



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Foundations of Cognitive Science and Artificial Intelligence

2526-2-F8501R072

Course title

Foundations of Cognitive Science and Artificial Intelligence

Topics and course structure

Born from the ashes of behaviorism and supported by the development of information technology, the so-called “**cognitive sciences**” analyze human mental processes in terms of information processing. This way of “thinking about the mind” plays a fundamental role in the study of individual and social learning and reasoning processes. The course introduces the epistemological, historical, and theoretical foundations of cognitive science, with particular reference to the “theory of mind,” and is especially recommended for students who wish to deepen their scientific study of cognitive processes related to learning and the relationship between psychology and artificial intelligence.

The first part of the course (38 hours of teaching, which will, however, give ample space to classroom discussion) addresses some fundamental epistemological issues for understanding how cognitive science theorizes about mental processes: mechanism, the concept of “mind,” the relationship between mind and brain, and the so-called “common sense psychology.” This epistemological overview will be intertwined with a history of cognitive science, starting with modern mechanistic thinking and moving on to behaviorism, cybernetics, the development of theoretical computer science and artificial intelligence, and the emergence of the first representational conceptions of the mind and “psychic machines” in the first half of the 20th century.

The second part of the course, conducted in the form of Interactive Teaching, will include 12 hours of in-depth study of “theory of mind” and its development in the early stages of life. This phase will take place through the reading of scientific articles of particular historical, theoretical, and methodological relevance, and will introduce the distinction between so-called “representational theories” and “simulative theories” on mentalization abilities.

Another 6 hours of Interactive Teaching (remote) will be dedicated to the analysis of scientific articles independently selected and analyzed by students (individually or in groups of two). This part of the course aims to promote the ability to navigate scientific literature and present complex content.

The course will be supported by the material and staff of the RobotiCSS Lab - Robotics Laboratory for Cognitive and Social Sciences of the University of Milan-Bicocca (<https://www.roboticss.formazione.unimib.it/>), located in building U16 and coordinated by the course coordinator.

Objectives

The objectives of the course are described here according to the “Dublin Descriptors.” The course is fully in line with the objectives of the Master's Degree in Advanced Educational Sciences and is particularly recommended for students who wish to deepen their scientific study of the cognitive processes related to learning (with particular reference to theory of mind) and the relationship between psychology and artificial intelligence.

1. Knowledge and understanding

Cognitive science is one of the main contemporary approaches to the study of the mind and the mental processes that take place during learning. The course develops knowledge that can be useful for interpreting, modeling, and analyzing from a scientific point of view how human cognition proceeds and changes in formal, non-formal, and informal educational contexts. It will provide basic knowledge of cognitive science (including its interaction with artificial intelligence) with particular reference, especially in the second part of the course, to the so-called ‘theory of mind’, the development of which is a fundamental step in learning and social action. More specifically, the knowledge provided will be epistemological, historical, and theoretical in nature.

- **Epistemology of cognitive science.** The main arguments supporting the idea that the human and animal mind, and the mental processes underlying learning, can be conceived in terms of the processing of representations and therefore simulated on a computer will be presented and discussed.
- **History of cognitive science.** Starting from the mechanistic approach of the modern age, the main historical antecedents of cognitive science (behaviorism, cybernetics, development of theoretical computer science) will be traced.
- **Theoretical knowledge.** The main theories (representational and simulation) developed to explain mentalization abilities in children and adults will be presented.

2. Applied knowledge and understanding

The course will stimulate the ability to analyze, from a cognitive perspective, the mental processes that take place during formal, informal, and non-formal learning (with particular reference to the development of theory of mind). The development of this ability will be aided in particular by

- The 12 hours of interactive teaching dedicated to reading and analyzing scientific articles on theory of mind that are part of the program;
- The 6 hours of interactive teaching (workshop) carried out remotely, in which students will be invited to study and present a scientific article dealing with cognitive processes in learning.

3. Autonomy of judgment

The frequency of the course—in particular, the 18 hours of interactive teaching—will stimulate students' ability to develop a personal but well-argued point of view on the role of cognitive science and artificial intelligence in the study of the mind and learning processes.

4. Communication skills

The frequency of the course – in particular, the 6 hours of workshops – will stimulate the ability to interpret and present the content of scientific articles in a coherent and well-argued manner, including through the use of multimedia tools.

5. Learning skills

Especially during the interactive teaching hours, the course will stimulate the ability to independently integrate one's own knowledge and skills, including through research on scientific search engines (Scopus, Web of Science, Scholar).

Methodologies

The course, with a total duration of 56 hours, will include 38 hours of Traditional Teaching (68%) and 18 hours of Interactive Teaching (32%). Of the 18 hours of Interactive Teaching, 6 (10.7% of the total hours) will be carried out remotely, on the Webex platform, in synchronous mode during regular course hours or at times agreed with students to avoid overlap with other lessons.

The 38 hours of Traditional Teaching will take the form of lectures, which will nevertheless promote constant dialogue in the classroom. The 18 hours of Interactive Teaching will be organized as follows:

- 12 hours (in person) will be dedicated to reading and analyzing scientific articles on theory of mind that are part of the program.
- 6 hours of interactive teaching (laboratory) will be carried out remotely. Students (individually or in groups of 2) will be invited to select, study, and present a scientific article dealing with cognitive processes in learning. The course will be taught in Italian.

Online and offline teaching materials

The e-learning page for the course will be frequently updated with the slides shown in class and additional texts for further reading.

Programme and references

1. E. Datteri, *Che cos'è la scienza cognitiva*. Carocci, 2017.
2. W. Bechtel, A. Abrahamsen, G. Graham, *Menti, cervelli e calcolatori*. Storia della scienza cognitiva. Laterza, 2004.
3. Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind" ? *Cognition*, 21(1), 37–46.
4. Butterfill, S. A., & Apperly, I. A. (2013). How to Construct a Minimal Theory of Mind. *Mind & Language*, 28(5), 606–637.
5. Gallese, V., & Goldman, A. (1998). Mirror neurons and the simulation theory of mind-reading. *Trends in Cognitive Sciences*, 2(12).
6. Low, J., & Perner, J. (2012). Implicit and explicit theory of mind: State of the art. *British Journal of Developmental Psychology*, 30(1), 1–13.

Assessment methods

The exam will consist exclusively of an oral test (there will be no written tests or ongoing assessments of any kind). There are two exam options. Each student is free to choose which option they prefer, informing the teacher shortly before the exam date.

A) General discussion on the topics covered in the course. This is the traditional method in which the teacher assesses the achievement of the learning objectives through questions on the topics covered in the course.

B) Presentation of a research article. The student presents a scientific article on topics related to cognitive science and/or theory of mind. The teacher engages in a dialogue in which they encourage the student to link the topics of the article to those discussed in class.

The final grade takes into account the following aspects (presented in line with the Dublin Descriptors):

1. Knowledge and understanding of the course topics; knowledge and understanding applied to the analysis of learning processes (50%);
2. Autonomy of judgment: ability, demonstrated during interaction with the teacher in the oral exam, to develop and argue one's own points of view (20%);
3. Communication skills: ability to use vocabulary appropriate to the field of study (20%);
4. Learning skills: ability to integrate one's own body of knowledge through independent research (10%).

Office hours

To arrange an appointment online or in person (building U6, fourth floor), please contact the instructor at edoardo.datteri@unimib.it.

Programme validity

The programs are valid for two academic years.

Course tutors and assistants

Sustainable Development Goals

QUALITY EDUCATION
