

COGNITIVE SCIENCE

Cognitive science investigates the nature and representation of knowledge, the structure and function of intelligence, and the relation of mind to brain and machine. While some might deem the mind mysterious and inaccessible, recent advances in computer science, experimental psychology, and philosophy have encouraged an approach to our mental life that is both scientific and broadly conceived.

Cognitive science is a relatively new approach to questions about the mind that has its roots in several disciplines. Psychologists in the past 40 years have moved away from a strict behavioral account of the human experience by investigating mental processes – such as memory, attention, and perception – that underlie our actions.

The development of artificial intelligence by computer scientists has altered how we define and conceive of intelligent action and raises many questions: Can intelligence be shown by inanimate objects such as computers? Is consciousness necessary for intelligence? Why are some human activities (for example, pattern recognition of objects) more difficult for computers to simulate than other human activities (such as well-defined mathematical problem-solving)?

Many contemporary philosophers of language and mind have attempted to define logically and quantitatively what we mean when we talk about representation or intent or belief. Although these may seem only intellectual games, the answers to these questions

profoundly affect how we construct machines to perform complex tasks, how we enable people to overcome disabilities or to learn new tasks, and even how we conceive of ourselves and others.

The interdisciplinary minor in cognitive science is particularly relevant for students interested in experimental psychology, computer science, linguistics, or philosophy. Students interested in other disciplines, such as anthropology, economics, political science, neuroscience, or music theory, may also find cognitive science an important perspective from which to consider their work.

While cognitive science is not a major, completion of this interdisciplinary minor will be noted on your Lawrence transcript.

CURRICULUM

You must select three core courses in cognitive science – *Cognitive Psychology*, which describes methods and results of psychological studies of human memory, perception, language, problem-solving, and reasoning; *Philosophy of Mind*, which examines our common conception of mental states and processes; and

Exploring Computer Science or Artificial Intelligence, which includes an examination of the nature and success of machine simulations of biological functions such as perceiving or problem-solving.

After these courses, you will take five additional courses, selecting from course offerings in anthropology, economics, education, and linguistics, as well as computer science, philosophy, and psychology. Three of the five courses must be in a department other than your major to provide a truly interdisciplinary approach to the study of the mind.

RESEARCH OPPORTUNITIES

Cognitive science is an active area of research, expanding the methods used and the questions asked within a particular discipline, and pursuing interdisciplinary connections in new and productive ways. Although an independent research project is not required for completion of the minor, such projects often are part of core course requirements. As a junior or senior you are encouraged to pursue independent research in either a tutorial or an independent study.

Matthew Kruse, '05, designed and implemented an artificial intelligence system to play chess: one version was designed to play based on A1 min-max search techniques and another used a model of his own intuition.

Tatiana Plaxina, '05, designed and implemented a neural network to recognize alphabetic characters even when they are corrupted or incomplete.

In an independent study project, Daniel Casner, '06, and Benjamin Willard, '07, implemented multi-robot coordination algorithms, using real-time information to recognize landmarks and communicate wirelessly.

Grace Ouyang, '06, earned honors in independent study for her project entitled "Effect of Musical Experience and Training on Learning Mandarin Chinese Tones".

Andrew McDuffee, '01, developed several pages for "Ryckman's Logic Works", a web-site devoted to teaching students propositional logic interactively (URL: www.lawrence.edu/dept/philosophy/research/ryckmant/).

Student-faculty collaboration on research in the various areas of cognitive science is strongly encouraged.

FACULTY

Joseph N. Gregg, Jr., associate professor of mathematics
Texas A&M University, B.S., M.S.;
Princeton University, Ph.D.

Interests: architecture of large software systems, software for math education, complex systems

Kurt D. Krebsbach, associate professor of computer science
Lawrence University, B.A.;
University of Minnesota, M.S.,
Ph.D.

Interests: artificial intelligence, automated planning, multi-agent systems, functional programming, music, zymurgy

Terry L. Gottfried, professor of psychology
University of Minnesota, B.A.,
Ph.D.

Interests: perception of speech and singing, psychology of cognition and perception, bilingualism, psychology of music

Thomas C. Ryckman, professor of philosophy
University of Michigan, Flint, B.A.;
University of Massachusetts, M.A.,
Ph.D.

Interests: philosophy of language, philosophy of mind, philosophy of science, philosophy of art

Robert F. Williams, assistant professor of education
Purdue University, B.A., B.S.;
University of Colorado at Denver,
M.A.;

University of California, San Diego, M.A., Ph. D.

Interests: cognitive science, distributed cognition, psychology of learning