

Semiotic modelling of biological processes

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Course description:

Here we introduce biosemiotics as a field of research that develops models of life processes focusing on their informational aspects. Peirce's general concept of semiosis can be used to analyze such processes, and provide a powerful basis for understanding the emergence of meaning in living systems, by contributing to the construction of a theory of biological information. Peirce's theory of sign action is introduced, and the relation between 'information processing' and sign processes is discussed, in fact, a semiotic definition of information is introduced. Three biosemiotic models of informational processes, at the behavioral and molecular levels, are developed, first, a model of genetic information processing in protein synthesis; second, a model of signal transduction in B-cell activation in the immune system; and, finally, a model of symbolic non-human primate communication. We also address some perspectives for the development of applied semiotic research in fields such as Artificial life, cognitive ethology, cognitive robotics, theoretical biology, and education.

Key words: biosemiotics, semiosis, emergence, genetic information, B-cell activation, non-human primate communication, C.S.Peirce

LECTURE 1

I. Theoretical semiotics

- I.1- Foundation of Peirce's philosophy of signs
- I.2. 'The essential nature and fundamental varieties of possible semiosis'
 - I.2.1. Semiosis, meaning and the action of signs
 - I.2.2. Sign, Object, Interpretant
 - I.2.3. The subdivision of the object
 - I.2.4. The subdivision of the interpretant

LECTURE 2

II.1- Multi-level model of emergent semiosis

- II.1.1. Central Characteristics of Emergentism
 - II.1.1.2. Varieties of Emergentism
 - II.1.1.3. Irreducibility

- II.1.1.4. Downward Causation/Determination
- II.1.1.5. Unpredictability

LECTURE 3

II.1- Multi-level model of emergent semiosis

- II.1.2. Levels of Semiosis: A General Model
- II.1.3. Stanley Salthe's basic triadic system
 - II.1.3.1. Micro-level of semiotic processes
 - II.1.3.2. Focal-level of semiotic processes
 - II.1.3.3. Macro-level of semiotic processes

LECTURE 4

III.1- Semiotic systems

- III.1.1. James Fetzer's semiotic systems
- III.1.2. Fundamental classes of semiotic systems
 - III.1.2.1. Iconic semiotic systems
 - III.1.2.2. Indexical semiotic systems
 - III.1.2.3. Symbolic semiotic systems

LECTURE 5

V.1- Biological applications

V.1.1- Genetic information system

- V.1.2. 'Gene' and 'information' as conceptual problems
- V.1.3. Applying the general model of levels of semiosis to the genetic information system
- V.1.4. Semiotic analysis of transcription
- V.1.5. Semiotic analysis of translation
- V.1.6. What is information?
- V.1.7. What is a gene?

LECTURE 6

V.2.1. Semiotic processes in the immune system

- V.2.2. Modeling a signaling process in B-cell activation
- V.2.3. Applying the general model of levels of semiosis to B-cell activation
- V.2.4. The necessity of semiotic models of signaling
- V.2.5. What is signaling?

LECTURE 7

V.3.1- Non-human primate communication

- V.3.1.1 An overview
- V.3.1.2. The meaning of alarm calls in vervet monkeys
- V.3.1.3. A neurosemiotic modeling of vervet monkey alarm calls

V.3.1.4. A semiotic discussion of context-modulated meaning in pigtailed macaques.

V.3.1.5. Symbolic communication in chimpanzees and bonobos

LECTURE 8

VI – Perspectives for applied biosemiotics (provisional version)

VI.1. Semiotics and Alife

VI.2. Semiotics and cognitive robotics

VI.3. Semiotics and cognitive ethology

VI.4. Ecosemiotics

VI.5. Semiotics and theoretical biology

VI.6. Semiotics and education

SHORT ACADEMIC BIOGRAPHY

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