Cognitive Science

Program of Study

Cognitive science explores the nature of cognitive processes such as perception, reasoning, memory, attention, language, decision making, emotion, motor control, and problem solving. The goal of cognitive science, stated simply, is to understand how minds work, in humans, animals, and machines. Cognitive science emerged in the latter part of the 20th century at the intersection of computer science, linguistics, philosophy, psychology, and neuroscience, and is an inherently interdisciplinary endeavor, drawing on tools and ideas from the social sciences, the physical and biological sciences, and the humanities. Topics of research include (but are not limited to) cognitive development, cognitive processing, judgment and decision making, language and communication, the neurological bases of cognition, perception, and memory, philosophy of mind, and artificial intelligence. A defining feature of cognitive science is its emphasis on integration among fields, for a truly interdisciplinary study of the mind. Students will be trained in formal methods of analysis and modeling that are common in majors in the physical and biological sciences, but often absent from majors in the humanities and social sciences; at the same time, students will also be trained in the advanced reasoning skills that define humanistic inquiry, but are often absent from more technical or applied majors.

The undergraduate major in Cognitive Science at the University of Chicago is designed to embody this interdisciplinary approach to the study of the mind and brain. Students gain broad knowledge of the field by taking courses in each of the five main disciplinary areas—computer science, linguistics, philosophy, psychology, and neuroscience—and then develop further focus and depth of understanding by taking additional courses in two of these disciplinary areas. Students will form key technical foundations through a Formal Foundations requirement, and will gain critical training in integrating interdisciplinary perspectives through the two core foundational courses: "Mind, Brain, and Meaning" and "Cognitive Models." A distinguishing feature of the Cognitive Science major at the University of Chicago is the centrality of the humanistic component of the study of the mind: starting immediately with the foundational course sequence, questions about what it *means* to learn, communicate, and think will be assigned equal significance to, and asked alongside, questions about what it *is* to learn, communicate, and think. Training emphasizes both engagement with the principal theories of mind and the evidence that bears on choices between them, and development of the conceptual and practical skills needed for understanding and conducting theoretical and empirical work in the field.

Program Requirements

Students majoring in Cognitive Science will receive the degree of bachelor of arts. To qualify for the BA, students must minimally satisfy the general education requirements and take an additional 15 required courses for the major, which fall into four categories: **Introductory Courses**, which engage students with the core questions, intellectual history, and analytical methods that unify cognitive scientific research (200 units); **Formal Foundations Courses**, which give students the analytical tools to explore different strands of contemporary cognitive scientific research (200 units); **Core Discipline Courses**, which provide breadth and depth in the five core disciplines (900 units); and **Extra-Disciplinary Courses**, which engage students with cognitive scientific work in areas beyond the core disciplines (200 units). These courses and their pedagogical roles in the major are described in more detail below.

Note that some courses may be used to satisfy different requirements; but no single course may be "double counted" towards satisfaction of two requirements. For example, a student who takes PHIL 20100 Introduction to Logic may count it either towards satisfaction of the Formal Foundations requirement or towards satisfaction of the Philosophy Core Discipline requirement, but not both.

Introductory Courses

There are two introductory courses in the Cognitive Science major, COGS 20001 Mind, Brain, and Meaning and COGS 20002 Cognitive Models, which serve two purposes. First, they introduce students to the empirical questions, theoretical concepts, and analytical methodologies that led to the emergence of cognitive science as a distinct field of study and continue to drive contemporary research. Second, they will highlight the ways that these issues manifest in the core disciplines of cognitive science—philosophy, psychology, linguistics, computer science, and neuroscience—and the ways that progress on central questions about the nature of the mind have been informed by interactions, conversations, and collaborations across the disciplines. Ideally, both courses will normally be co-taught by faculty from different fields, with the dual goal of providing substantive disciplinary expertise in more than one area, and of manifesting, in the classroom, the kind of interdisciplinarity that defines the field.

Formal Foundations Courses

The Cognitive Science major requires students to develop expertise in the formal analytical methods used in the field. The specific formal skills that will be most useful to individual students depend on their particular areas of interest, so students are free to select any two courses from an approved set of options from a range of courses in mathematics, computer science, statistics, and logic. Though not formally required, experience with the equivalent of one course in calculus is highly recommended, as expertise in this area is required for many of

the Core Discipline courses. (NOTE: Calculus I-II may be used to satisfy the Formal Foundations requirement only if the courses are not used to satisfy the general education requirement in the mathematical sciences.)

The following list provides examples of courses that could be used to satisfy the Formal Foundations requirement, but it is meant to be illustrative only and is not exhaustive. Students may petition for approval of a course not on this list as satisfaction of the Formal Foundations requirement by submitting a proposal and rationale to the Director of the Cognitive Science Program.

Cognitive Science Formal Foundations Courses

CHDV 39301	Qualitative Research Methods	100
CMSC 12100	Computer Science with Applications I	100
CMSC 12200	Computer Science with Applications II	100
CMSC 14100	Introduction to Computer Science I	100
CMSC 14200	Introduction to Computer Science II	100
CMSC 14300	Systems Programming I	100
CMSC 14400	Systems Programming II	100
CMSC 15100	Introduction to Computer Science I	100
CMSC 15200	Introduction to Computer Science II	100
CMSC 15400	Introduction to Computer Systems	100
CMSC 25300	Mathematical Foundations of Machine Learning	100
CMSC 27100	Discrete Mathematics	100
LING 21020	Formal Foundations of Linguistics	100
LING 22500	Quantitative Research Methods in Linguistics	100
MATH 13100	Elem Functions and Calculus I (or higher)	100
MATH 13200	Elem Functions and Calculus II (or higher)	100
MATH 19620	Linear Algebra	100
MATH 27700	Mathematical Logic I	100
MATH 28000	Introduction to Formal Languages	100
PHIL 20100	Introduction to Logic	100
PSYC 20200	Psychological Research Methods	100
PSYC 20250	Introduction to Statistical Concepts and Methods	100
STAT 24400	Statistical Theory and Methods I	100
STAT 24500	Statistical Theory and Methods II	100
STAT 27410	Introduction to Bayesian Data Analysis	100

Core Discipline Courses

The core disciplines of cognitive science are computer science, linguistics, philosophy, psychology, and neuroscience. The Core Discipline requirements are designed to strike a balance between breadth and depth in the core disciplines, while also allowing students a great deal of freedom to construct an individualized plan of study that best matches their interests in cognitive science. Students in the Cognitive Science major must take:

- **Five Core Discipline breadth courses:** one approved course in each of the five core disciplines
- **Four Core Discipline depth courses:** two additional courses in two of the core disciplines

Approved electives from each of the five core disciplines are listed below; students may, in addition, request approval of a course that is not on this list by submitting a proposal and rationale to the Director of the Cognitive Science Program.

Cognitive Science Core Discipline Courses: Computer Science

CMSC 13600	Introduction to Data Engineering	100
CMSC 14100	Introduction to Computer Science I	100
CMSC 14200	Introduction to Computer Science II	100
CMSC 14300	Systems Programming I	100
CMSC 14400	Systems Programming II	100
CMSC 15100	Introduction to Computer Science I	100
CMSC 15200	Introduction to Computer Science II	100
CMSC 15400	Introduction to Computer Systems	100
CMSC 20600	Introduction to Robotics	100
CMSC 21800	Data Science for Computer Scientists	100

CMSC 23900	Data Visualization	100
CMSC 25300	Mathematical Foundations of Machine Learning	100
CMSC 25400	Machine Learning	100
CMSC 25500	Introduction to Neural Networks	100
CMSC 25700	Natural Language Processing	100

Cognitive Science Core Discipline Courses: Linguistics

LING 20101	Introduction to Phonetics and Phonology	100
LING 20201	Introduction to Syntax	100
LING 20301	Introduction to Semantics and Pragmatics	100
LING 21020	Formal Foundations of Linguistics	100
LING 27010	Psycholinguistics	100
LING 28610	Undergraduate Computational Linguistics	100

Cognitive Science Core Discipline Courses: Philosophy

PHIL 20100	Introduction to Logic	100
PHIL 23000	Introduction to Metaphysics and Epistemology	100
PHIL 22960	Bayesian Epistemology	100
PHIL 23501	Philosophy of Mind	100
PHIL 24010	Meaning and Reference	100
PHIL 26000	History of Philosophy II: Medieval and Early Modern Philosophy	100

Cognitive Science Core Discipline Courses: Psychology

PSYC 20400	Cognitive Psychology	100
PSYC 20500	Developmental Psychology	100
PSYC 20700	Sensation and Perception	100
PSYC 21510	Neuroscience of Communication	100
PSYC 23200	Introduction to Language Acquisition	100
PSYC 23820	Attention and Working Memory in the Mind and Brain	100
PSYC 25101	The Psychology of Decision Making	100
PSYC 28990	Constructing consciousness: From matter to mind, through the lens of seeing color	100

Cognitive Science Core Discipline Courses: Neuroscience

NSCI 20101	Foundations of Neuroscience	100
NSCI 20130	Systems Neuroscience	100
NSCI 21000	Social Neuroscience	100
NSCI 21015	Biological Psychology	100
NSCI 21625	Cognitive Neuroscience in Humans and Rodents	100
NSCI 21750	Ethics through a Neurobiological Lens	100
NSCI 22010	Neuroscience of Consciousness	100
NSCI 23700	Methods in Computational Neuroscience	100

Extra-Disciplinary Courses

The Extra-Disciplinary requirement ensures that students also engage with cognitive scientific work outside the core disciplines, in areas such as music, anthropology, religion, economics, and political science, and so are exposed to the full breadth of the interdisciplinary study of the mind. Students in the major must take a total of two Extra-Disciplinary courses.

A partial list of courses that could be used to satisfy the Extra-Disciplinary requirement is provided below; as above, students may also request approval of courses not included in this list, or courses from other fields, by submitting a proposal and rationale to the Director of the Cognitive Science Program.

Cognitive Science Extra-Disciplinary Courses

ANTH 21355	Remembering: An Anthropological Approach	100
ANTH 22540	Games: Theory, Practice, and Experience	100
ANTH 24321	Psychological Anthropology	100

ASTR 23000	Cosmos and Conscience: Looking for Ourselves Elsewhere	100
BPRO 28400	Thinking Psychoanalytically: From the Sciences to the Arts	100
BUSN 20710	Behavioral Economics	100
ENGL 12720	Inventing Consciousness: Literature, Philosophy, Psychology	100
CHDV 20703	Literacy, Language, and Education	100
CHDV 22580	Child Development in the Classroom	100
CHDV 23100	Human Language and Interaction	100
CHDV 27950	Evolution and Economics of Human Behavior	100
MUSI 20719	Music and Mind	100
MUSI 43720	Music and Affect	100
PLSC 24210	Politicizing the Passions: Emotions and Collective Action	100
RLST 23750	The End of Metaphysics and the Future of Philosophy	100

Summary of Requirements

COGS 20001 Mind, Brain and Meaning	100
COGS 20002 Cognitive Models	100
Two Formal Foundations Courses	200
Five Core Discipline breadth courses	500
Four Core Discipline depth courses	400
Two Extra-Disciplinary courses	200
Total Units	1500

Grading

All courses used to satisfy requirements for the major must be taken for quality grades. With consent of the instructor, nonmajors may take COGS courses for P/F grading.

Honors

Students wishing to receive a BA in Cognitive Science with honors must carry out an independent research project that culminates in an honors thesis. Any student who has maintained a 3.25 or better overall GPA and a 3.5 or better GPA in courses that count towards the major may apply to receive a degree with honors; the deadline for application is the end of the fifth week of the third quarter before the student graduates, canonically Autumn Quarter of the fourth year. Applications must include a research proposal of no more than three pages, which explains the project and its significance, documents the student's preparation for the work, and has been approved by a faculty advisor or advisors. Students are strongly encouraged to identify co-advisors from distinct disciplines. The thesis must be submitted by the fifth week of the quarter in which the student plans to graduate.

This program may accept an honors thesis or project used to satisfy the same requirement in another major with the consent of both program directors. Students should consult with the relevant program directors by the earliest BA proposal deadline, or by the end of their third year if neither program publishes a deadline. A consent form, to be signed by both program directors, can be obtained from the College adviser. It must be completed and returned to the College adviser by the end of Autumn Quarter of the student's year of graduation.

Cognitive Science Courses