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.

- BIOL 204(S) Animal Behavior
  Taught by: Manuel Morales
  Catalog details

- CSCI 134(F, S) Introduction to Computer Science
  Taught by: Jeannie R Albrecht, Andrea Danyluk, Iris Howley, Thomas Murtagh, Shikha Singh
  Catalog details

- CSCI 361 / MATH 361(F, S) Theory of Computation
  Taught by: Thomas Murtagh, Aaron Williams
  Catalog details

- CSCI 373 Artificial Intelligence
  Taught by: Jon Park
  Catalog details

- CSCI 374 T(S) Machine Learning
  Taught by: Andrea Danyluk
  Catalog details

- NSCI 201 / BIOL 212 / PSYC 212(F) Neuroscience
  Taught by: Tim Lebestky, Shivon Robinson
  Catalog details

- PHIL 207 Contemporary Philosophy of Mind
  Taught by: Joseph Cruz
  Catalog details

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

- PHIL 388 T Consciousness
  Taught by: Joseph Cruz
  Catalog details

- PSYC 221(S) Cognitive Psychology
  Taught by: Nate Kornell
  Catalog details

- PSYC 322(S) Concepts: Mind, Brain, and Culture
  Taught by: Nate Kornell
  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): Evolution**
- Taught by: Luana Maroja
- Catalog details

**MATH 250(F, S): Linear Algebra**
- Taught by: Eva Goedhart, Haydee M. A. Lindo
- Catalog details

**PHIL 209 / SCST 209: Philosophy of Science**
- Taught by: Bojana Mladenovic
- Catalog details

**PSYC 201(F, S): Experimentation and Statistics**
- Taught by: Jeremy Cone, Kris Kirby, Kenneth Savitsky
- Catalog details

**STAT 101(F, S): Elementary Statistics and Data Analysis**
- Taught by: Elizabeth Upton
- Catalog details

**STAT 201(F, S): Statistics and Data Analysis**
- Taught by: Stewart Johnson, Shaoyang Ning
- Catalog details

**STAT 344: Statistical Design of Experiments**
- Taught by: Richard De Veaux
- 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 31 (W) Senior Thesis: Cognitive Science
May be taken by students registered for Cognitive Science 494.

Class Format: independent study
Grading: pass/fail only
Distributions: (D2)

Winter 2020
HON Section: 01 TBA Sala R. Zaki

COGS 99 (W) Ind Study: Cognitive Science
Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study
Grading: pass/fail only
Distributions: (D2)

Winter 2020
IND Section: 01 TBA Sala R. Zaki

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

Cross-listings: PSYC 222 COGS 222 PHIL 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.

Class Format: lecture/discussion
Requirements/Evaluation: midterm and final exams, and self-paced weekly exercises
Prerequisites: PSYC 101 or any introduction to PHIL course or CSCI 134 or permission of instructor; background in more than one of these is recommended
Enrollment Limit: 25
Enrollment Preferences: first-year and sophomore students
Expected Class Size: 25
Grading: yes 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 (D2) COGS 222 (D2) PHIL 222 (D2)
Attributes: Linguistics PHIL Contemp Metaphysics & Epistemology Courses PSYC 200-level Courses

Fall 2019
LEC Section: 01 TR 11:20 am - 12:35 pm Joseph L. Cruz

COGS 493 (S) 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 current trends in mind and cognition by considering research in cognitive neuroscience, embodied cognition, dynamic systems theory, and empirical approaches to consciousness. Throughout, we will attend both to the specific empirical details as well as the conceptual foundations of this work. We will discuss how it elaborates, expands, and sharpens early views of the domain and methodology of philosophy of mind and cognitive science.
Class Format: seminar
Requirements/Evaluation: weekly short essays 1000 words, seminar presentation, final paper/project 7,000 words
Prerequisites: senior Cognitive Science concentrator
Enrollment Limit: 12
Enrollment Preferences: open only to senior COGS concentrators
Expected Class Size: 7
Grading: no pass/fail option, yes fifth course option
Distributions: (D2)

Spring 2020
SEM Section: 01 TBA 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.
Class Format: independent study
Prerequisites: permission of program chair
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)

Spring 2020
HON Section: 01 TBA Sala R. Zaki

COGS 497 (F) Independent Study: Cognitive Science
Cognitive Science independent study.
Class Format: independent study
Prerequisites: permission of program chair
Grading: yes pass/fail option, yes fifth course option
COGS 498 (S) Independent Study: Cognitive Science

Cognitive Science independent study.

Class Format: independent study

Prerequisites: permission of program chair

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

Distributions: (D2)

Spring 2020

IND Section: 01    TBA    Safa R. Zaki

COGS Interdepartmental Electives

BIOL 204 (S) Animal Behavior

Making sense of what we see while watching animals closely is both an enthralling pastime and a discipline that draws on many aspects of biology. Explanations can be found on many levels: evolutionary theory tells us why certain patterns have come to exist, molecular biology can help us understand how those patterns are implemented, neuroscience gives insights as to how the world appears to the behaving animal, endocrinology provides information on how suites of behaviors are regulated. The first part of the course focuses upon how descriptive studies provide the basis for formulating questions about behavior as well as the statistical methods used to evaluate the answers to these questions. We then consider the behavior of individuals, both as it is mediated by biological mechanisms and as it appears from an evolutionary perspective. The second half of the course is primarily concerned with the behaviors of groups of animals from a wide variety of vertebrate and invertebrate species, concentrating upon the stimuli, responses, and internal mechanisms that maintain social systems and on the selection pressures that drive animals toward a particular social system.

Class Format: lecture/laboratory, six hours per week

Requirements/Evaluation: evaluation will be based on examinations, lab reports, and a research paper

Prerequisites: BIOL 102, or PSYC 101, or permission of instructor

Enrollment Limit: 32

Enrollment Preferences: Biology majors and Neuroscience concentrators

Expected Class Size: 32

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

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3)

Attributes: COGS Interdepartmental Electives NSCI Group C Electives

Spring 2020

LAB Section: 03    W 1:00 pm - 4:00 pm    Manuel A. Morales

LEC Section: 01    TR 8:30 am - 9:45 am    Manuel A. Morales

LAB Section: 02    T 1:00 pm - 4:00 pm    Manuel A. Morales

BIOL 212 (F) Neuroscience

Cross-listings: BIOL 212 NSCI 201 PSYC 212

Secondary Cross-listing
A study of the relationship between brain, mind, and behavior. Topics include a survey of the structure and function of the nervous system, basic neurophysiology, development, learning and memory, sensory and motor systems, consciousness and clinical disorders such as schizophrenia, autism, Parkinson's disease, and addiction. The laboratory focuses on current topics in neuroscience.

**Class Format:** lecture, three hours a week; laboratory, every other week

**Requirements/Evaluation:** a lab practical, lab reports, two hour exams and a final exam

**Prerequisites:** PSYC 101 or BIOL 101; open to first-year students only with permission of instructor

**Enrollment Limit:** 72

**Enrollment Preferences:** sophomores and Biology and Psychology majors

**Expected Class Size:** 72

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

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3)

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

BIOL 212 (D3) NSCI 201 (D3) PSYC 212 (D3)

**Attributes:** COGS Interdepartmental Electives NSCI Required Courses PSYC 200-level Courses

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**CSCI 134 (F)(S) Introduction to Computer Science** (QFR)

This course introduces students to the science of computation by exploring the representation and manipulation of data and algorithms. We organize and transform information in order to solve problems using algorithms written in a modern object-oriented language. Topics include organization of data using objects and classes, and the description of processes using conditional control, iteration, methods and classes. We also begin the study of abstraction, self-reference, reuse, and performance analysis. While the choice of programming language and application area will vary in different offerings, the skills students develop will transfer equally well to more advanced study in many areas. In particular, this course is designed to provide the programming skills needed for further study in computer science and is expected to satisfy introductory programming requirements in other departments.

**Class Format:** lecture/laboratory

**Requirements/Evaluation:** weekly assignments, programming projects, and examinations

**Prerequisites:** none, except for the standard prerequisites for a (QFR) course; previous programming experience is not required

**Enrollment Limit:** 90(18/lab)

**Enrollment Preferences:** If the course is over-enrolled, enrollment will be determined by lottery

**Expected Class Size:** 90

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

**Unit Notes:** students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

**Distributions:** (D3) (QFR)

**Attributes:** BIGP Recommended Courses COGS Interdepartmental Electives

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**Fall 2019**

**LAB Section: 02** M 1:00 pm - 4:00 pm Martha J. Marvin

**LAB Section: 03** T 1:00 pm - 4:00 pm Martha J. Marvin

**LAB Section: 04** W 1:00 pm - 4:00 pm Martha J. Marvin

**LEC Section: 01** TR 9:55 am - 11:10 am Tim J. Lebestky, Shivon A. Robinson

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**CSCI 134 (F)(S) Introduction to Computer Science** (QFR)

This course introduces students to the science of computation by exploring the representation and manipulation of data and algorithms. We organize and transform information in order to solve problems using algorithms written in a modern object-oriented language. Topics include organization of data using objects and classes, and the description of processes using conditional control, iteration, methods and classes. We also begin the study of abstraction, self-reference, reuse, and performance analysis. While the choice of programming language and application area will vary in different offerings, the skills students develop will transfer equally well to more advanced study in many areas. In particular, this course is designed to provide the programming skills needed for further study in computer science and is expected to satisfy introductory programming requirements in other departments.

**Class Format:** lecture/laboratory

**Requirements/Evaluation:** weekly assignments, programming projects, and examinations

**Prerequisites:** none, except for the standard prerequisites for a (QFR) course; previous programming experience is not required

**Enrollment Limit:** 90(18/lab)

**Enrollment Preferences:** If the course is over-enrolled, enrollment will be determined by lottery

**Expected Class Size:** 90

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

**Unit Notes:** students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

**Distributions:** (D3) (QFR)

**Attributes:** BIGP Recommended Courses COGS Interdepartmental Electives

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**Fall 2019**

**LEC Section: 03** MWF 11:00 am - 11:50 am Jeannie R Albrecht

**LEC Section: 01** MWF 9:00 am - 9:50 am Thomas P. Murtagh

**LEC Section: 02** Cancelled
CSCI 361  (F)(S)  Theory of Computation  (QFR)

Cross-listings:  CSCI 361  MATH 361

Primary Cross-listing
This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory--the examination of what problems can be solved and what problems cannot be solved--and the study of complexity theory--the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: lecture

Requirements/Evaluation: evaluation will be based on problem sets, a midterm examination, and a final examination

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit:  30

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size:  30

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

Distributions:  (D3)  (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:
CSCI 361 (D3)  MATH 361 (D3)

Attributes:  COGS Interdepartmental Electives

Fall 2019
LEC Section:  01  MWF 11:00 am - 11:50 am  Aaron M. Williams

Spring 2020
LEC Section:  01  MWF 12:00 pm - 12:50 pm  Thomas P. Murtagh

CSCI 373  (S)  Artificial Intelligence  (QFR)

Artificial Intelligence (AI) has become part of everyday life, but what is it, and how does it work? This course introduces theories and computational techniques that serve as a foundation for the study of artificial intelligence. Potential topics include the following: Problem solving by search, Logic, Planning, Constraint satisfaction problems, Uncertainty and probabilistic reasoning, Bayesian networks, and Automated Learning.
**Class Format:** lecture/laboratory  

**Requirements/Evaluation:** several programming projects in the first half of the semester and a larger project spanning most of the second half of the semester; reading responses and discussion; midterm examination  

**Prerequisites:** CSCI 136 and (CSCI 256 or permission of instructor)  

**Enrollment Limit:** 24  

**Enrollment Preferences:** current or expected Computer Science majors  

**Expected Class Size:** 24  

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

**Distributions:** (D3) (QFR)  

**Attributes:** COGS Interdepartmental Electives  

Not offered current academic year

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**CSCI 374 (S) Machine Learning (QFR)**  

This tutorial examines the design, implementation, and analysis of machine learning algorithms. Machine Learning is a branch of Artificial Intelligence that aims to develop algorithms that will improve a system's performance. Improvement might involve acquiring new factual knowledge from data, learning to perform a new task, or learning to perform an old task more efficiently or effectively. This tutorial will cover examples of supervised learning algorithms (including decision tree learning, support vector machines, and neural networks), unsupervised learning algorithms (including k-means and expectation maximization), and possibly reinforcement learning algorithms (such as Q learning and temporal difference learning). It will also introduce methods for the evaluation of learning algorithms, as well as topics in computational learning theory.  

**Class Format:** This class will follow the meeting structure of a tutorial, with groups of three or four  

**Requirements/Evaluation:** evaluation will be based on presentations, problem sets, programming exercises, empirical analyses of algorithms, critical analysis of current literature  

**Prerequisites:** CSCI 136 and CSCI 256 or permission of instructor  

**Enrollment Limit:** 10  

**Enrollment Preferences:** Computer Science majors  

**Expected Class Size:** 10  

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

**Distributions:** (D3) (QFR)  

**Attributes:** COGS Interdepartmental Electives

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Spring 2020  

TUT Section: T1 TBA Andrea Danyluk

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**ENVI 216 (S) Philosophy of Animals**  

**Cross-listings:** ENVI 216 PHIL 216  

**Secondary Cross-listing**  

Animals are and always have been part of human life. To name just a few: We treat animals as companions, as food, as objects of wonder in the wild, as resources to be harvested, as testing grounds for science, and as religious sacrifice. The abstract philosophical question before us is, what are animals such that they can be all these things? In this course we aim to engage that abstract question through two more focused projects. Firstly, we will try to understand the mental lives of non-human animals. Secondly, we will try to make sense of the moral dimensions of our relationship to animals. Throughout we will to fuse a rigorous scientific perspective with more humanistic themes and philosophical inquiry. Topics include sentience, animal cognition, language in non-human animals, empathy and evolution, the history of domestication, animal rights, cross-cultural views on animals, arguments against and for vegetarianism and veganism, the morality of zoos, hunting and fishing, and pets and happiness.  

**Class Format:** seminar  

**Requirements/Evaluation:** four 4- to 5-page papers and one 10- to 12-page final paper  

**Prerequisites:** none
Enrollment Limit: 19

Enrollment Preferences: students with at least one previous philosophy course; there is no need to email the professor in advance to indicate interest in the course

Expected Class Size: 19

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:

ENVI 216 (D2) PHIL 216 (D2)

Attributes: COGS Interdepartmental Electives PHIL Contemp Metaphysics & Epistemology Courses

Not offered current academic year

MATH 361 (F)(S) Theory of Computation (QFR)

Cross-listings: CSCI 361 MATH 361

Secondary Cross-listing

This course introduces a formal framework for investigating both the computability and complexity of problems. We study several models of computation including finite automata, regular languages, context-free grammars, and Turing machines. These models provide a mathematical basis for the study of computability theory—the examination of what problems can be solved and what problems cannot be solved—and the study of complexity theory—the examination of how efficiently problems can be solved. Topics include the halting problem and the P versus NP problem.

Class Format: lecture

Requirements/Evaluation: evaluation will be based on problem sets, a midterm examination, and a final examination

Prerequisites: CSCI 256 or both a 300-level MATH course and permission of instructor

Enrollment Limit: 30

Enrollment Preferences: current or expected Computer Science majors

Expected Class Size: 30

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

Distributions: (D3) (QFR)

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

CSCI 361 (D3) MATH 361 (D3)

Attributes: COGS Interdepartmental Electives

Fall 2019
LEC Section: 01 MWF 11:00 am - 11:50 am Aaron M. Williams

Spring 2020
LEC Section: 01 MWF 12:00 pm - 12:50 pm Thomas P. Murtagh

NSCI 201 (F) Neuroscience

Cross-listings: BIOL 212 NSCI 201 PSYC 212

Primary Cross-listing

A study of the relationship between brain, mind, and behavior. Topics include a survey of the structure and function of the nervous system, basic neurophysiology, development, learning and memory, sensory and motor systems, consciousness and clinical disorders such as schizophrenia, autism, Parkinson's disease, and addiction. The laboratory focuses on current topics in neuroscience.

Class Format: lecture, three hours a week; laboratory, every other week

Requirements/Evaluation: a lab practical, lab reports, two hour exams and a final exam

Prerequisites: PSYC 101 or BIOL 101; open to first-year students only with permission of instructor
Enrollment Limit: 72
Enrollment Preferences: sophomores and Biology and Psychology majors
Expected Class Size: 72
Grading: yes pass/fail option, no fifth course option
Unit Notes: does not satisfy the distribution requirement for the Biology major
Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:
BIOL 212 (D3) NSCI 201 (D3) PSYC 212 (D3)
Attributes: COGS Interdepartmental Electives NSCI Required Courses PSYC 200-level Courses

Fall 2019
LAB Section: 03 T 1:00 pm - 4:00 pm Martha J. Marvin
LAB Section: 04 W 1:00 pm - 4:00 pm Martha J. Marvin
LEC Section: 01 TR 9:55 am - 11:10 am Tim J. Lebestky, Shivon A. Robinson
LAB Section: 02 M 1:00 pm - 4:00 pm Martha J. Marvin

PHIL 207 (S) Contemporary Philosophy of Mind
The philosophy of mind has been one of the liveliest and most active areas of philosophical inquiry over the last century, and it has taken a place at the center of the field. Part of the explanation for this is the rise of compelling scientific accounts of who and what we are. The question of whether the mind can be fully understood within a physicalist, materialist framework has taken on an exciting urgency. In this course we will investigate the mind/body problem, mental representation, the conceptual and nonconceptual content of mental states, and the nature of consciousness. Throughout we will attend to the relevant empirical literature.

Class Format: seminar
Requirements/Evaluation: weekly two page papers on focused topics and two 8- to 10-page papers
Prerequisites: at least one prior 100- or 200-level PHIL course
Enrollment Limit: 19
Enrollment Preferences: prospective Philosophy majors and Cognitive Science concentrators
Expected Class Size: 14
Grading: no pass/fail option, no fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PHIL Contemp Metaphysics & Epistemology Courses
Not offered current academic year

PHIL 216 (S) Philosophy of Animals
Cross-listings: ENVI 216 PHIL 216
Primary Cross-listing
Animals are and always have been part of human life. To name just a few: We treat animals as companions, as food, as objects of wonder in the wild, as resources to be harvested, as testing grounds for science, and as religious sacrifice. The abstract philosophical question before us is, what are animals such that they can be all these things? In this course we aim to engage that abstract question through two more focused projects. Firstly, we will try to understand the mental lives of non-human animals. Secondly, we will try to make sense of the moral dimensions of our relationship to animals. Throughout we will to fuse a rigorous scientific perspective with more humanistic themes and philosophical inquiry. Topics include sentience, animal cognition, language in non-human animals, empathy and evolution, the history of domestication, animal rights, cross-cultural views on animals, arguments against and for vegetarianism and veganism, the morality of zoos, hunting and fishing, and pets and happiness.

Class Format: seminar
Requirements/Evaluation: four 4- to 5-page papers and one 10- to 12-page final paper
Prerequisites: none
PHIL 288  (F)  Embodiment and Consciousness: A Cross-Cultural Exploration

Secondary Cross-listing

This course examines some of the central questions raised by the study of the consciousness: the place of intentionality, the role of emotions, the relation with the body, the nature of subjectivity, the scope of reflexivity, the nature of perceptual presence, etc. In confronting these difficult questions, we do not proceed purely theoretically but consider the contributions of various observation-based traditions, from Buddhist psychology and meditative practices to phenomenology to neurosciences. We begin by examining some of the central concepts of Buddhist psychology, its treatment of the mind as a selfless stream of consciousness, its examination of the variety of mental factors and its accounts of the relation between cognition and affects. We also introduce the practice of meditation as a way to observe the mind and raise questions concerning the place of its study in the mind-sciences. We pursue this reflection by examining the views of James, Husserl, Sartre and Merleau-Ponty, particularly as they concern the methods for the study of the mind and the relation between consciousness, reflexivity and the body. In this way, we develop a rich array of analytical tools and observational practices to further our understanding of the mind. But we also question the value of these tools based on first person approaches by relating them to the third person studies of the mind. In this way, we come to appreciate the importance of considering the biology on which mental processes are based and the light that this approach throws on the nature of consciousness. We conclude by considering the relation between first and third person studies of the mind, focusing on the concept of the embodied mind as a fruitful bridge between these different traditions.

Class Format: seminar

Requirements/Evaluation:  regular practice of meditation, a class presentation, a short essay (6-pages); a long final research paper (15 pages)

Prerequisites: any introduction to philosophy and at least two upper level courses in PHIL, at least one of which meets the Contemporary Metaphysics or Epistemology distribution requirement for the major, no exceptions;

Enrollment Limit:  18

Enrollment Preferences: Religion and Philosophy majors

Fall 2019

SEM Section: 01    M 7:00 pm - 9:40 pm     Georges B. Dreyfus

PHIL 388  (S)  Consciousness

The nature of consciousness remains a fundamental mystery of the universe. Our internal, felt experience--what chocolate tastes like to oneself, what
it is like to see the color red, or, more broadly, what it is like to have a first person, waking perspective at all—resists explanation in any terms other than the conscious experience itself in spite of centuries of intense effort by philosophers and, more recently, by scientists. As a result, some prominent researchers propose that the existence of consciousness requires a revision of basic physics, while others (seemingly desperately) deny that consciousness exists at all. Those positions remain extreme, but the challenge that consciousness poses is dramatic. It is at the same time the most intimately known fact of our humanity and science's most elusive puzzle. In this tutorial we will read the contemporary literature on consciousness. We will concentrate both on making precise the philosophical problem of consciousness and on understanding the role of the relevant neuroscientific and cognitive research. Tutorial partners will have an opportunity to spend the end of the semester working on a special topic of their choosing including, for instance, consciousness and free will, pain and anesthesia, consciousness and artificial intelligence, or disorders of consciousness.

**Class Format:** tutorial; expect several short lectures by the instructor over the course of the semester where all the tutorial members convene

**Requirements/Evaluation:** participants will present substantial written work in the tutorial every other week, and will be responsible for commenting on their tutorial partner's work on off weeks

**Prerequisites:** any introduction to philosophy and at least two upper level courses in PHIL, at least one of which meets the Contemporary Metaphysics or Epistemology distribution requirement for the major, no exceptions; no need to email the professor in advance

**Enrollment Limit:** 10

**Enrollment Preferences:** Philosophy majors, Neuroscience or Cognitive Science concentrators; open to sophomores; every effort will be made to pair students according to similar or complementary background

**Expected Class Size:** 10

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

**Distributions:** (D2)

**Attributes:** COGS Interdepartmental Electives PHIL Contemp Metaphysics & Epistemology Courses

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**PSYC 212 (F) Neuroscience**

**Cross-listings:** BIOL 212 NSCI 201 PSYC 212

**Secondary Cross-listing**

A study of the relationship between brain, mind, and behavior. Topics include a survey of the structure and function of the nervous system, basic neurophysiology, development, learning and memory, sensory and motor systems, consciousness and clinical disorders such as schizophrenia, autism, Parkinson's disease, and addiction. The laboratory focuses on current topics in neuroscience.

**Class Format:** lecture, three hours a week; laboratory, every other week

**Requirements/Evaluation:** a lab practical, lab reports, two hour exams and a final exam

**Prerequisites:** PSY 101 or BIOL 101; open to first-year students only with permission of instructor

**Enrollment Limit:** 72

**Enrollment Preferences:** sophomores and Biology and Psychology majors

**Expected Class Size:** 72

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

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3)

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

BIOL 212 (D3) NSCI 201 (D3) PSYC 212 (D3)

**Attributes:** COGS Interdepartmental Electives NSCI Required Courses PSYC 200-level Courses

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Fall 2019

LAB Section: 04  W 1:00 pm - 4:00 pm  Martha J. Marvin

LAB Section: 03  T 1:00 pm - 4:00 pm  Martha J. Marvin

LEC Section: 01  TR 9:55 am - 11:10 am  Tim J. Lebestky, Shivon A. Robinson
PSYC 221 (S) Cognitive Psychology
This course surveys current research on human cognition. Topics include perception, attention, learning, education, memory, psychology and law, categorization, language, judgment, decision making, reasoning, intelligence, problem solving, and consciousness.

Class Format: lecture
Requirements/Evaluation: three midterms, a cumulative final exam, two short essays, and weekly quizzes
Prerequisites: PSYC 101 or permission of instructor
Enrollment Limit: 50
Enrollment Preferences: Psychology majors
Expected Class Size: 50
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PSYC 200-level Courses

Spring 2020
LEC Section: 01 MWF 9:00 am - 9:50 am Nate Kornell

PSYC 322 (S) Concepts: Mind, Brain, and Culture
Every time we see something as a kind of thing, every time that we decide that an object is a cup rather than a glass, when we recognize a picture of a familiar face as a picture of ourselves, or even when we understand speech, we are employing categories. Most categorization decisions are automatic and unconscious, and therefore have the illusion of simplicity. The complexity of these decisions, however, becomes apparent when we attempt to build machines to do what humans perform so effortlessly. What are the systems in place that allow us this extraordinary ability to segment the world? Are they universal? How does conceptual knowledge differ across cultural groups? How do concepts affect our perception? How do the categories of experts differ from the categories of novices? Do children have the same kind of conceptual knowledge as adults? How are categories represented in the brain? In this course, we explore various empirical findings from cognitive psychology, cognitive neuroscience, and anthropology that address these questions.

Class Format: empirical lab course
Requirements/Evaluation: short papers, class presentation, and research paper
Prerequisites: PSYC 221 or 222 or permission of instructor
Enrollment Limit: 16
Enrollment Preferences: Psychology majors and Cognitive Science concentrators
Expected Class Size: 16
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology PSYC Empirical Lab Course

Spring 2020
LAB Section: 02 W 1:00 pm - 4:00 pm Safa R. Zaki
SEM Section: 01 TR 11:20 am - 12:35 pm Safa R. Zaki

PSYC 324 (S) Great Debates in Cognition
The field of cognition is filled with controversies about how the mind really works. For example, is there sufficient evidence for a system in vision that can become aware of things without actually "seeing" them? Is it necessary to assume that babies come into the world armed with innate linguistic knowledge? Are humans inherently rational? Can we make inference about the mind using neuroimaging? These debates, and others that we will consider, help fuel scientific discovery in cognition in interesting ways. In this class, we will consider some of these contemporary debates, weigh
evidence on both sides, and discuss the implications for what we know about the mind.

Class Format: tutorial; students will meet in pairs with the instructor for an hour each week
Requirements/Evaluation: evaluation will be based on weekly papers and oral arguments
Prerequisites: PSYC 221 or 222 or permission of instructor
Enrollment Limit: 10
Enrollment Preferences: Psychology majors and Cognitive Science concentrators
Expected Class Size: 10
Grading: no pass/fail option, no fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology
Not offered current academic year

PSYC 326  (S)  Choice and Decision Making
One aspect of “being human” is that we often make choices that we know are bad for us. In this course we survey theoretical and experimental approaches to understanding our strengths and weaknesses as decision makers. Topics include normative decision theories, biases in probability judgments, “fast and frugal” heuristics, impulsiveness and self-control, addictions and bad habits, gambling, and moral decision making.

Class Format: empirical lab course
Requirements/Evaluation: problem sets, essay papers, class and lab participation, and a research report
Prerequisites: PSYC 221 or 222 or permission of instructor; permission is typically given to students who have successfully completed ECON 110
Enrollment Limit: 16
Enrollment Preferences: senior Psychology majors who need the course to fulfill the major
Expected Class Size: 16
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PHLH Decision-Making by Institutions + Individuals PSYC Area 2 - Cognitive Psychology PSYC Empirical Lab Course

Spring 2020
LAB Section: 02  Cancelled
SEM Section: 01  Cancelled

PSYC 327  (F)  Cognition and Education
This class will focus on basic research into the cognitive processes underlying learning. How does the mind encode, store, and retrieve knowledge? How do learners (and teachers) manage their own learning? How do educational practices depart from what research recommends? The readings will be scientific articles. Students will do original research.

Class Format: empirical lab
Requirements/Evaluation: class participation, daily quizzes, research papers
Prerequisites: PSYC 201 and PSYC 221 or 222, or permission of instructor
Enrollment Limit: 16
Enrollment Preferences: Psychology majors
Expected Class Size: 12
Grading: yes pass/fail option, yes fifth course option
Distributions: (D2)
Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology PSYC Empirical Lab Course TEAC Teaching Sequence

Courses
REL 288 (F) Embodiment and Consciousness: A Cross-Cultural Exploration

Cross-listings: PHIL 288 REL 288

Primary Cross-listing

This course examines some of the central questions raised by the study of the consciousness: the place of intentionality, the role of emotions, the relation with the body, the nature of subjectivity, the scope of reflexivity, the nature of perceptual presence, etc. In confronting these difficult questions, we do not proceed purely theoretically but consider the contributions of various observation-based traditions, from Buddhist psychology and meditative practices to phenomenology to neurosciences. We begin by examining some of the central concepts of Buddhist psychology, its treatment of the mind as a selfless stream of consciousness, its examination of the variety of mental factors and its accounts of the relation between cognition and affects. We also introduce the practice of meditation as a way to observe the mind and raise questions concerning the place of its study in the mind-sciences. We pursue this reflection by examining the views of James, Husserl, Sartre and Merleau-Ponty, particularly as they concern the methods for the study of the mind and the relation between consciousness, reflexivity and the body. In this way, we develop a rich array of analytical tools and observational practices to further our understanding of the mind. But we also question the value of these tools based on first person approaches by relating them to the third person studies of the mind. In this way, we come to appreciate the importance of considering the biology on which mental processes are based and the light that this approach throws on the nature of consciousness. We conclude by considering the relation between first and third person studies of the mind, focusing on the concept of the embodied mind as a fruitful bridge between these different traditions.

Class Format: seminar

Requirements/Evaluation: regular practice of meditation, a class presentation, a short essay (6-pages); a long final research paper (15 pages)

Prerequisites: any introduction to philosophy and at least two upper level courses in PHIL, at least one of which meets the Contemporary Metaphysics or Epistemology distribution requirement for the major, no exceptions;

Enrollment Limit: 18

Enrollment Preferences: Religion and Philosophy majors

Expected Class Size: 18

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

Unit Notes: there is no need to email the professor in advance to indicate interest in the course

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:
PHIL 288 (D2) REL 288 (D2)

Attributes: COGS Interdepartmental Electives PHIL Contemp Metaphysics & Epistemology Courses

Fall 2019

SEM Section: 01 M 7:00 pm - 9:40 pm Georges B. Dreyfus

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COGS Related Courses

BIOL 305 (S) Evolution (QFR)

This course offers a critical analysis of contemporary concepts in biological evolution. We focus on the relation of evolutionary mechanisms (e.g., selection, drift, and migration) to long term evolutionary patterns (e.g., evolutionary innovations, origin of major groups, and the emergence of diversity). Topics include micro-evolutionary models, natural selection and adaptation, sexual selection, speciation, the inference of evolutionary history among others.

Class Format: lecture/discussion/laboratory, six hours per week

Requirements/Evaluation: evaluation will be based on independent research project, problem sets, participation in discussions and exams

Prerequisites: BIOL 202

Enrollment Limit: 24

Enrollment Preferences: Seniors and biology majors
Expected Class Size: 24
Grading: yes pass/fail option, yes fifth course option
Unit Notes: satisfies the distribution requirement for the Biology major
Distributions: (D3) (QFR)
Attributes: BIGP Recommended Courses  BIMO Interdepartmental Electives  COGS Related Courses

Spring 2020
LAB Section: 02  T 1:00 pm - 4:00 pm  Luana S. Maroja
LAB Section: 03  R 1:00 pm - 4:00 pm  Luana S. Maroja
LEC Section: 01  MWF 10:00 am - 10:50 am  Luana S. Maroja

MATH 250  (F)(S) Linear Algebra  (QFR)
Many social, political, economic, biological, and physical phenomena can be described, at least approximately, by linear relations. In the study of systems of linear equations one may ask: When does a solution exist? When is it unique? How does one find it? How can one interpret it geometrically? This course develops the theoretical structure underlying answers to these and other questions and includes the study of matrices, vector spaces, linear independence and bases, linear transformations, determinants and inner products. Course work is balanced between theoretical and computational, with attention to improving mathematical style and sophistication.

Class Format: lecture
Requirements/Evaluation: evaluation will be based primarily on homework and exams
Prerequisites: MATH 150/151 or MATH 200
Enrollment Limit: 45
Expected Class Size: 35
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Attributes: COGS Related Courses

Fall 2019
LEC Section: 01  TR 9:55 am - 11:10 am  Eva Goedhart
LEC Section: 02  TR 11:20 am - 12:35 pm  Eva Goedhart

Spring 2020
LEC Section: 02  TR 11:20 am - 12:35 pm  Haydee M. A. Lindo
LEC Section: 01  TR 9:55 am - 11:10 am  Haydee M. A. Lindo

PHIL 209  (S) Philosophy of Science
Cross-listings: SCST 209  PHIL 209
Primary Cross-listing
It is a generally held belief, in our time and culture, that science is the best source of our knowledge of the world, and of ourselves. The aim of this course is to examine the origins, grounds, and nature of this belief. We will analyze and discuss various accounts of scientific method, structure and justification of scientific theories, scientific choice, change, and the idea that scientific knowledge is progressive. The course will begin with the "received view" of science, advanced by logical empiricists, which assumes the objectivity and the rationality of science. We will then discuss philosophies of science which emerged out of various criticisms of this view - especially those of Popper, Lakatos, Kuhn and Feyerabend - and the challenges to the assumptions of scientific objectivity and rationality their works provoked. This discussion will naturally lead us to the relativist and social-constructivist views developed within contemporary science studies. Finally, we will analyze the current debate about cognitive credentials of science and proper approach to the study of science, which came to be known as "the science wars."

Class Format: seminar with a short lecture component in each class
Requirements/Evaluation: class attendance, preparedness and participation; three short assignments; three 5 pages long papers, the last of which
will be the final paper, due a week after the end of classes

**Prerequisites:** one PHIL course, or declared major in a natural science, or permission of instructor

**Enrollment Limit:** 19

**Enrollment Preferences:** Philosophy majors and prospective majors

**Expected Class Size:** 10-15

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

**Distributions:** (D2)

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

SCST 209 (D2) PHIL 209 (D2)

**Attributes:** COGS Related Courses  HSCI Interdepartmental Electives  PHIL Contemp Metaphysics & Epistemology Courses

*Not offered current academic year*

**PSYC 201 (F)(S) Experimentation and Statistics (QFR)**

An introduction to the basic principles of research in psychology. We focus on how to design and execute experiments, analyze and interpret results, and write research reports. Students conduct a series of research studies in different areas of psychology that illustrate basic designs and methods of analysis.

**Class Format:** lecture/lab

**Requirements/Evaluation:** papers, exams, and problem sets

**Extra Info:** two sections; must register for the lab and lecture with the same instructor

**Prerequisites:** PSYC 101; not open to first-year students except with permission of instructor

**Enrollment Limit:** 16

**Enrollment Preferences:** Psychology majors

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

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

**Attributes:** COGS Related Courses  PHLH Statistics Courses

Fall 2019

LEC Section: A1  TF 2:35 pm - 3:50 pm  Jeremy D. Cone

LAB Section: B2  W 1:00 pm - 4:00 pm  Kenneth K. Savitsky

LEC Section: B1  TR 9:55 am - 11:10 am  Kenneth K. Savitsky

LAB Section: A2  W 1:00 pm - 4:00 pm  Jeremy D. Cone

Spring 2020

LAB Section: A2  W 1:00 pm - 3:40 pm  Kenneth K. Savitsky

LEC Section: A1  MR 1:10 pm - 2:25 pm  Kenneth K. Savitsky

LAB Section: B2  Cancelled

LEC Section: B1  Cancelled

LAB Section: C2  T 1:00 pm - 4:00 pm  Kris N. Kirby

LEC Section: C1  MR 1:10 pm - 2:25 pm  Kris N. Kirby

**SCST 209 (S) Philosophy of Science**

**Cross-listings:** SCST 209 PHIL 209

**Secondary Cross-listing**

It is a generally held belief, in our time and culture, that science is the best source of our knowledge of the world, and of ourselves. The aim of this course is to examine the origins, grounds, and nature of this belief. We will analyze and discuss various accounts of scientific method, structure and justification of scientific theories, scientific choice, change, and the idea that scientific knowledge is progressive. The course will begin with the
"received view" of science, advanced by logical empiricists, which assumes the objectivity and the rationality of science. We will then discuss philosophies of science which emerged out of various criticisms of this view - especially those of Popper, Lakatos, Kuhn and Feyerabend - and the challenges to the assumptions of scientific objectivity and rationality their works provoked. This discussion will naturally lead us to the relativist and social-constructivist views developed within contemporary science studies. Finally, we will analyze the current debate about cognitive credentials of science and proper approach to the study of science, which came to be known as "the science wars."

Class Format: seminar with a short lecture component in each class

Requirements/Evaluation: class attendance, preparedness and participation; three short assignments; three 5 pages long papers, the last of which will be the final paper, due a week after the end of classes

Prerequisites: one PHIL course, or declared major in a natural science, or permission of instructor

Enrollment Limit: 19

Enrollment Preferences: Philosophy majors and prospective majors

Expected Class Size: 10-15

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

Distributions: (D2)

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

SCST 209 (D2) PHIL 209 (D2)

Attributes: COGS Related Courses HSCI Interdepartmental Electives PHIL Contemp Metaphysics & Epistemology Courses

Not offered current academic year

STAT 101 (F)(S) Elementary Statistics and Data Analysis (QFR)

It is impossible to be an informed citizen in the world today without an understanding of data and information. Whether opinion polls, unemployment rates, salary differences between men and women, the efficacy of vaccines or consumer webdata, we need to be able to separate the signal from the noise. We will learn the statistical methods used to analyze and interpret data from a wide variety of sources. The goal of the course is to help reach conclusions and make informed decisions based on data.

Class Format: lecture

Requirements/Evaluation: based primarily on performances on quizzes and exams

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)

Enrollment Limit: 50

Expected Class Size: 40

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

Unit Notes: students with calculus background and social science interest should consider STAT 161; students with MATH 150 should enroll in STAT 201; students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stat should consult the department

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses COGS Related Courses PHLH Statistics Courses

Fall 2019
LEC Section: 01 TF 2:35 pm - 3:50 pm Elizabeth M. Upton

Spring 2020
LEC Section: 01 TR 9:55 am - 11:10 am Elizabeth M. Upton
LEC Section: 02 TR 11:20 am - 12:35 pm Elizabeth M. Upton

STAT 201 (F)(S) Statistics and Data Analysis (QFR)

Statistics can be viewed as the art and science of turning data into information. Real world decision-making, whether in business or science is often based on data and the perceived information it contains. Sherlock Holmes, when prematurely asked the merits of a case by Dr. Watson, snapped back, "Data, data, data! I can’t make bricks without clay." In this course, we will study the basic methods by which statisticians attempt to extract information from data. These will include many of the standard tools of statistical inference such as hypothesis testing, confidence intervals, and linear
regression as well as exploratory and graphical data analysis techniques. This is an accelerated introductory statistics course that involves computational programming and incorporates modern statistical techniques.

Class Format: lecture

Requirements/Evaluation: based primarily on performance on quizzes and exams

Prerequisites: MATH 150 or equivalent; not open to students who have completed STAT 101 or STAT 161 or equivalent

Enrollment Limit: 40

Expected Class Size: 40

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

Unit Notes: students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stats should consult the department; students with MATH 130/140 background should consider STAT 161; students with no calc. should consider STAT 101

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses COGS Related Courses EVST Methods Courses PHLH Statistics Courses

Fall 2019
LEC Section: 01 TR 9:55 am - 11:10 am Shaoyang Ning
LEC Section: 02 TR 11:20 am - 12:35 pm Shaoyang Ning

Spring 2020
LEC Section: 01 TR 8:30 am - 9:45 am Stewart D. Johnson
LEC Section: 02 TR 9:55 am - 11:10 am Stewart D. Johnson

STAT 344 (F) Statistical Design of Experiments (QFR)

What does statistics have to do with designing and carrying out experiments? The answer is, surprisingly perhaps, a great deal. In this course, we will study how to design experiments with the fewest number of observations possible that are still capable of understanding which factors influence the results. After reviewing basic statistical theory and two sample comparisons, we cover one and two-way ANOVA and (fractional) factorial designs extensively. The culmination of the course will be a project where each student designs, carries out, analyzes, and presents an experiment of interest to him or her. Throughout the course, we will use both the statistics program R and the package JMP to carry out the statistical analyses.

Class Format: lecture

Requirements/Evaluation: problem sets, midterm, final exam, project

Prerequisites: STAT 201, 202, or equivalent

Enrollment Limit: 20

Enrollment Preferences: Statistics majors, seniors

Expected Class Size: 15

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

Distributions: (D3) (QFR)

Attributes: COGS Related Courses

Not offered current academic year

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