Cognitive Science

Program Director: Barbara Malt, Ph.D. (Stanford) (https://psychology.cas2.lehigh.edu/content/bcm0)
Email: bcm0@lehigh.edu  # Phone: 610-758-4797
Website: http://cogsci.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Kate Arrington, Ph.D. (Psychology); Mark Bickhard, Ph.D. (Philosophy and Psychology); Amanda Brandon, Ph.D. (Psychology); Nancy Carlisle, Ph.D. (Psychology); John Gatewood, Ph.D. (Sociology and Anthropology); Jeffrey Hefflin, Ph.D. (Computer Science and Engineering); Almut Hupbach, Ph.D. (Psychology); Kiri Lee, Ph.D. (Modern Languages and Literatures); Barbara Malt, Ph.D. (Psychology); Jesseca Marsh, Ph.D. (Psychology); Hector Munoz-Avila, Ph.D. (Computer Science and Engineering); Padraig O'Seaghdha, Ph.D. (Psychology); Dominic Packer, Ph.D. (Psychology); and Aladdin Yaqub, Ph.D. (Philosophy)

The mission of the Cognitive Science Program is to advance the study of minds and brains, real or artificial, in all their aspects, through research and teaching. This interdisciplinary field, encompassing the fields of psychology, linguistics, computer science, philosophy, anthropology, and neuroscience, provides excellent preparation for life in the age of information. The program aims to instill in students a solid grasp of the intellectual problems, frameworks, and methodologies currently available; to provide experience exploring these through guided research; and to foster the desire to create and disseminate new knowledge. With this foundation, students are well prepared for a wide variety of careers in technology, human thought and behavior, or their interaction, or for graduate studies in Cognitive Science or any of the contributing disciplines.

We offer an undergraduate major in Cognitive Science, an undergraduate minor, a graduate minor, and a graduate certificate. A Cognitive Science major is easy to combine with a second major in the humanities, natural sciences, social sciences, or computer science.

Associate Professor. Padraig G O'Seaghdha, PhD (University of Toronto)

B.A. IN COGNITIVE SCIENCE

The B.A. with a major in Cognitive Science requires a minimum of 13 courses. All majors take COGS 007, an introduction to cognitive science, core courses in cognitive psychology, philosophy, artificial intelligence, and cognitive neuroscience, and collateral in computer science and math. In a second tier, students pursue their individual interests in their selections of major electives by completing at least five electives from three tracks. A capstone integration occurs in the required two-semester senior thesis (COGS 301 and COGS 399), in which students focus on a topic of their choice spanning at least two cognitive science sub-disciplines.

Additional coursework in affiliated disciplines is recommended, to be selected in consultation with the major adviser and dependent upon anticipated career path. These courses may fulfill college distribution requirements. Note: A number of courses have pre-requisites. Students considering this major should check pre-requisites and plan accordingly. A preliminary meeting with the program director may be useful.

Collateral Requirements
CSE 001  Breadth of Computing  2
CSE 002  Fundamentals of Programming  2
MATH 021  Calculus I  4
or MATH 051  Survey of Calculus I

Introductory Course
COGS 007  Introduction to Cognitive Science  4

Disciplinary Core Courses
COGS/PSYC 117  Cognitive Psychology  4
COGS/PSYC 176  Cognitive Neuroscience  4
COGS/PHIL 250  Philosophy of Mind  4
COGS/CSE 327  Artificial Intelligence Theory and Practice  3

Major Electives
Select a minimum of five electives, with at least one course from each of the three tracks.

Senior Thesis
COGS 301  Senior Project in Cognitive Science: Proposal  3
COGS 399  Senior Project in Cognitive Science: Thesis  3

Total Credits  49-53

MAJOR ELECTIVES

Artificial Intelligence and Formal Models
CSE 017  Programming and Data Structures
CSE 042/MATH 261  Game Design
CSE 261  Discrete Structures
CSE 262  Programming Languages
CSE 318  Introduction to the Theory of Computation
CSE 326  Pattern Recognition
CSE 335  Topics on Intelligent Decision Support Systems
CSE 337  Reinforcement Learning
CSE 348  AI Game Programming
CSE 360  Introduction to Mobile Robotics
CSE 431  Intelligent Agents
PHIL/MATH 114  Symbolic Logic
PHIL/MATH 214  Topics in Philosophical Logic
PHIL 265  Philosophy of Mathematics
PHIL/MATH 303  Mathematical Logic
MATH 304  Axiomatic Set Theory
MATH 329  Computability Theory

Language, Culture, and Meaning
ANTH 376  Culture and the Individual
COGS/ANTH/MLL 140  Introduction to Linguistics
PHIL 139  Contemporary Philosophy
PHIL 220  Ways of Knowing
PHIL 260  Making Sense of Words
PSYC 307  Higher Order Cognition
PSYC 313  Person Perception
PSYC 314  Social Cognition
PSYC 320  Psychology of Language
PSYC 321  Language Development
PSYC/HMS 344  Health Care Reasoning and Decision Making
PSYC 351  Children's Thinking
PSYC 362  Cognition in Practice & Policy
PSYC/GS 365  Human Development in Cross-Cultural Perspective
PSYC 384  Self and Identity
SOC/JOUR 135  Human Communication

Cognition and Neuroscience
BIOS 121  Biology Core III: Integrative & Comparative Biology
The Graduate Minor requires five graduate level courses. Requirements of the student's major program, with the approval of the Program Director. Courses taken towards the minor may also fulfill electives must be taken outside the student's home department. Special topics courses with a cognitive science emphasis may also be taken with the approval of an adviser in their major program, by contacting the Director of the Cognitive Science Program. On completion of the program, the Director of the Cognitive Science Program will issue a letter to the student certifying that he or she has met the requirements of the minor.

The Graduate Minor requires five graduate level courses: the core course COGS/PSYC 423 and four electives. At least two of the four electives must be at the 400-level, and the three electives must be spread over at least two departments.

The Graduate Certificate requires four graduate level courses: the core course COGS/PSYC 423 and three electives. At least two of the three electives must be at the 400-level, and the three electives must be spread over at least two departments.

The undergraduate minor in Cognitive Science requires five courses:

COGS 007 Introduction to Cognitive Science 4
Four additional courses selected from among the major's core courses and major electives, with at least two of these being Disciplinary Core Courses.

Total Credits 16-20

**MINOR IN COGNITIVE SCIENCE**
The undergraduate minor in Cognitive Science requires five courses:

COGS 007 Introduction to Cognitive Science 4
Four additional courses selected from among the major's core courses and major electives, with at least two of these being Disciplinary Core Courses.

Total Credits 16-20

**PROGRAM HONORS**
Majors seeking to graduate with honors in cognitive science must have a 3.30 GPA in the major, a 3.30 GPA overall, and complete a high quality senior thesis. Theses submitted for honors will be evaluated by a committee of at least three cognitive science faculty.

**FOR GRADUATE STUDENTS**
There are two concentrations in Cognitive Science available for post-baccalaureate students: a Graduate Minor and a Graduate Certificate. The minor is intended for students currently enrolled in a degree-granting graduate program at Lehigh University. The certificate is intended for non-degree students.

**Graduate Minor in Cognitive Science**
The minor gives graduate students who are enrolled in Lehigh University degree programs, such as computer science or psychology, an opportunity to develop expertise at the intersection of information processing by humans and intelligent machines. Graduate students investigating mental processes or applications such as artificial intelligence or educational technology are encouraged to participate, with the approval of an adviser in their major program, by contacting the Director of the Cognitive Science Program. On completion of the program, the Director of the Cognitive Science Program will issue a letter to the student certifying that he or she has met the requirements of the minor.

The Graduate Minor requires five graduate level courses: the core course COGS/PSYC 423 and four electives. At least two of the four electives must be taken outside the student's home department. Special topics courses with a cognitive science emphasis may also count towards the minor, with the approval of the Cognitive Science Program Director. Courses taken towards the minor may also fulfill requirements of the student's major program, with the approval of the major department.

The Graduate Minor requires five graduate level courses.

COGS/PSYC 423 Foundations of Cognitive Science 3
Four electives from the list below (or approved substitutions). 12-16

**Computer Science**

CSE 348 AI Game Programming
CSE 426 Pattern Recognition
CSE 428 Semantic Web Topics
CSE 431 Intelligent Agents
CSE 435 Topics on Intelligent Decision Support Systems
CSE 447 Data Mining
CSE 460 Mobile Robotics

**Psychology**

PSYC 402 Developmental Psychology
PSYC 403 Cognitive Psychology
PSYC 406 Social Cognition
PSYC 443 Seminar in Language Acquisition
PSYC 448 Seminar in Psychology of Language
PSYC 464 Naive Realism in Social Judgement
PSYC 476 Seminar in Cognition
PSY/COSG 478 Ontological Psychology
PSYC 480 Seminar in Cognitive Development

**Philosophy**

PHIL/COGS 250 Philosophy of Mind
PHIL 260 Making Sense of Words

**Sociology and Anthropology**

ANTH 376 Culture and the Individual

**Total Credits** 15-19

Note: These particular 200-level courses may be taken by graduate students.

**Graduate Certificate in Cognitive Science**
This concentration is intended for people working in technology-related businesses and other qualified individuals with an interest in cognitive science. It provides non-degree post-baccalaureate students with an interdisciplinary perspective on human and machine intelligence.

The Graduate Certificate requires four graduate level courses: the core course COGS/PSYC 423 and three electives. At least two of the tree electives must be at the 400-level, and the three electives must be spread over at least two departments.

COGS 423 Foundations of Cognitive Science 3
Three electives from the list below. 9-12

**Computer Science**

CSE 327 Artificial Intelligence Theory and Practice
CSE 331 User Interface Systems and Techniques
CSE 332 Multimedia Design and Development
CSE 335 Topics on Intelligent Decision Support Systems
CSE 348 AI Game Programming
CSE 426 Pattern Recognition
CSE 428 Semantic Web Topics
CSE 431 Intelligent Agents
CSE 435 Topics on Intelligent Decision Support Systems
CSE 437 Reinforcement Learning and Markov Decision Processes
CSE 447 Data Mining
CSE 460 Mobile Robotics

**Psychology**

PSYC 307 Higher Order Cognition
PSYC 313 Person Perception
PSYC 314 Social Cognition
PSYC 317 Psychology of Emotion
PSYC 320 Psychology of Language
PSYC 321 Language Development
PSYC 347 Cognitive Neuroscience of Memory
PSYC 351 Children's Thinking
PSYC 358 Inside the Infant Mind
PSYC 362 Cognition in Practice & Policy
PSYC 365 Human Development in Cross-Cultural Perspective
PSYC 369 Memory Under Construction
PSYC 377 Attention and Attentional Failures
PSYC 402 Developmental Psychology
PSYC 403  Cognitive Psychology
PSYC 406  Social Cognition
PSYC 443  Seminar in Language Acquisition
PSYC 448  Seminar in Psychology of Language
PSYC 464  Naive Realism in Social Judgement
PSYC 476  Seminar in Cognition
PSYC/COGS 478  Ontological Psychology
PSYC 480  Seminar in Cognitive Development

Philosophy 1
PHIL/COGS 250  Philosophy of Mind
PHIL 260  Making Sense of Words

Sociology and Anthropology
ANTH 376  Culture and the Individual

Total Credits 12-15

1 Note: These particular 200-level courses may be taken by graduate students.

Courses
COGS 007  Introduction to Cognitive Science 4 Credits
What is a mind? How is the mind related to the brain? Could we make an artificial mind? Issues concerning knowledge representation and intelligence in minds and computers as investigated by psychologists, philosophers, linguists, neuroscientists, and researchers in artificial intelligence.
Attribute/Distribution: SS

COGS 117 (PSYC 117)  Cognitive Psychology 4 Credits
The architecture and dynamics of the human mind: How we acquire knowledge through perception, represent and activate it in memory, and use it to communicate, make decisions, solve problems, and reason creatively. May not be taken pass/fail.
Prerequisites: PSYC 001 or COGS 007
Attribute/Distribution: SS

COGS 140 (ANTH 140, MLL 140)  Introduction to Linguistics 4 Credits
Relationship between language and mind; formal properties of language; language and society; how languages change over time. May not be taken pass/fail.
Attribute/Distribution: SS

COGS 161 Supervised Research 2-4 Credits
Research under the direct supervision of a faculty member in the cognitive science program. Students must arrange the particular project with a faculty member before enrolling. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

COGS 176 (PSYC 176)  Cognitive Neuroscience 4 Credits
Perception and cognitive neuroscience as the link between mental processes and their biological bases. Visual and auditory perception; the control of action; neuropsychological syndromes of perception, language, memory, and thought; neural network (connectionist) models of mental processes. May not be taken pass/fail.
Prerequisites: PSYC 001 or COGS 007
Attribute/Distribution: NS

COGS 250 (PHIL 250)  Philosophy of Mind 4 Credits
An exploration of the mind-body problem. Are the body and mind distinct substances (dualism); or is there only body (materialism); or only mind (idealism)? Other views to be considered include behaviorism (the view that behavior can be explained without recourse to mental states), and the view that the mind is a complex computer. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Attribute/Distribution: HU

COGS 300 1-4 Credits

COGS 301 Senior Project in Cognitive Science: Proposal 1-3 Credits
Senior year integration of the material from cognitive science begins with the proposal of a substantial review or research project spanning at least two cognitive science disciplines under the direction of a Cognitive Science faculty member. Students must enroll for a total of three credits which may be split between the sections of a primary and secondary adviser. Consent of program director required.
Repeat Status: Course may be repeated.

COGS 327 (CSE 327)  Artificial Intelligence Theory and Practice 3 Credits
Introduction to the field of artificial intelligence: Problem solving, knowledge representation, reasoning, planning and machine learning. Use of AI systems or languages. Advanced topics such as natural language processing, vision, robotics, and uncertainty. CSE 261 is recommended.
Prerequisites: (CSE 001 and CSE 002) or CSE 017

COGS 361 Independent Research 2-4 Credits
Independent research in cognitive science with a faculty advisor. Students must arrange the particular project with a faculty advisor before enrolling. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

COGS 399 Senior Project in Cognitive Science: Thesis 1-3 Credits
Research during senior year culminating in senior thesis advised by a member of the Cognitive Science faculty. Execution and written report of project proposed and approved in COGS 301. Students must enroll for a total of three credits which may be split between the sections of a primary and secondary adviser. Theses submitted for honors will be evaluated by a committee of at least three cognitive science faculty. Prerequisite: COGS 301 and consent of the program director.
Repeat Status: Course may be repeated.
Prerequisites: COGS 301

COGS 405 Individual Study in Cognitive Science 1-6 Credits
Study of a topic not covered in regular course offerings. By arrangement with a consulting faculty member. Consent of program director required.
Repeat Status: Course may be repeated.

COGS 423 (PSYC 423)  Foundations of Cognitive Science 3 Credits
Survey of fundamental theory and methodologies from artificial intelligence, linguistics, cognitive psychology, philosophy, and neuroscience, as well as salient research problems such as knowledge acquisition and representation, natural language processing, skill acquisition, perception and action, and the philosophical question of intentionality.

COGS 478 (PSYC 478)  Ontological Psychology 3 Credits
Principles and constraints for modeling psychological phenomena. Representation; perception; memory; knowing; learning; emotions; consciousness; language; rationality.