Cognitive science is concerned with how humans, non-human animals, and computers acquire, represent, manipulate, and use information. As an interdisciplinary field it combines research and theory from computer science (e.g., artificial intelligence), cognitive psychology, philosophy, linguistics, and neuroscience, and to some extent evolutionary biology, math, and anthropology. Complex issues of cognition are not easily addressed using traditional intra-disciplinary tools. Cognitive researchers in any discipline typically employ a collection of analytic and modeling tools from across traditional disciplinary boundaries. Thus, the methods and research agenda of cognitive science are broader than those of any of the fields that have traditionally contributed to cognitive science. The Cognitive Science Program is designed to provide students with the broad interdisciplinary foundation needed to approach issues of cognition.

THE CONCENTRATION

The concentration in Cognitive Science consists of six courses, including an introductory course, four electives, and a senior seminar.

Minds, Brains, and Intelligent Behavior (COGS 222) is the entry point into the concentration, and provides an interdisciplinary perspective on issues of cognition. Ideally, it should be taken before the end of the sophomore year. Emphasizing the highly interdisciplinary nature of the field, the four electives must be distributed over at least three course prefixes. In the fall of the senior year, concentrators will participate in a senior seminar (COGS 493) or a senior tutorial, depending on enrollments.

Required Courses

COGS/PHIL/PSYC 222 Minds, Brains, and Intelligent Behavior: An Introduction to Cognitive Science

COGS 493 Senior Seminar or Senior Tutorial (In years where 493 is not offered, students should contact the Program Chair for details).

Elective Courses

Four electives are required, chosen from at least three prefixes, at most two of which can be at the 100 level.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Taught by</th>
<th>Catalog details</th>
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<tbody>
<tr>
<td>BIOL 204(S)</td>
<td>LEC Animal Behavior</td>
<td>Manuel Morales</td>
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<tr>
<td>COGS 224</td>
<td>/ PHIL 221(F) SEM Introduction to Formal Linguistics</td>
<td>Christian De Leon</td>
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<td>COGS 323</td>
<td>/ PSYC 323(F) TUT Visual Consciousness</td>
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<td>COGS 328</td>
<td>/ PSYC 328(S) SEM Cognitive Approaches to Visual Perception</td>
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<td>COGS 390</td>
<td>/ PHIL 390(S) SEM Discourse Dynamics</td>
<td>Christian De Leon</td>
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<tr>
<td>CSCI 134(F,S)</td>
<td>LEC Introduction to Computer Science</td>
<td>Jeannie R Albrecht, Mark Hopkins, Rohit Bhattacharya, Iris Howley</td>
<td>Catalog details</td>
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<tr>
<td>CSCI 361</td>
<td>/ MATH 361(F) LEC Theory of Computation</td>
<td>Aaron Williams</td>
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<tr>
<td>CSCI 373(F,S)</td>
<td>LEC Artificial Intelligence</td>
<td>Mark Hopkins</td>
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<tr>
<td>CSCI 374(F)</td>
<td>LEC Machine Learning</td>
<td>Mark Hopkins</td>
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</table>
Taught by: Rohit Bhattacharya
Catalog details
CSCI 379 LEC Causal Inference

Taught by: Rohit Bhattacharya
Catalog details
NSCI 201 / BIOL 212 / PSYC 212(F) LEC Neuroscience
Taught by: Matt Carter, Shannon Moore
Catalog details
PHIL 207(S) SEM Contemporary Philosophy of Mind

Taught by: Joseph Cruz
Catalog details
PHIL 216 / ENVI 216 SEM Philosophy of Animals

Taught by: Joseph Cruz
Catalog details
PSYC 221(F) LEC Cognitive Psychology
Taught by: Kris Kirby
Catalog details
PSYC 322 SEM Concepts: Mind, Brain, and Culture

Taught by: TBA
Catalog details
PSYC 326 SEM Choice and Decision Making
Taught by: Kris Kirby
Catalog details
PSYC 327(S) SEM Cognition and Education
Taught by: Nate Kornell
Catalog details
REL 288 / PHIL 288(F) SEM Embodiment and Consciousness: A Cross-Cultural Exploration
Taught by: Georges Dreyfus, Joseph Cruz
Catalog details

Recommended Courses

The following courses are recommended for students seeking a richer background in cognitive science. These will not count as electives for the cognitive science concentration.

BIOL 305(S) LEC Evolution
Taught by: Luana Maroja
Catalog details
COGS 224 / PHIL 221(F) SEM Introduction to Formal Linguistics
Taught by: Christian De Leon
Catalog details
COGS 390 / PHIL 390(S) SEM Discourse Dynamics
Taught by: Christian De Leon
Catalog details
ECON 502(F) LEC Statistics/Econometrics
Taught by: Anand Swamy
Catalog details
MATH 250(F, S) LEC Linear Algebra
Taught by: Thomas Garrity, Jenna Zomback
Catalog details
PHIL 209 / STS 209 SEM Philosophy of Science
Taught by: Bojana Mladenovic
Catalog details
PSYC 201(F, S) LEC Experimentation and Statistics
Taught by: Kris Kirby, Jeremy Cone, Amie Hane, Catherine Stroud, Victor Cazares
Catalog details
STAT 101(F, S) LEC Elementary Statistics and Data Analysis
Taught by: Elizabeth Upton
Catalog details
STAT 201(F, S) LEC Statistics and Data Analysis
Taught by: Stewart Johnson, Anna Plantinga
Catalog details

Formal admission to candidacy for honors will occur at the end of the fall semester of the senior year and will be based on promising performance in COGS 493. This program will consist of COGS W31-494(S), and will be supervised by members of the advisory committee from at least two departments. Presentation of a thesis, however, should not be interpreted as a guarantee of a degree with honors.
STUDY ABROAD

Students who wish to discuss plans for study abroad are invited to meet with any member of the Cognitive Science advisory committee.

FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in many cases, though students should be sure to contact the department.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Complete syllabus and course description, including readings/assignments.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

No.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

No. As long as the study abroad courses conform to the interdisciplinary distribution requirements of the concentration.

Are there specific major requirements that cannot be fulfilled while on study away?

No.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

No.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn’t:

None to date.

COGS 222  (F)(S) Minds, Brains, and Intelligent Behavior: An Introduction to Cognitive Science

Cross-listings: PSYC 222  PHIL 222  COGS 222

Primary Cross-listing

This course will emphasize interdisciplinary approaches to the study of intelligent systems, both natural and artificial. Cognitive science synthesizes research from cognitive psychology, computer science, linguistics, neuroscience, and contemporary philosophy. Special attention will be given to the philosophical foundations of cognitive science, representation and computation in symbolic and connectionist architectures, concept acquisition, problem solving, perception, language, semantics, reasoning, and artificial intelligence.

Requirements/Evaluation: midterm and final exams, and weekly exercises

Prerequisites: PSYC 101 or any PHIL course or CSCI 134 or permission of instructor; background in more than one of these is recommended.

Enrollment Limit: 20

Enrollment Preferences: sophomore and first-year students, with additional preference given to students who satisfy more of the prerequisites. There is no need to contact the instructor to indicate special interest in the course.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: meets Contemporary Metaphysics & Epistemology requirement only if registration is under PHIL

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:

PSYC 222 (D3) PHIL 222 (D2) COGS 222 (D2)

Attributes: Linguistics PHIL Contemp Metaphysics + Epistemology Courses PSYC 200-level Courses
The sentence "Every cookie is chocolate chip and three of them are oatmeal raisin" is a perfectly grammatical sentence of English, but it's self-contradictory. What does it take to realize this fact? One must grasp the meanings of the various parts of the sentence. In particular, one must grasp that "three of them" picks out a subset of the group picked out by "every cookie", and that there's no such thing as a cookie that is both chocolate chip and oatmeal raisin. There two ways to understand "Many students took every class". According to one, there is a single group of students that had their hands extremely full this semester. According to the other, every class was well-populated, potentially by different groups. The reason for this is that there are two underlying structures that the original sentence can realize. This course serves as an introduction to formal methods in the scientific study of language. Our goal will be to characterize phenomena like those above with logical and mathematical precision. The focus will be on model-theoretic semantics, the sub-field of linguistics that studies meanings. Along the way we will discuss principles of syntax, the sub-field that studies sentence structures, and pragmatics, the sub-field that studies inferences of non-literal content. This is a formal course, but no prior logical or mathematical background will be expected. Starting from scratch, students will learn the building blocks of current-day linguistic research. This introduction will be of use to students interested in language from a variety of perspectives, including philosophy, cognitive science, and computer science.

**Requirements/Evaluation:** Weekly problem sets, plus a final project (paper/presentation/other type, to be discussed with instructor)

**Prerequisites:** No prerequisites

**Enrollment Limit:** 20

**Enrollment Preferences:** Preference given to seniors and philosophy/cognitive science majors.

**Expected Class Size:** 20

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 224 (D2) PHIL 221 (D2)

**Quantitative/Formal Reasoning Notes:** This course teaches the fundamentals of the formal analysis of language. Students will learn to provide translation schemes from English to a logical language (typed lambda calculus).

**Attributes:** COGS Interdepartmental Electives COGS Related Courses Linguistics PHIL Contemp Metaphysics + Epistemology Courses

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Consciousness is considered as the 'last great mystery of science.' In this course we are going to delve into one of the most well-studied areas of this mystery, that is visual consciousness. Do you really perceive everything you look at? Are you aware of everything you see? Is our visual experience a grand illusion? We will start our investigation of such questions by reading about various approaches in understanding human consciousness. Then, we are going to apply these approaches to perception, and discuss theoretical and empirical controversies in visual consciousness. Finally, we are going to focus on evaluating empirical studies that attempt to resolve such controversies. The goal of this course is to build a bridge between theory and experimentation by learning how to interpret the results of scientific studies to shed light on theoretical and philosophical debates in the literature.

**Requirements/Evaluation:** 5 - 7 page essays every other week, and 2-page response papers to their partner's essays in alternate weeks
Prerequisites: COGS 222 (same as PHIL 222 or PSYC 222); or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: Cognitive Science concentrators and Psychology majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (WS)

This course is cross-listed and the prefixes carry the following divisional credit:
PSYC 323 (D3) COGS 323 (D2)

Writing Skills Notes: In a tutorial format, students will receive detailed feedback on their writing each week from the professor, as well as from their partner. Students will receive timely comments on their writing skills, with suggestions for improvement. The written essays will be discussed during tutorial meetings.

Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology

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COGS 328 (S) Cognitive Approaches to Visual Perception

Cross-listings: PSYC 328 COGS 328

Primary Cross-listing

When you open your eyes, you immediately perceive your environment in great detail. Seeing is so quick and effortless that people mistakenly think that vision works like a camera. However, the reason it feels effortless is due to the tremendous amount of complex processes and computations that take place in your brain whenever you open your eyes. In this course, we will explore such processes from a computational perspective and examine the concept of "visual illusion". We will focus on research methodologies used in vision science and look into how we can use such methodologies to explain visual illusions. We will learn about how our visual system processes certain visual features in our environment, such as motion, color, depth and shape. Learning about these processes will make us appreciate how everything we see around us can be a visual illusion.

Requirements/Evaluation: Class participation, weekly take-home quizzes, weekly short commentaries on readings, class presentation, individual 10-page final paper

Prerequisites: PSYC 221, COGS/PHIL/PSYC 222, or permission of instructor

Enrollment Limit: 19

Enrollment Preferences: Cognitive Science concentrators

Expected Class Size: 19

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:
PSYC 328 (D3) COGS 328 (D2)

Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology

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COGS 390 (S) Discourse Dynamics (WS)

Cross-listings: COGS 390 PHIL 390

Primary Cross-listing

It'd be perfectly natural to say "I might've left the stove on", then check the stove, then say "I didn't leave the stove on". But perform those exact same steps in a different order--check the stove, say "I didn't leave the stove on", then say "I might've left the stove on"--and something's gone quite wrong. Conversation is dynamic--the back and forth exchange of information is a process that grows and adapts to the surrounding context. The order in
which you say things matters, and it matters for what you communicate what actions you take and what events happen around you. In this course, we will investigate dynamic communicative phenomena and discuss competing theoretical explanations about how they’re interpreted. Of particular interest will be the extent to which discourse dynamics are built into the meanings of linguistic expressions vs. the extent to which they’re consequences of our rational cognition. Is a sentence’s relation to previously uttered sentences similar to its relation to extra-linguistic events? How much inference goes into interpreting what’s said? In pursuing the answers to these questions, we will discuss both classic and contemporary theories from philosophy and linguistics.

Requirements/Evaluation: Four short papers (3-4 pages), take-home midterm paper (5-7) pages, take-home final paper (6-8 pages)
Prerequisites: At least one philosophy or cognitive science course (any level), or permission of instructor.
Enrollment Limit: 19
Enrollment Preferences: Preference given to seniors and philosophy/cognitive science majors, then to students who have taken 200-Level Intro to Formal Linguistics
Expected Class Size: 19
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2) (WS)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 390 (D2) PHIL 390 (D2)

Writing Skills Notes: There will be four short papers (3-4 pages each) that will receive written comments on substance, argument structure, and writing style. These will be designed to include sections that, upon revision in light of comments, can be incorporated into the longer midterm and final papers (5-7 pages and 6-8 pages respectively). Students will be required to meet with the instructor before the midterm and final papers to discuss outlines and revisions of short papers.

Attributes: COGS Interdepartmental Electives COGS Related Courses Linguistics PHIL Contemp Metaphysics + Epistemology Courses

Spring 2023
SEM Section: 01  TF 2:35 pm - 3:50 pm  Christian De Leon

COGS 493 (F) Advanced Topics in Mind and Cognition
In the last decade the science of the mind has continued to draw on its 20th century history as well as expand its methodological repertoire. In this seminar we will investigate some of the current trends in mind and cognition. We will attend both to the specific empirical details as well as the conceptual foundations of cognitive science. In particular, we will focus on the concept of mental representation, which is the core and defining theoretical posit in the field of cognitive sciences. We will discuss both the philosophical foundations of this concept, as well as how it is utilized in the current empirical literature in this field.

Requirements/Evaluation: in-class participation, seminar presentations, final paper & project
Prerequisites: Senior Cognitive Science concentrator
Enrollment Limit: 12
Enrollment Preferences: Open only to Senior Cognitive Science concentrators
Expected Class Size: 5
Grading: no pass/fail option, no fifth course option
Distributions: (D2)

Fall 2022
SEM Section: 01  W 1:10 pm - 3:50 pm  Joseph L. Cruz

COGS 494 (S) Senior Thesis: Cognitive Science
The senior concentrator, having completed the senior seminar and with approval from the advisory committee, may devote winter study and the spring semester to a senior thesis based on the fall research project.

Requirements/Evaluation: Determined by thesis advisor
Prerequisites: permission of program chair
Enrollment Limit: none
Enrollment Preferences: Senior Cognitive Science concentrators
Expected Class Size: NA
Grading: no pass/fail option, no fifth course option
Distributions: (D2)

Spring 2023
HON Section: 01  TBA  Nate Kornell

COGS 497 (F) Independent Study: Cognitive Science
Cognitive Science independent study.

Class Format: This course is coordinated in agreement with a sponsoring Cognitive Science faculty member.
Requirements/Evaluation: Determined by individual instructors
Prerequisites: permission of program chair
Enrollment Limit: none
Enrollment Preferences: Cognitive Science concentrators
Expected Class Size: NA
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)

Fall 2022
IND Section: 01  TBA  Nate Kornell

COGS 498 (S) Independent Study: Cognitive Science
Cognitive Science independent study.

Class Format: This course is coordinated in agreement with a sponsoring Cognitive Science faculty member.
Requirements/Evaluation: Determined by individual instructors
Prerequisites: permission of program chair
Enrollment Limit: none
Enrollment Preferences: Cognitive Science concentrators
Expected Class Size: NA
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)

Spring 2023
IND Section: 01  TBA  Nate Kornell