essential part of the quest for an understanding of reality
- Scientific generalists and basic principles are those general system theory tries to fill
- General system theory seems to be an important headway towards interdisciplinary synthesis and integrated education

Science and Society

- We should consider not only scientific values but also ethical values in education
- The value of science
 - advance of physics, biology, agriculture, and etc. lead prosperity of mankind
 - Advanced machines, modern medicine, and more provisions
- What is lacking, however, is knowledge of the laws of human society
 - Famines in vast parts of the world while harvests rot or are destroyed in other parts
 - War and indiscriminate annihilation of human life
- Thus, a well-developed science of human society would be the way out of the chaos and impending destruction



The Ultimate Precept: Man as the Individual

- We may conceive of a scientific understanding of human society and its laws in a somewhat different and modest way
- The real value of humanity are stem from the individual mind, not from the function of an organism or a community of animals
- Human society is not a community of ants or termites
- The ultimate precept of a theory of organization
 - Not a manual for dictators with scientific application of Iron Laws, but a warning that the Leviathan of organization must not shallow the individual

Summary and Conclusion

- In the theory of modern communication, we should understand about different characteristics of information with energy of conventional physics
 - Opposite to the flow of energy and Without a flow of energy or matter
- Feedback is a kind of general scheme which is able to be applied into many fields
 - Mechanics, biology, cybernetics, and etc.
- We should reconsider the causality and teleology
- We should have not reductionism, but perspectivism for unity of science
- Also, scientific generalist will become important and fundamental principles will be highly needed in the future
- Research of sociology is very important for human society but we should not ignore individual mind of human

Chapter 2. The Meaning of General System Theory

Q&A