Course Summary C.8-14: Introduction to Cognitivism III/IV

Overview

This course provides an integrated synthesis and completion of the preceding courses on cognitivism, critically examining the complex field of cognitive sciences from the perspective of the philosophy of mind.

Starting from a renewed definition of cognition as the processing, coding, and storage of information within a multifaceted human system, the course maps out the five constituent disciplines - computer science/artificial intelligence, cognitive psychology, generative linguistics, neuroscience or brain sciences, and the philosophy of mind - and traces their historical development.

The course then analyses the tension between the formalized symbolic calculus of mathematical logic and substantive "natural" logic, demonstrating that purely syntactic systems inevitably encounter semantic paradoxes and inconsistencies.

Drawing on insights from cybernetics and computer science, algorithmic and heuristic search strategies are compared. Neurological brain research - including the two cerebral hemispheres, the supposed "illusion" of free will, and Penrose's quantum hypothesis concerning consciousness - is then critically assessed.

Finally, the course examines the psychology of thinking developed by A. D. de Groot and Otto Selz, contrasts classical computationalism with connectionist neural networks, and defends the indispensable nature of the lived human mind and everyday folk psychology against one-sided eliminative-materialist reductions.

1: Defining Cognition and the Interdisciplinary Field

The explicit aim of this course is to summarize, deepen, and critically complete the insights gained from earlier courses on cognitivism. The course does not define "cognition" as a rigid concept, but as the totality of higher mental processes through which an individual or a social system receives information from its environment, processes it, encodes it in symbols, and stores and applies it through memory. To investigate this multifaceted phenomenon, cognitive science uses both introspective (reflective) and extrospective (physiological) measurement methods.

Cognitivism is characterized as an interdisciplinary pentagon in which five fields work closely together:

- *Computer Science / Artificial Intelligence*: translates thought processes into algorithms and computer programs.

- *Cognitive Psychology*: investigates how humans process situations and engage in problem-solving thought.
- *Linguistics*: studies how language and formal logical rules encode mental operations.
- *Neuroscience and Brain Sciences*: maps the biological, neuronal, and genetic foundations of the mind.
- *Philosophy of Mind*: reflects on the relationship between language, mind, and physical reality.

Historically, this field developed in three major phases: the pioneering phase of cybernetics and automata theory (1945–1955); the breakthrough of AI, generative grammar, and cognitive psychology (1956–1979); and worldwide expansion and institutionalization (from 1980 onwards).

2: Mathematical Logic, Systems Theory, and the Limits of Formalization

A major focus of the course is the foundations of reasoning. It draws a sharp distinction between traditional, ontological logic and formalized symbolic mathematical logic. Whereas classical logic is based on substantive identity and meaningful relationships between concepts and reality, mathematical logic is an abstract symbolic calculus that strives for a purely syntactic system.

The course nevertheless demonstrates that radically formalized systems inevitably encounter their own limitations. As Georg Wilhelm Friedrich Hegel and Georg Alexander Bolland showed, purely intellectual, abstract thinking repeatedly lapses into paradoxes and inconsistencies when detached from concrete content. This is also apparent in Noam Chomsky's generative grammar: once a formal syntactic model is applied to concrete language, it often produces semantic nonsense and ambiguities.

Within systems theory and cybernetics, reality is approached as a dynamic, self-regulating system operating through the principles of input, processing, output, and corrective feedback. This control-oriented model of thought—which has ancient and biblical roots in the idea of restoring order after a deviation—forms the theoretical basis of modern computer science. A computer is essentially a dynamic system in which hardware and software work together to execute a logically designed algorithm.

3: Brain Sciences, the Mind–Brain Interaction, and Consciousness

Neuroscience investigates the biological foundations of thought through subdisciplines such as neuroanatomy, neurophysiology, neuroendocrinology, and neuropsychology. The human brain consists of approximately one hundred billion neurons and nine times as many glial cells, which exchange electrical and chemical signals through an immense network of synapses and neurotransmitters. Research into the two cerebral hemispheres reveals a functional division of labor: the left hemisphere operates primarily in a logical, analytical, and precise manner, whereas the right hemisphere is more sensory, dreamlike, and oriented towards vague wholes.

In radically materialist neuroscientific circles, human consciousness is often reduced to mere brain activity, and free will is dismissed as an "illusion". The course qualifies these bold claims by pointing to the fundamental blind spots of neuroscientific reductionism. Neuroscientists must acknowledge that the exact interaction between neuronal activity and complex concepts remains a mystery. To explain the emergence of consciousness, Oxford mathematician Roger Penrose proposed the hypothesis that coherent quantum states within the microtubules of nerve cells play a role.

4: Cognitive Psychology, the Psychology of Thinking, and Problem-Solving Strategies

Cognitive psychology emerged in the 1950s as a reaction to rigid behaviorism, which ignored inner mental life as an inseparable "black box". Cognitive psychologists such as Jerome Bruner reopened this black box by investigating how people actively categorize, anticipate, and strategically process information.

In the psychology of thinking, the Dutch scholar A. D. de Groot made pioneering contributions by introducing the "think-aloud" method with chess grandmasters. He demonstrated that expert human thinking relies on experience and intuitive pattern recognition rather than on mechanically calculating every possibility. This connects with the earlier psychology of thinking developed by Otto Selz and the Würzburg school, whose experimental introspection showed that human thought is primarily goal-directed and guided by non-intuitive intellectual insights rather than by blind associations or sensory images.

When solving problems, humans use two types of search strategies:

Algorithms: A systematic, exhaustive enumeration that is guaranteed to lead to a solution, but requires considerable time and energy.

- *Heuristics*: Flexible search rules based on probability and experience that work quickly and efficiently, although they are not entirely infallible.

5: Artificial Intelligence, Connectionism, and the Philosophy of Mind

Artificial intelligence (AI) attempts to imitate human mental operations mechanically through algorithms, expert systems, and fuzzy logic. Two major models compete within AI:

- *Computationalism:* Views thinking as the step-by-step processing of symbols according to strict rules (the computer as a Turing machine).
- *Connectionism*: Uses the brain as a biological model and builds distributed neural networks that process information in parallel.

Although AI systems excel at the syntax of symbols, they encounter an insurmountable barrier when it comes to grasping semantics, context, and emotional meaning. A machine lacks human intentionality: the lived orientation of consciousness towards reality.

In the philosophy of mind, different conceptions of the human being are in conflict. On one side stands eliminative materialism, as defended by Paul and Patricia Churchland. It dismisses everyday “folk psychology”, with concepts such as consciousness, belief, and desire, as an outdated theory that must be eliminated entirely in favor of neurobiology.

On the other side, thinkers such as Donald Davidson, Jerry Fodor, and Edward Pols defend the causal reality of our mental states (propositional attitudes).

The course concludes that reducing human beings exclusively to their brains or genes overlooks the essence of the human mind: human beings remain narrative, value-oriented, and conscious selves who give meaning to their existence within a cultural community.