

COGNITIVE SCIENCE

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Cognitive Science is the cross-disciplinary study of how the mind works, with a focus on perception, reasoning, memory, attention, language, decision-making, motor control, and problem solving. Cognitive scientists often compare minds to computers. In particular, they describe mental processes as computational operations on internal representations. For instance, perception is seen as a representation of the external world that results from sensory stimulation; learning is analyzed as the addition of new representations through interactions with the environment; reasoning is treated as the addition of new representations through operations on existing representations.

Cognitive Science is an interdisciplinary field: it draws on tools and ideas from psychology, neuroscience, linguistics, economics, computer science, and philosophy, with affiliated faculty in each of these disciplines. Psychologists study the computational operations that we use to solve specific tasks; neuroscientists study the implementation of those operations in the brain; linguists study the representations involved in communication; economists study the representations involved in decisions involving uncertainty and reward; computer scientists consider how the processes involved in human cognition fit into a more general theory of computations and a larger space of tasks; and philosophers ask fundamental questions about the nature of representation and computation.

Learning Objectives

Cognitive Science majors will gain fluency in computational methods; a capacity for rigorous and careful thought; a broad understanding of the affiliated disciplines; and a deep understanding of cognition.

Barnard Director: Professor John Morrison (Philosophy, Barnard)
Columbia Director: Professor Mariusz S. Kozak (Music, Columbia)

Steering Committee:

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Alex White (Neuroscience and Behavior, Barnard)
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Cognitive science is the cross-disciplinary study of how the mind works, with a focus on perception, reasoning, memory, attention, language, decision-making, motor control, and problem solving. It draws on tools and ideas from psychology, neuroscience, linguistics, economics, computer science, and philosophy. The major requirements are designed to provide breadth in the affiliated disciplines and depth in the student's chosen area of specialization.

A major in Cognitive Science consists of seven required courses and four electives in a chosen area of specialization culminating in the senior capstone. The minimum number of courses is 13 and the minimum number of points is 39.

Required courses (7 classes)

- COGS UN1001 Introduction to Cognitive Science Introduction to Cognitive Science
- One course in each of four areas: psychology, neuroscience, philosophy, and linguistics.
- Two courses in a fifth area: mathematical and computational methods. These two courses must be selected in consultation with the program director to make sure they aren't redundant.
- Please see below for the lists of approved courses in each area.

Area of Specialization and Electives (four classes)

Students must choose an area of specialization when they declare the major and choose four electives to build expertise in that area.

- Possible areas of specialization include: aesthetics, cognitive development, cognitive linguistics, cognitive neuroscience, cognitive psychology, computer vision, consciousness, decision science, human-computer interaction, intelligence, learning, memory, natural language processing, neuroeconomics, perception, and social cognition.
- The choice of specialization is flexible; there is not a predefined list. This is an opportunity for students to be creative; a student who has

ideas about a new specialization that they would like to pursue may do so with the approval of the program director.

- Although there is no predefined list, each student's area of specialization and choice of electives must be approved by the program director, and there must be at least one faculty member affiliated with the program who has expertise in the student's chosen area.
- The program director will consult with a faculty member who has expertise in the student's area of specialization to ensure that the student's electives will provide sufficient preparation for the senior project.
- Please see below for a list of courses that students might want to consider as possible electives (depending upon their specialization), but please note that this list is not definitive. Any Barnard or Columbia (or approved transfer) course that builds expertise in the student's area of specialization may be counted as an elective with the approval of the program director.

Senior Capstone

Students may fulfill the Senior Capstone requirement in two ways: with a year-long senior project, or by taking two additional advanced courses.

- The senior project is a year-long project in a student's area of specialization under the supervision of a chosen advisor. The project could be an experiment or a paper.
 - Students who do senior projects must register for both COGS UN3903 Senior Project (3 points) and COGS UN3901 Senior Project Seminar (1 point) in the fall and COGS UN3904 Senior Project (3 points) and COGS UN3902 Senior Project Seminar (1 point) in the spring (8 points total).
- The Senior Project Seminar is an opportunity for students to present their projects to each other.
- While a year-long project is recommended, students may also satisfy the senior capstone requirement by taking two advanced courses, at least one of which must include a significant paper or project. The courses must be chosen in consultation with the program director and must be related to the student's area of specialization. Both courses should be at the 3000-level or above.

Courses approved to count in each area:

Psychology

PSYC BC2107	PSYCHOLOGY OF LEARNING - LEC
PSYC BC2110	PERCEPTION-LECTURE
PSYC BC2115	COGNITIVE PSYCHOLOGY - LEC
PSYC UN2210	COGNITION: BASIC PROCESSES
PSYC UN2220	COGNITION: MEMORY AND STRESS
PSYC UN2270	Perception and Cognition in Social Life
PSYC UN2430	COGNITIVE NEUROSCIENCE
PSYC BC3394	METACOGNITION

Please note that PSYC UN2430 Cognitive Neuroscience may be used to fulfill either the Neuroscience requirement or the Psychology requirement, but not both.

Neuroscience

NSBV BC1001	INTRODUCTION TO NEUROSCIENCE
NSBV BC2008	ADAPTIVE OR ARRESTED DEVELOPMENT OF THE ADOLESCENT BRAIN
PSYC UN2430	COGNITIVE NEUROSCIENCE
PSYC UN2435	Social Neuroscience
PSYC UN2450	BEHAVIORAL NEUROSCIENCE
PSYC UN2481	Developmental Cognitive Neuroscience
NSBV BC3381	Visual Neuroscience: From the Eyeball to the Mind's Eye

Please note that PSYC UN2430 Cognitive Neuroscience may be used to fulfill either the Neuroscience requirement or the Psychology requirement, but not both.

Philosophy

PHIL UN2655	COGNITIVE SCIENCE AND PHILOSOPHY
PHIL UN3252	Philosophy of Language and Mind
PHIL UN3651	
PHIL UN3655	TOPICS IN COGNITIVE SCIENCE AND PHILOSOPHY
PHIL UN3912	SEMINAR

Please note that only the "Perception" section of PHIL UN3912 counts.

Linguistics

LING UN3101	INTRODUCTION TO LINGUISTICS
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Mathematical and Computational Methods

Logic and Decision Theory:

ECON GU4850	COGNITIVE MECH # ECON BEHAVIOR
PHIL UN1401	INTRODUCTION TO LOGIC
PHIL UN3411	SYMBOLIC LOGIC
PHIL GU4561	PROBABILITY # DECISION THEORY
PSYC UN2235	THINKING AND DECISION MAKING

Statistics:

ECON BC1007	MATH METHODS FOR ECONOMICS
ECON BC2411	STATISTICS FOR ECONOMICS
PSYC BC1101	STATISTICS LECTURE AND RECITATION
PSYC UN1610	STATISTICS-BEHAVIORAL SCIENTISTS
STAT UN1001	INTRO TO STATISTICAL REASONING
STAT UN1101	INTRODUCTION TO STATISTICS
STAT UN1201	CALC-BASED INTRO TO STATISTICS

Computer Science:

COMS BC1016	Introduction to Computational Thinking and Data Science
COMS W1001	Introduction to Information Science
COMS W1002	COMPUTING IN CONTEXT
COMS W1004	Introduction to Computer Science and Programming in Java
COMS W1007	Honors Introduction to Computer Science

COMS W3134	Data Structures in Java
COMS W3136	ESSENTIAL DATA STRUCTURES
COMS W3137	HONORS DATA STRUCTURES # ALGOL
ENGI E1006	INTRO TO COMP FOR ENG/APP SCI
STEM BC2223	PROGRAMMING BEHAV SCIENCES

Possible electives:

Please note that the list of possible electives below is just to give students ideas. Whether or not a student can count a particular course as an elective depends upon the student's area of specialization. Any course that builds expertise in the student's area of specialization may be counted as an elective with the program director's approval, regardless of whether it is listed below; a course that does not build expertise in the student's area of specialization may not be counted as an elective even if it is listed below.

ANTH UN1009	INTRO TO LANGUAGE # CULTURE
COGS GU4050	Natural and Artificial Neural Networks
COGS GU4051	Natural and Artificial Neural Networks Lab
COGS GU4800	Resource-Constrained Decision Making
COMS W4170	USER INTERFACE DESIGN
COMS W4701	ARTIFICIAL INTELLIGENCE
COMS W4705	NATURAL LANGUAGE PROCESSING
COMS W4731	Computer Vision I: First Principles
COMS W4771	MACHINE LEARNING
COMS W4772	ADVANCED MACHINE LEARNING
CPLS GU4510	The Mind Between Literature and the Brain
ECON GU4020	ECON OF UNCERTAINTY # INFORMTN
ECON GU4840	BEHAVIORAL ECONOMICS
ECON GU4860	BEHAVIORAL FINANCE
LING GU4202	COGNITIVE LINGUISTICS
LING GU4206	ADV GRAMMAR AND GRAMMARS
LING GU4376	PHONETICS # PHONOLOGY
LING GU4903	SYNTAX
MUSI UN2320	Introduction to Music Cognition
MUSI GU4325	Topics in Music Cognition
PHIL UN2685	INTRO TO PHIL OF LANGUAGE
PHIL UN3685	PHILOSOPHY OF LANGUAGE
PHIL UN3840	The Nature and Significance of Animal Minds
PHIL GU4495	PERCEPTION
PHIL GU4660	PHILOSOPHY OF MIND
PSYC BC2129	DEVELOPMENTAL PSYCHOLOGY-LEC
PSYC BC2163	Human Learning and Memory
PSYC BC3164	PERCEPTION AND LANGUAGE
PSYC BC3369	Language Development
PSYC BC3372	Comparative Cognition
PSYC BC3381	Theory of Mind and Intentionality
PSYC BC3384	Social Cognition
PSYC BC3390	CANINE COGNITION
PSYC BC3399	HUMAN AND MACHINES
PSYC UN2250	Evolution of Cognition
PSYC UN2280	Developmental Psychology
PSYC UN3270	COMPUT APPROACHES-HUMAN VISION
PSYC UN3290	Self: A Cognitive Exploration (Seminar)

PSYC UN3445	THE BRAIN AND MEMORY
PSYC UN3450	Evolution of Intelligence, Animal Communication, # Language
PSYC GU4202	Theories of Change in Human Development
PSYC GU4222	The Cognitive Neuroscience of Aging (Seminar)
PSYC GU4223	MEMORY # EXEC FUNCT:LIFESPAN
PSYC GU4225	CONSCIOUSNESS # ATTENTION
PSYC GU4229	ATTENTION AND PERCEPTION
PSYC GU4239	COG NEURO NARRATIVE FILM
PSYC GU4242	Evolution of Language (seminar)
PSYC GU4244	LANGUAGE AND MIND
PSYC GU4270	COGNITIVE PROCESSES
PSYC GU4280	CORE KNOWLEDGE
PSYC GU4281	The Psychology of Curiosity
PSYC GU4287	DECISION ARCHITECTURE
PSYC GU4289	THE GAMES PEOPLE PLAY:PSYCH OF STRAT DEC
PSYC GU4430	Learning and the Brain (Seminar)
PSYC GU4435	NON-MNEMONIC FUNC OF MEMORY SYSTEMS
SOAR AV4000	SOUND:Music, Math, and Mind

Required Courses

Required for all Cognitive Science majors:

COGS UN1001 Introduction to Cognitive Science. 3 points.

Required for Cognitive Science majors doing senior projects:

COGS UN3901 Senior Project Seminar. 1.00 point.

Discussion of senior research projects during the fall and spring terms that culminate in written and oral senior theses. Each project must be supervised by a cognitive scientist working at Barnard or Columbia

COGS UN3902 Senior Project Seminar. 1.00 point.

Discussion of senior research projects during the fall and spring terms that culminate in written and oral senior theses. Each project must be supervised by a cognitive scientist working at Barnard or Columbia

COGS UN3903 Senior Project. 3.00 points.

Senior Project in Cognitive Science

COGS UN3904 Senior Project. 3.00 points.

Senior Project in Cognitive Science

Psychology:

PSYC BC2107 PSYCHOLOGY OF LEARNING - LEC. 3.00 points.

Prerequisites: BC1001 Introduction of Psychology or permission of the instructor. Enrollment limited to 72 students.

Prerequisites: PSYC BC1001 Introduction to Psychology or COGS UN1001 Introduction to Cognitive Science or permission of the instructor.

Lecture course covering the basic methods, results, and theory in the study of how experience affects behavior. The roles of early exposure, habitation, sensitization, conditioning, imitation, and memory in the acquisition and performance of behavior are studied. The following Columbia University course is considered overlapping and a student cannot receive credit for both the BC course and the equivalent CU course: PSYC UN1440 Experimental: Learning and Motivation

PSYC BC2110 PERCEPTION-LECTURE. 3.00 points.

Prerequisites: PSYC BC1001 Introduction to Psychology or COGS UN1001 Introduction to Cognitive Science or permission of the instructor. Lecture course covering an introduction to problems, methods, and research in perception. Discussion of psychological studies of seeing, hearing, touching, tasting, and smelling. Note that this lecture can be taken without its affiliated lab, PSYC BC2109, however, if a student completes this lecture, she cannot enroll in the lab in a later semester. The following Columbia University course is considered overlapping and a student cannot receive credit for both the BC course and the equivalent CU course: PSYC UN1480 Perception and Attention; and PSYC UN2230 Perception and Sensory Processes

PSYC BC2115 COGNITIVE PSYCHOLOGY - LEC. 3.00 points.

Prerequisites: BC1001 or permission of the instructor.

Prerequisites: PSYC BC1001 Introduction to Psychology or COGS UN1001 Introduction to Cognitive Science or permission of the instructor. Lecture covering selected topics illustrating the methods, findings, and theories of contemporary cognitive psychology. Topics include attention, memory, categorization, perception, and decision making. Special topics include neuropsychology and cognitive neuroscience. Note that this lecture can be taken without its affiliated lab, PSYC BC2114, however, if a student completes this lecture, she cannot enroll in the lab in a later semester. The following Columbia University courses are considered overlapping and a student cannot receive credit for both the BC course and the equivalent CU course: PSYC UN2220 Cognition: Memory and Stress; and PSYC UN2210 Cognition: Basic Processes

PSYC UN2210 COGNITION: BASIC PROCESSES. 3.00 points.**PSYC UN2220 COGNITION: MEMORY AND STRESS. 3.00 points.**

CC/GS: Partial Fulfillment of Science Requirement
Attendance at the first class is mandatory.

Prerequisites: PSYC UN1001 or PSYC UN1010 or the instructor's permission.

Prerequisites: PSYC UN1001 or PSYC UN1010 or the instructors permission. Memory, attention, and stress in human cognition

PSYC UN2270 Perception and Cognition in Social Life. 3.00 points.

This course focuses on perception and cognition in social life. We start by addressing the core social motivations we experience in everyday life (e.g., our desire to feel like we belong to a group). Next, we examine how these motivations shape our basic sensory experiences—for example why we can't help but anthropomorphize inanimate objects or enjoy holding hands with our partner. We then examine the mental strategies we use to meet our social needs, such as how we figure out other people's thoughts and feelings, as well as our own. Finally, we wrap up by examining how these motivations, perceptions, and cognitions play out not just within one mind – but also between minds in everyday social interaction. This course will not only teach you the fundamental science behind the social mind. It will also let you see your own social life through a whole new lens

PSYC UN2430 COGNITIVE NEUROSCIENCE. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 or equivalent introductory course in Psychology

Prerequisites: PSYC UN1001 or equivalent introductory course in Psychology This course provides an in-depth survey of data and models of a wide variety of human cognitive functions. Drawing on behavioral, neuropsychological, and neuroimaging research, the course explores the neural mechanisms underlying complex cognitive processes, such as perception, memory, and decision making. Importantly, the course examines the logic and assumptions that permit us to interpret brain activity in psychological terms

PSYC BC3394 METACOGNITION. 4.00 points.

Prerequisites: BC1001, and one psychology laboratory course; final enrollment determined on the first day of class Metacognition is one of the latest psychological buzzwords, but what exactly is metacognition? Metacognition enables us to be successful learners, problem solvers, and decision makers, and as often been used synonymously with words such as language, awareness, and consciousness. In this seminar, we will examine various components of metacognition, including its role in learning and memory, and its existence in various non-human populations. In addition, we will explore the fragility of metacognition, including illusions of confidence and harmful control strategies that people use. Readings will include classic and important recent papers in the field, looking at metacognition as a higher-level cognitive process, and as knowledge individuals use to guide behavior

Please note that PSYC UN2430 Cognitive Neuroscience may be used to fulfill either the Neuroscience requirement or the Psychology requirement, but not both.

Neuroscience**NSBV BC1001 INTRODUCTION TO NEUROSCIENCE. 3.00 points.**

This course is required for all the other courses offered in Neuroscience and Behavior. The course introduces students to the anatomy and physiology of the nervous system. The topics include the biological structure of the nervous system and its different cell types, the basis of the action potential, principles of neurotransmission, neuronal basis of behavior, sleep/wake cycles, and basic aspects of clinical neuroscience

NSBV BC2008 ADAPTIVE OR ARRESTED DEVELOPMENT OF THE ADOLESCENT BRAIN. 3.00 points.

The teen brain has received a lot of media coverage with advances in brain imaging techniques that provide a voyeuristic opportunity for us to look under the hood of the behaving adolescent brain. This course will cover empirical and theoretical accounts of adolescent-specific changes in brain and behavior that relate to the development of self control. These accounts of adolescent brain and behavior will then be discussed in the context of relevant legal, social and health policy issues. Lectures and discussion will address: Under what circumstances self control appears to be diminished in adolescents. How do dynamic changes in neural circuitry help to explain changes in self control across development? When does the capacity for self control fully mature? Are these changes observed in other species? How might these changes be evolutionarily adaptive and when are they maladaptive? How might understanding adolescent brain and behavioral development inform interventions and treatments for maladaptive behavior or inform policy for changing the environment to protect youth?

PSYC UN2430 COGNITIVE NEUROSCIENCE. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 or equivalent introductory course in Psychology

Prerequisites: PSYC UN1001 or equivalent introductory course in Psychology This course provides an in-depth survey of data and models of a wide variety of human cognitive functions. Drawing on behavioral, neuropsychological, and neuroimaging research, the course explores the neural mechanisms underlying complex cognitive processes, such as perception, memory, and decision making. Importantly, the course examines the logic and assumptions that permit us to interpret brain activity in psychological terms

PSYC UN2435 Social Neuroscience. 3.00 points.

This course will provide a broad overview of the field of social neuroscience. We will consider how social processes are implemented at the neural level, but also how neural mechanisms help give rise to social phenomena and cultural experiences. Many believe that the large expansion of the human brain evolved due to the complex demands of dealing with social others—competing or cooperating with them, deceiving or empathizing with them, understanding or misjudging them. What kind of “social brain” has this evolutionary past left us with? In this course, we will review core principles, theories, and methods guiding social neuroscience, as well as research examining the brain basis of processes such as theory of mind, emotion, stereotyping, social group identity, empathy, judging faces and bodies, morality, decision-making, the impact of culture and development, among others. Overall, this course will introduce students to the field of social neuroscience and its multi-level approach to understanding the brain in its social context

PSYC UN2450 BEHAVIORAL NEUROSCIENCE. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 or PSYC UN1010 or the instructor's permission.

Prerequisites: PSYC UN1001 or PSYC UN1010 or the instructors permission. Examines the principles governing neuronal activity, the role of neurotransmitter systems in memory and motivational processes, the presumed brain dysfunctions that give rise to schizophrenia and depression, and philosophical issues regarding the relationship between brain activity and subjective experience

PSYC UN2481 Developmental Cognitive Neuroscience. 3.00 points.

The course will be an introduction to the science of structural and functional brain development beginning in the prenatal period. We will cover major domains in both cognitive and social development. This is a flipped course, where students will watch lectures online (three 55 minute lectures each week) and participate in classroom discussions and exercises (1 hour 50 minutes twice a week) with the Professor and each other when in person

NSBV BC3381 Visual Neuroscience: From the Eyeball to the Mind's Eye. 4.00 points.

By absorbing electromagnetic radiation through their eyes, people are able to catch frisbees, recognize faces, and judge the beauty of art. For most of us, seeing feels effortless. That feeling is misleading. Seeing requires not only precise optics to focus images on the retina, but also the concerted action of millions of nerve cells in the brain. This intricate circuitry infers the likely causes of incoming patterns of light and transforms that information into feelings, thoughts, and actions. In this course we will study how light evokes electrical activity in a hierarchy of specialized neural networks that accomplish many unique aspects of seeing. Students will have the opportunity to focus their study on particular aspects, such as color, motion, object recognition, learning, attention, awareness, and how sight can be lost and recovered. Throughout the course we will discuss principles of neural information coding (e.g., receptive field tuning, adaptation, normalization, etc.) that are relevant to other areas of neuroscience, as well as medicine, engineering, art and design

Please note that PSYC UN2430 Cognitive Neuroscience may be used to fulfill either the Neuroscience requirement or the Psychology requirement, but not both.

Philosophy:**PHIL UN2655 COGNITIVE SCIENCE AND PHILOSOPHY. 3.00 points.**

This course will survey a number of topics at the intersection of cognitive science and philosophy. Potential topics include free will, consciousness, embodied cognition, artificial intelligence, neural networks, and the language of thought

PHIL UN3252 Philosophy of Language and Mind. 3 points.

This course will provide an introduction to meaning, reference, understanding, and content in language, thought, and perception. A central concern will be the question of the relation of meaning to truth-conditions, and what is involved in language and thought successfully latching on to reality. If you have not already taken an elementary course in first order logic, you will need to catch up in that area to understand some crucial parts of the course. All the same, the primary concerns of the course will be philosophical, rather than technical.

PHIL UN3655 TOPICS IN COGNITIVE SCIENCE AND PHILOSOPHY. 3.00 points.

This course will focus on one topic at the intersection of cognitive science and philosophy. Potential topics include free will, consciousness, modularity, mental representation, probabilistic inference, the language of thought, and the computational theory of mind

PHIL UN3912 SEMINAR. 3.00 points.

Required of senior majors, but also open to junior majors, and junior and senior concentrators who have taken at least four philosophy courses. This exploration will typically involve writing a substantial research paper. Capped at 20 students with preference to philosophy majors

(Please note that only the "Perception" section of the PHIL UN3912 Seminar counts towards your Cognitive Science major; that section is not offered every year.)

Linguistics

LING UN3101 INTRODUCTION TO LINGUISTICS. 3.00 points.

An introduction to the study of language from a scientific perspective. The course is divided into three units: language as a system (sounds, morphology, syntax, and semantics), language in context (in space, time, and community), and language of the individual (psycholinguistics, errors, aphasia, neurology of language, and acquisition). Workload: lecture, weekly homework, and final examination

Mathematical and Computational Methods

Logic and Decision Theory

ECON GU4850 COGNITIVE MECH # ECON BEHAVIOR. 4.00 points.

Prerequisites: ECON UN3211 and ECON UN3213 and STAT UN1201
 Prerequisites: ECON UN3211 and ECON UN3213 and STAT UN1201
 Standard economic theory seeks to explain human behavior (especially in economic settings, such as markets) in terms of rational choice, which means that the choices that are made can be predicted on the basis of what would best serve some coherent objective, under an objectively correct understanding of the predictable consequences of alternative actions. Observed behavior often seems difficult to reconcile with a strong form of this theory, even if incentives clearly have some influence on behavior; and the course will discuss empirical evidence (both from laboratory experiments and observations in the field) for some well-established anomalies. But beyond simply cataloguing anomalies for the standard theory, the course will consider the extent to which departures from a strong version of rational choice theory can be understood as reflecting cognitive processes that are also evident in other domains such as sensory perception; examples from visual perception will receive particular attention. And in addition to describing what is known about how the underlying mechanisms work (something that is understood in more detail in sensory contexts than in the case of value-based decision making), the course will consider the extent to which such mechanisms — while suboptimal from a normative standpoint that treats perfect knowledge of one's situation as costless and automatic — might actually represent efficient uses of the limited information and bounded information-processing resources available to actual people (or other organisms). Thus the course will consider both ways in which the realism of economic analysis may be improved by taking into account cognitive processes, and ways in which understanding of cognitive processes might be advanced by considering the economic problem of efficient use of limited (cognitive) resources

PHIL UN1401 INTRODUCTION TO LOGIC. 3.00 points.

Explicit criteria for recognizing valid and fallacious arguments, together with various methods for schematizing discourse for the purpose of logical analysis. Illustrative material taken from science and everyday life

PHIL UN3411 SYMBOLIC LOGIC. 4.00 points.

Corequisites: PHILV3413 Required Discussion Section (0 points).
 Advanced introduction to classical sentential and predicate logic. No previous acquaintance with logic is required; nonetheless a willingness to master technicalities and to work at a certain level of abstraction is desirable

PHIL GU4561 PROBABILITY # DECISION THEORY. 3.00 points.

Examines interpretations and applications of the calculus of probability including applications as a measure of degree of belief, degree of confirmation, relative frequency, a theoretical property of systems, and other notions of objective probability or chance. Attention to epistemological questions such as Hume's problem of induction, Goodman's problem of projectibility, and the paradox of confirmation

PSYC UN2235 THINKING AND DECISION MAKING. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: an introductory course in psychology.

Prerequisites: an introductory course in psychology. Models of judgment and decision making in both certain and uncertain or risky situations, illustrating the interplay of top-down (theory-driven) and bottom-up (data-driven) processes in creating knowledge. Focuses on how individuals do and should make decisions, with some extensions to group decision making and social dilemmas

Statistics

ECON BC1007 MATH METHODS FOR ECONOMICS. 4.00 points.

Covers basic mathematical methods required for intermediate theory courses and upper level electives in economics, with a strong emphasis on applications. Topics include simultaneous equations, functions, partial differentiation, optimization of functions of more than one variable, constrained optimization, and financial mathematics. This course satisfies the Calculus requirement for the Barnard Economics major. NOTE: students who have previously taken Intermediate Micro Theory (ECON BC3035 or the equivalent) are *not* allowed to take Math Methods for Economics

ECON BC2411 STATISTICS FOR ECONOMICS. 4.00 points.

Elementary computational methods in statistics. Basic techniques in regression analysis of econometric models. One-hour weekly recitation sessions to complement lectures

PSYC BC1101 STATISTICS LECTURE AND RECITATION. 4.00 points.

Prerequisites: BC1001 and instructor permission. Enrollment limited to 20 students per recitation section.

Prerequisite (or co-requisite): PSYC BC1001. Lecture course and associated recitation section introducing students to statistics and its applications to psychological research. The course covers basic theory, conceptual underpinnings, and common statistics. The following Columbia University courses are considered overlapping and a student cannot receive credit for both the BC course and the equivalent CU course: STAT UN1001 Introduction to Statistical Reasoning; STAT UN1101 Introduction to Statistics; STAT UN1201 Introduction to Statistics

PSYC UN1610 STATISTICS-BEHAVIORAL SCIENTISTS. 4.00 points.

Lecture and lab. Priority given to psychology majors. Fee \$70.

Prerequisites: PSYC UN1001 or PSYC UN1010 Recommended preparation: one course in behavioral science and knowledge of high school algebra.

Corequisites: PSYC UN1611

Prerequisites: PSYC UN1001 or PSYC UN1010 Recommended preparation: one course in behavioral science and knowledge of high school algebra. Corequisites: PSYC UN1611 Introduction to statistics that concentrates on problems from the behavioral sciences

STAT UN1001 INTRO TO STATISTICAL REASONING. 3.00 points.

A friendly introduction to statistical concepts and reasoning with emphasis on developing statistical intuition rather than on mathematical rigor. Topics include design of experiments, descriptive statistics, correlation and regression, probability, chance variability, sampling, chance models, and tests of significance

STAT UN1101 INTRODUCTION TO STATISTICS. 3.00 points.

Prerequisites: intermediate high school algebra. Designed for students in fields that emphasize quantitative methods. Graphical and numerical summaries, probability, theory of sampling distributions, linear regression, analysis of variance, confidence intervals and hypothesis testing. Quantitative reasoning and data analysis. Practical experience with statistical software. Illustrations are taken from a variety of fields. Data-collection/analysis project with emphasis on study designs is part of the coursework requirement

STAT UN1201 CALC-BASED INTRO TO STATISTICS. 3.00 points.

Prerequisites: one semester of calculus. Designed for students who desire a strong grounding in statistical concepts with a greater degree of mathematical rigor than in STAT W1111. Random variables, probability distributions, pdf, cdf, mean, variance, correlation, conditional distribution, conditional mean and conditional variance, law of iterated expectations, normal, chi-square, F and t distributions, law of large numbers, central limit theorem, parameter estimation, unbiasedness, consistency, efficiency, hypothesis testing, p-value, confidence intervals, maximum likelihood estimation. Serves as the pre-requisite for ECON W3412

Computer Science

COMS BC1016 Introduction to Computational Thinking and Data Science. 3.00 points.

This course and its co-requisite lab course will introduce students to the methods and tools used in data science to obtain insights from data. Students will learn how to analyze data arising from real-world phenomena while mastering critical concepts and skills in computer programming and statistical inference. The course will involve hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks. The course is ideal for students looking to increase their digital literacy and expand their use and understanding of computation and data analysis across disciplines. No prior programming or college-level math background is required

COMS W1001 Introduction to Information Science. 3 points.

Lect: 3.

Basic introduction to concepts and skills in Information Sciences: human-computer interfaces, representing information digitally, organizing and searching information on the internet, principles of algorithmic problem solving, introduction to database concepts, and introduction to programming in Python.

COMS W1002 COMPUTING IN CONTEXT. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Introduction to elementary computing concepts and Python programming with domain-specific applications. Shared CS concepts and Python programming lectures with track-specific sections. Track themes will vary but may include computing for the social sciences, computing for economics and finance, digital humanities, and more. Intended for nonmajors. Students may only receive credit for one of ENGI E1006 or COMS W1002

COMS W1004 Introduction to Computer Science and Programming in Java. 3 points.

Lect: 3.

A general introduction to computer science for science and engineering students interested in majoring in computer science or engineering. Covers fundamental concepts of computer science, algorithmic problem-solving capabilities, and introductory Java programming skills. Assumes no prior programming background. Columbia University students may receive credit for only one of the following two courses: 1004 or 1005.

COMS W1007 Honors Introduction to Computer Science. 3 points.

Lect: 3.

Prerequisites: AP Computer Science with a grade of 4 or 5 or similar experience.

An honors-level introduction to computer science, intended primarily for students considering a major in computer science. Computer science as a science of abstraction. Creating models for reasoning about and solving problems. The basic elements of computers and computer programs. Implementing abstractions using data structures and algorithms. Taught in Java.

COMS W3134 Data Structures in Java. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W1004) or knowledge of Java.

Data types and structures: arrays, stacks, singly and doubly linked lists, queues, trees, sets, and graphs. Programming techniques for processing such structures: sorting and searching, hashing, garbage collection. Storage management. Rudiments of the analysis of algorithms. Taught in Java. Note: Due to significant overlap, students may receive credit for only one of the following three courses: COMS W3134, COMS W3136, COMS W3137.

COMS W3136 ESSENTIAL DATA STRUCTURES. 4.00 points.

Prerequisites: (COMS W1004) or (COMS W1005) or (COMS W1007) or (ENGI E1006)

A second programming course intended for nonmajors with at least one semester of introductory programming experience. Basic elements of programming in C and C++, array-based data structures, heaps, linked lists, C programming in UNIX environment, object-oriented programming in C++, trees, graphs, generic programming, hash tables. Due to significant overlap, students may only receive credit for either COMS W3134, W3136, or W3137

COMS W3137 HONORS DATA STRUCTURES # ALGOL. 4.00 points.

Prerequisites: (COMS W1004) or (COMS W1007)

Corequisites: COMS W3203

An honors introduction to data types and structures: arrays, stacks, singly and doubly linked lists, queues, trees, sets, and graphs. Programming techniques for processing such structures: sorting and searching, hashing, garbage collection. Storage management. Design and analysis of algorithms. Taught in Java. Note: Due to significant overlap, students may receive credit for only one of the following three courses: COMS W3134, W3136, or W3137

ENGI E1006 INTRO TO COMP FOR ENG/APP SCI. 3.00 points.

An interdisciplinary course in computing intended for first year SEAS students. Introduces computational thinking, algorithmic problem solving and Python programming with applications in science and engineering. Assumes no prior programming background

STEM BC2223 PROGRAMMING BEHAV SCIENCES. 4.00 points.

Possible Electives

Please note that the list of possible electives below is just to give students ideas. Whether or not a student can count a particular course as an elective depends upon the student's area of specialization. Any course that builds expertise in the student's area of specialization may be counted as an elective with the program director's approval, regardless of whether it is listed below; a course that does not build expertise in the student's area of specialization may not be counted as an elective even if it is listed below.

ANTH UN1009 INTRO TO LANGUAGE & CULTURE. 3.00 points.

This is an introduction to the study of the production, interpretation, and reproduction of social meanings as expressed through language. In exploring language in relation to culture and society, it focuses on how communication informs and transforms the sociocultural environment

COGS GU4050 Natural and Artificial Neural Networks. 3.00 points.

Artificial neural networks can do amazing things. They can play chess, recognize faces, predict human behavior, learn language, and create art. Natural neural networks – that is to say, brains – can do many of the same things, often a little more clumsily. But, unlike artificial networks, they can switch seamlessly between two tasks, learn to perform them without supervision, and do not need to be told to – actually, they can choose to refuse. Brains provided the initial inspiration for the artificial networks, which is why we call them 'artificial neural networks.' But how deep are the similarities between the two? Do they share more than a few abilities, a similar structure, and a common nomenclature?

COGS GU4051 Natural and Artificial Neural Networks Lab. 1.00 point.

Understanding the powers and limitations of artificial neural networks requires exposure to both concepts and practice. This lab section focuses on the latter, supplementing the conceptual framework from the lecture, Natural and Artificial Neural Networks. The lab focuses on giving students without a background in computer science hands-on experience with basic programming in Python, tools for data science, and a variety of machine learning algorithms

COGS GU4800 Resource-Constrained Decision Making. 4.00 points.

There is a fundamental puzzle about human intelligence: How are we incredibly smart and stupid at the same time? Humans deal successfully with the world in a way that no machine can (for now), yet we routinely behave in ways that seem grossly inconsistent with normative canons of rational inference and rational choice. This course will seek to resolve the paradox by exploring the idea that while we make many mistakes, these mistakes are not haphazard; instead, they reflect a brain that is highly efficient at inference and decision making within the information, time, and energy constraints imposed by the finite resources available to it. In other words, our brains may be "resource-rational" even if they fail to conform to ideal canons of rationality. We will explore this idea by considering the structure of errors, biases and illusions in the context of perceptual judgments, more abstract cognitive judgments (perceptions of numerical magnitudes or probabilities), and economic decisions; we will see that there are many analogies between the kinds of characteristic errors that people make in all of these contexts. A potential explanatory framework, which can be applied across contexts, considers what optimal decisions should be like in the case of a decision unit that has only imprecise information about its situation. Hence statistical modeling and statistical inference are key elements in the computational models of human decision making that we wish to discuss

COMS W4170 USER INTERFACE DESIGN. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137)

Introduction to the theory and practice of computer user interface design, emphasizing the software design of graphical user interfaces. Topics include basic interaction devices and techniques, human factors, interaction styles, dialogue design, and software infrastructure. Design and programming projects are required

COMS W4701 ARTIFICIAL INTELLIGENCE. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and any course on probability. Prior knowledge of Python is recommended. Prior knowledge of Python is recommended. Provides a broad understanding of the basic techniques for building intelligent computer systems. Topics include state-space problem representations, problem reduction and and-or graphs, game playing and heuristic search, predicate calculus, and resolution theorem proving, AI systems and languages for knowledge representation, machine learning and concept formation and other topics such as natural language processing may be included as time permits

COMS W4705 NATURAL LANGUAGE PROCESSING. 3.00 points.

Lect: 3.

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) or the instructor's permission.

Computational approaches to natural language generation and understanding. Recommended preparation: some previous or concurrent exposure to AI or Machine Learning. Topics include information extraction, summarization, machine translation, dialogue systems, and emotional speech. Particular attention is given to robust techniques that can handle understanding and generation for the large amounts of text on the Web or in other large corpora. Programming exercises in several of these areas

COMS W4731 Computer Vision I: First Principles. 3.00 points.

Lect: 3.

Prerequisites: Fundamentals of calculus, linear algebra, and C programming. Students without any of these prerequisites are advised to contact the instructor prior to taking the course.

Introductory course in computer vision. Topics include image formation and optics, image sensing, binary images, image processing and filtering, edge extraction and boundary detection, region growing and segmentation, pattern classification methods, brightness and reflectance, shape from shading and photometric stereo, texture, binocular stereo, optical flow and motion, 2D and 3D object representation, object recognition, vision systems and applications

COMS W4771 MACHINE LEARNING. 3.00 points.

Lect: 3.

Prerequisites: Any introductory course in linear algebra and any introductory course in statistics are both required. Highly recommended: COMS W4701 or knowledge of Artificial Intelligence.

Topics from generative and discriminative machine learning including least squares methods, support vector machines, kernel methods, neural networks, Gaussian distributions, linear classification, linear regression, maximum likelihood, exponential family distributions, Bayesian networks, Bayesian inference, mixture models, the EM algorithm, graphical models and hidden Markov models. Algorithms implemented in MATLAB

COMS W4772 ADVANCED MACHINE LEARNING. 3.00 points.

Lect: 3.

Prerequisites: (COMS W4771) or instructor's permission; knowledge of linear algebra & introductory probability or statistics is required. An exploration of advanced machine learning tools for perception and behavior learning. How can machines perceive, learn from, and classify human activity computationally? Topics include appearance-based models, principal and independent components analysis, dimensionality reduction, kernel methods, manifold learning, latent models, regression, classification, Bayesian methods, maximum entropy methods, real-time tracking, extended Kalman filters, time series prediction, hidden Markov models, factorial HMMs, input-output HMMs, Markov random fields, variational methods, dynamic Bayesian networks, and Gaussian/Dirichlet processes. Links to cognitive science

CPLS GU4510 The Mind Between Literature and the Brain. 3.00 points.

What — to paraphrase Catherine Malabou — should literary studies do with neuroscience? How should critics and theorists approach the wealth of research about the neural bases of cognition? Should empirical findings about the brain supplant or complement interpretative and speculative theories of the psyche in the literary critic's toolkit? Is the psyche and its "inner life" still a meaningful level of analysis for literary scholars? The field of "cognitive literary studies," as the heterogeneous body of work drawing from research psychology, cognitive science and neuroscience is known, has steadily grown in stature over the last few decades, in lockstep with the burgeoning prominence of neuroscience in popular culture and within the academy. Some of its exponents argue that the rise of neuroscience must imply the decline of psychoanalysis and other "folk" psychologies. Others point to the constraints of reproducibility and of the empirical method as insurmountable handicaps for the study of complex cultural objects such as literature. In this seminar, we will consider the literary experience as a whole — from the act of reading and comprehension, to the affective impact of reading and even the lifelong permanence in one's memory and imagination of what Eve Sedgwick called "phantasy books" — and ask which parts of the experience can be fruitfully elucidated by reference to empirical knowledge about neural processes. Individual classes will focus on neuro-phenomenology, neuro-psychoanalysis, neuro-aesthetics, the neuroscience of reading, theory of mind, affect studies and critical theory. We complement these theoretical explorations with a small archive of twentieth-century writing (by Virginia Woolf, Samuel Beckett, Alain Robbe-Grillet, W.G. Sebald and Sarah Kane) that questions and subverts our assumptions about the representation of mental life in literary work. The course has no pre-requisites and it is open to undergraduate and graduate students

ECON GU4020 ECON OF UNCERTAINTY # INFORMTN. 3.00 points.

Prerequisites: ECON UN3211 and ECON UN3213 and STAT UN1201
Prerequisites: ECON UN3211 and ECON UN3213 and STAT UN1201
Topics include behavior uncertainty, expected utility hypothesis, insurance, portfolio choice, principle agent problems, screening and signaling, and information theories of financial intermediation

ECON GU4840 BEHAVIORAL ECONOMICS. 3.00 points.

Prerequisites: ECON UN3211 and ECON UN3213

Prerequisites: ECON UN3211 and ECON UN3213 Within economics, the standard model of behavior is that of a perfectly rational, self interested utility maximizer with unlimited cognitive resources. In many cases, this provides a good approximation to the types of behavior that economists are interested in. However, over the past 30 years, experimental and behavioral economists have documented ways in which the standard model is not just wrong, but is wrong in ways that are important for economic outcomes. Understanding these behaviors, and their implications, is one of the most exciting areas of current economic inquiry. The aim of this course is to provide a grounding in the main areas of study within behavioral economics, including temptation and self control, fairness and reciprocity, reference dependence, bounded rationality and choice under risk and uncertainty. For each area we will study three things: 1. The evidence that indicates that the standard economic model is missing some important behavior 2. The models that have been developed to capture these behaviors 3. Applications of these models to (for example) finance, labor and development economics As well as the standard lectures, homework assignments, exams and so on, you will be asked to participate in economic experiments, the data from which will be used to illustrate some of the principals in the course. There will also be a certain small degree of classroom 'flipping', with a portion of many lectures given over to group problem solving. Finally, an integral part of the course will be a research proposal that you must complete by the end of the course, outlining a novel piece of research that you would be interested in doing

ECON GU4860 BEHAVIORAL FINANCE. 3.00 points.

Prerequisites: ECON UN3211 and ECON UN3213 and ECON UN3412

Prerequisites: ECON UN3211 and ECON UN3213 and ECON UN3412

Neoclassical finance theory seeks to explain financial market valuations and fluctuations in terms of investors having rational expectations and being able to trade without costs. Under these assumptions, markets are efficient in that stocks and other assets are always priced just right. The efficient markets hypothesis (EMH) has had an enormous influence over the past 50 years on the financial industry, from pricing to financial innovations, and on policy makers, from how markets are regulated to how monetary policy is set. But there was very little in prevailing EMH models to suggest the instabilities associated with the Financial Crisis of 2008 and indeed with earlier crises in financial market history. This course seeks to develop a set of tools to build a more robust model of financial markets that can account for a wider range of outcomes. It is based on an ongoing research agenda loosely dubbed "Behavioral Finance", which seeks to incorporate more realistic assumptions concerning human rationality and market imperfections into finance models. Broadly, we show in this course that limitations of human rationality can lead to bubbles and busts such as the Internet Bubble of the mid-1990s and the Housing Bubble of the mid-2000s; that imperfections of markets — such as the difficulty of short-selling assets — can cause financial markets to undergo sudden and unpredictable crashes; and that agency problems or the problems of institutions can create instabilities in the financial system as recently occurred during the 2008 Financial Crisis. These instabilities in turn can have feedback effects to the performance of the real economy in the form of corporate investments

LING GU4202 COGNITIVE LINGUISTICS. 3.00 points.

Prerequisites: LING UN3101 previously or concurrently.

Reading and discussion of scholarly literature on the cognitive approach to language, including: usage-oriented approaches to language, frame semantics, construction grammar, theories of conceptual metaphor and mental spaces; alongside of experimental research on language acquisition, language memory, prototypical and analogous thinking, and the role of visual imagery in language processing

LING GU4206 ADV GRAMMAR AND GRAMMARS. 3.00 points.

Prerequisites: LING UN3101 *LING W3107*.

An investigation of the possible types of grammatical phenomena (argument structure, tense/aspect/mood, relative clauses, classifiers, and deixis). This typological approach is enriched by the reading of actual grammars of languages from Asia, Africa, Australia, and the Americas in which grammatical descriptions are read with an eye to important notional concepts of grammar: reference and categorization, case and role of arguments with predicates (ergativity), tense/aspect/mood. Discussion of meaning is combined with attention to expression (that is, morphology), which yanks our attention towards language change (grammaticalization)

LING GU4376 PHONETICS # PHONOLOGY. 3.00 points.

Prerequisites: LING UN3101

Prerequisites: LING UN3101 An investigation of the sounds of human language, from the perspective of phonetics (articulation and acoustics, including computer-aided acoustic analysis) and phonology (the distribution and function of sounds in individual languages)

LING GU4903 SYNTAX. 3.00 points.

Prerequisites: LING UN3101

Prerequisites: LING UN3101 Syntax - the combination of words - has been at the center of the Chomskyan revolution in Linguistics. This is a technical course which examines modern formal theories of syntax, focusing on later versions of generative syntax (Government and Binding) with secondary attention to alternative models (HPSG, Categorical Grammar)

MUSI UN2320 Introduction to Music Cognition. 3.00 points.

The aim of music cognition is to understand the musical mind. This course is an introduction to a variety of key topics in this field, including human development, evolution, neural processing, embodied knowledge, memory and anticipation, cross-cultural perspectives, and emotions. The course explores recent research on these topics, as well as ways in which this research can be applied to music scholarship. Readings are drawn from fields as diverse as music theory, psychology, biology, anthropology, and neuroscience, and include general works in cognitive science, theoretical work focused on specific musical issues, and reports of empirical research

MUSI GU4325 Topics in Music Cognition. 3.00 points.

This advanced seminar builds on the Introduction to Music Cognition (MUSIC UN2320) with an in-depth inquiry into selected key topics in the field of Music Cognition. Specific topics vary each year, depending on interest and availability of instructors, and include human development; evolution; communication and music's relation to language; embodied knowledge; first-person awareness; metaphor; ineffability; neuroscience; mental representations; memory and anticipation; cross-cultural studies; emotions; musical aesthetics; artificial intelligence; agency; creativity; and music's relation to other art forms. Each semester the course delves into recent research on 3–4 of these topics, focusing in particular on how this research can be applied to questions of musical knowledge. Advanced readings are drawn from fields as diverse as music theory, psychology, biology, anthropology, philosophy, and neuroscience. They include general works in cognitive science, theoretical work focused on specific musical issues, and reports of empirical research

PHIL UN2685 INTRO TO PHIL OF LANGUAGE. 4.00 points.

This course gives students an introduction to various topics in the Philosophy of Language

PHIL UN3685 PHILOSOPHY OF LANGUAGE. 3.00 points.

This course is a survey of analytic philosophy of language. It addresses central issues about the nature of meaning, including: sense and reference, speech acts, pragmatics, and the relationship between meaning and use, meaning and context, and meaning and truth

PHIL UN3840 The Nature and Significance of Animal Minds. 3 points.

Humans have a complicated relationship with other animals. We love them, befriend them and save them. We hunt, farm and eat them. We experiment on and observe them to discover more about them and to discover more about ourselves. For many of us, our pets are amongst the most familiar inhabitants of our world. Yet when we try to imagine what is going on in a dog or cat's mind—let alone that of a crow, octopus or bee—many of us are either stumped about how to go about this, or (the science strongly suggests) getting things radically wrong. Is our thought about and behavior towards animals ethically permissible, or even consistent, Can we reshape our habits of thought about animals to allow for a more rational, richer relationship with the other inhabitants of our planet? In this course, students will reflect on two closely intertwined questions: an ethical question, what sort of relationship ought we to have with animals?; and a metaphysical question, what is the nature of animal minds? Readings will primarily be from philosophy and ethics and the cognitive sciences, with additional readings from literature and biology. There are no prerequisites for this class—it will be helpful but certainly not necessary to have taken previous classes in philosophy (especially ethics and philosophy of mind) or in cognitive science.

PHIL GU4495 PERCEPTION. 3.00 points.

This course addresses the fabulously rich range of issues about the nature of perception, including: perceptual mental representation and its content; computational explanation; justifying beliefs; knowledge and thought about perception; and perception of music. Perception is an interdisciplinary subject par excellence. Readings will be drawn from philosophy and psychology, aesthetics, and artificial intelligence

PHIL GU4660 PHILOSOPHY OF MIND. 3.00 points.**PSYC BC2129 DEVELOPMENTAL PSYCHOLOGY-LEC. 3.00 points.**

Prerequisites: BC1001 or permission of the instructor.
 Prerequisites: PSYC BC1001 Introduction to Psychology or COGS UN1001 Introduction to Cognitive Science or permission of the instructor.
 Lecture course covering cognitive, linguistic, perceptual, motor, social, affective, and personality development from infancy to adolescence. Note that this lecture can be taken without its affiliated lab, PSYC BC2128, however, if a student completes this lecture, she cannot enroll in the lab in a later semester. The following Columbia University course is considered overlapping and a student cannot receive credit for both the BC course and the equivalent CU course: PSYC UN2280 Introduction to Developmental Psychology

PSYC BC2163 Human Learning and Memory. 3 points.

Prerequisites: BC1001 and at least one psychology lab course, or permission of the instructor. Enrollment limited to 20 students.
 Survey of contemporary theories and empirical research on human memory. Topics will include sensory, short term and long term memory, levels of processing, organization, forgetting, and encoding specificity. Special topics include eyewitness testimony, amnesia, implicit memory, and false memory.

PSYC BC3164 PERCEPTION AND LANGUAGE. 4.00 points.

Prerequisites: BC 1001 and one of the following: BC2106/2107, BC2109/2110, BC2118/2119, BC2128/2129, or permission of the instructor. Enrollment limited to 20 students
 Psychological investigations of spoken communication from a listener's perspective. Topics include perception and sounds of speech and the apprehension of meaning from words and utterances; the perceptual basis for rhyme and rhythm in speech; and the natural history of vocal communication.

PSYC BC3369 Language Development. 4 points.

Not offered during 2023-2024 academic year.

Prerequisites: BC1001, one Psychology laboratory course, one of the following: PSYC W2240, BC1128/1129, BC1129, or LIN BC V1101, and permission of the instructor. Enrollment limited to 15 students.
 Examines the acquisition of a first language by children, from babbling and first words to complex sentence structure and wider communicative competence. Signed and spoken languages, cross-linguistic variation and universalities, language genesis and change, and acquisition by atypical populations will be discussed.

PSYC BC3372 Comparative Cognition. 4 points.

Not offered during 2023-2024 academic year.

Prerequisites: BC1001 and one additional course in psychology. Or permission of the instructor. Enrollment limited to 20 students.
 Review and critical evaluation of current empirical research investigating cognitive processes in both human and non-human species. Topics include comparisons in episodic memory, metacognition, theory of mind, self-awareness, and language abilities.

PSYC BC3381 Theory of Mind and Intentionality. 4 points.

Not offered during 2023-2024 academic year.

Prerequisites: BC1001 and one other Psychology course, or permission of the instructor. Enrollment limited to 15 students.
 Survey and critical analysis of the developmental and neurological research on theory of mind -the attribution of mental states like belief, desire, and knowledge to others- in humans and nonhuman animals. Emphasis on the role of intentionality, stages of acquisition, neurological and genetic bases, and deficits in theory of mind.

PSYC BC3384 Social Cognition. 4 points.

Not offered during 2023-2024 academic year.

Prerequisites: BC 1001 and one of the following: BC1138/1137 Social Psychology, BC1115/1114 Cognitive Psychology, or permission of the instructor.
 Survey of research from the field of social cognition, exploring cognitive processes involved in social functioning. Topics include attention, interpretation, evaluation, judgment, attribution, and memory processes. Both controlled and automatic processes will be considered, and the roles of motives, goals, and affective variables will be discussed.

PSYC BC3390 CANINE COGNITION. 4.00 points.

Prerequisites: BC1001 and one other Psychology course. Enrollment limited to 15 students. Permission of the instructor is required. An examination of the scientific study of the domestic dog. Emphasis will be on the evolutionary history of the species; the dogs social cognitive skills; canid perceptual and sensory capacities; dog-primate comparative studies; and dog-human interaction

PSYC BC3399 HUMAN AND MACHINES. 4.00 points.

Prerequisites: (PSYC BC1001) and Instructor approval
 Prerequisites: (PSYC BC1001) and Instructor approval This course will examine the social psychology of Human-Machine interactions, exploring the idea that well-established social psychological processes play critical roles in interactions with non-social objects. The first half of the seminar will examine the social psychology of perception across distinct sensory modalities (shape, motion, voice, touch), whereas the second half will focus on social psychological processes between humans and non-human entities (objects, computers, robots)

PSYC UN2250 Evolution of Cognition. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 or PSYC UN1010 or the instructor's permission.
 A systematic review of different forms of cognition as viewed in the context of the theory of evolution. Specific topics include the application of the theory of evolution to behavior, associative learning, biological constraints on learning, methods for studying the cognitive abilities of animals, levels of representation, ecological influences on cognition, and evidence of consciousness in animals.

PSYC UN2280 Developmental Psychology. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement
 Enrollment may be limited. Attendance at the first two classes is mandatory.

Prerequisites: PSYC UN1001 or PSYC UN1010 or the equivalent.
 Prerequisites: PSYC UN1001 or PSYC UN1010 or the equivalent.
 Introduction to the scientific study of human development, with an emphasis on psychobiological processes underlying perceptual, cognitive, and emotional development

PSYC UN3270 COMPUT APPROACHES-HUMAN VISION. 3.00 points.

This course will be offered in Fall 2016.

Prerequisites: some background in psychology and/or neurophysiology (e.g., PSYC UN1001, PSYC UN1010, PSYC UN2230, PSYC UN2450; BIOL UN3004 or BIOL UN3005) is desirable. See instructor if you have questions about your background. Some background in mathematics and computer science (e.g., calculus or linear algebra, a programming language) is highly recommended.

Prerequisites: some background in psychology and/or neurophysiology (e.g. PSYC UN1001, PSYC UN1010, PSYC UN2230, PSYC UN2450; BIOL UN3004 or BIOL UN3005) is desirable. See instructor if you have questions about your background. Some background in mathematics and computer science (e.g. calculus or linear algebra, a programming language) is highly recommended. Study of human vision—both behavioral and physiological data—within a framework of computational and mathematical descriptions. Please contact Prof. Graham by e-mail (nvg1@columbia.edu) if you are interested in this course

PSYC UN3290 Self: A Cognitive Exploration (Seminar). 4 points.

Not offered during 2023-2024 academic year.

Prerequisites: PSYC UN1001 or PSYC UN1010, or the equivalent, plus the instructor's permission.

What does it mean to have a sense of self? Is it uniquely human? Taking a cognitive perspective, we will discuss these questions as well as self-reflective and self-monitoring abilities, brain structures relevant to self-processing, and disorders of self. We will also consider the self from evolutionary, developmental, neuroscience, and psychopathological perspectives.

PSYC UN3445 THE BRAIN AND MEMORY. 4.00 points.

Prerequisites: (PSYC UN1010) or Equivalent introductory course in neuroscience or cognitive psychology and the instructor's permission

Prerequisites: (PSYC UN1010) or Equivalent introductory course in neuroscience or cognitive psychology and the instructors permission
This seminar will give a comprehensive overview of episodic memory research: what neuroimaging studies, patient studies, and animal models have taught us about how the brain creates, stores, and retrieves memories

PSYC UN3450 Evolution of Intelligence, Animal Communication, # Language. 3.00 points.

Prerequisites: PSYC UN1001 or PSYC UN1010, and the instructor's permission.

Prerequisites: PSYC UN1001, and the instructors permission. A systematic review of the evolution language covering the theory of evolution, conditioning theory, animal communication, ape language experiments, infant cognition, preverbal antecedents of language and contemporary theories of language

PSYC GU4202 Theories of Change in Human Development. 4.00 points.

What are the agents of developmental change in human childhood? How has the scientific community graduated from nature versus nurture, to nature and nurture? This course offers students an in-depth analysis of the fundamental theories in the study of cognitive and social development

PSYC GU4222 The Cognitive Neuroscience of Aging (Seminar). 4 points.

Prerequisites: courses in introductory psychology and cognitive psychology; and the instructor's permission.

Comprehensive overview of various conceptual and methodologic approaches to studying the cognitive neuroscience of aging. The course will emphasize the importance of combining information from cognitive experimental designs, epidemiologic studies, neuroimaging, and clinical neuropsychological approaches to understand individual differences in both healthy and pathological aging.

PSYC GU4223 MEMORY # EXEC FUNCT:LIFESPAN. 4.00 points.

Prerequisites: the instructor's permission, plus PSYC UN1001 or PSYC UN1010, or the equivalent. Optimal preparation will include some background in experimental design and statistics.

Prerequisites: the instructors permission, plus PSYC UN1001 or PSYC UN1010, or the equivalent. Optimal preparation will include some background in experimental design and statistics. Memory and executive processing are critical cognitive functions required for successfully navigating everyday life. In lifespan studies, both exhibit relatively long developmental trajectories followed by stasis and then relative decline in old age. Yet, neither memory nor executive function is a unitary construct. Rather, each is comprised of separable components that may show different developmental trajectories and declines or maintenance at older ages. Moreover, memory is malleable and is a reconstruction of past experience, not an exact reproduction. We will discuss a range of topics related to the development, maintenance and potential decline in memory and executive function from infancy through old age

PSYC GU4225 CONSCIOUSNESS # ATTENTION. 4.00 points.

Prerequisites: the instructor's permission; some basic knowledge of cognitive science and neuroanatomy is desirable, but not necessary. Modern theories attempt to characterize the human mind in terms of information processing. But machines that process information do not seem to feel anything; a computer may for instance receive inputs from a video camera, yet it would be hard to imagine that it sees or experiences the vividness of colors like we do. Nobody has yet provided a convincing theory as to how to explain the subjective nature of our mental lives in objective physical terms. This is called the problem of consciousness, and is generally considered to be one of the last unsolved puzzles in science. Philosophers even debate whether there could be a solution to this problem at all. Students in this course may be recruited for participation in a voluntary research study. Students who choose not to participate in the study will complete the same course requirements as those who do, and an individual's choice will not affect their grade or status as a student in the course

PSYC GU4229 ATTENTION AND PERCEPTION. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (PSYC UN1010) or Equivalent introductory course in neuroscience or cognitive psychology

Prerequisites: (PSYC UN1010) or Equivalent introductory course in neuroscience or cognitive psychology This seminar aims to provide an in-depth overview of neuroscientific knowledge regarding two critical cognitive functions: attention and perception. For each topic, results from behavioral studies are combined with those from recent neurocognitive approaches – primarily neuropsychological and functional brain imaging studies – that reveal the underlying neural networks and brain mechanisms

PSYC GU4239 COG NEURO NARRATIVE FILM. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (PSYC UN1010 or Equivalent introductory course in neuroscience or cognitive psychology)

Prerequisites: (PSYC UN1010 or Equivalent introductory course in neuroscience or cognitive psychology) This seminar will provide a broad survey of how narrative stories, films, and performances have been used as tools to study cognition in psychology and neuroscience

PSYC GU4242 Evolution of Language (seminar). 3.00 points.

Prerequisites: PSYC UN1001 or

This seminar will consider the evolution of language at the levels of the word and grammar, in each instance, phylogenetically and ontogenetically. Since humans are the only species that use language, attention will be paid to how language differs from animal communication.

PSYC GU4244 LANGUAGE AND MIND. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 and Preferably, an additional course in psychology, focusing on cognition, development, or research methods. Instructor permission required.

Prerequisites: PSYC UN1001 and Preferably, an additional course in psychology, focusing on cognition, development, or research methods. Instructor permission required. This seminar explores the relationship between language and thought by investigating how language is mentally represented and processed; how various aspects of language interact with each other; and how language interacts with other aspects of cognition including perception, concepts, world knowledge, and memory. Students will examine how empirical data at the linguistic, psychological, and neuroscientific levels can bear on some of the biggest questions in the philosophy of mind and language and in psychology

PSYC GU4270 COGNITIVE PROCESSES. 3.00 points.

Prerequisites: For undergraduates: one course in cognitive psychology or cognitive neuroscience, or the equivalent, and the instructor's permission.

Prerequisites: For undergraduates: one course in cognitive psychology or cognitive neuroscience, or the equivalent, and the instructor's permission. Metacognition and control processes in human cognition. Basic issues include the cognitive mechanisms that enable people to monitor what they know and predict what they will know, the errors and biases involved in self-monitoring, and the implications of metacognitive ability for people's self-determined learning, behavior, and their understanding of self

PSYC GU4280 CORE KNOWLEDGE. 4.00 points.

Prerequisites: For undergraduates: courses in introductory psychology, cognitive or developmental psychology, and the instructor's permission.

Prerequisites: For undergraduates: courses in introductory psychology, cognitive or developmental psychology, and the instructor's permission. Core Knowledge explores the origins and development of knowledge in infants and children, with an additional emphasis on evolutionary cognition. In this course, we will examine evidence from cognitive psychology, developmental psychology, comparative psychology, neuroscience, and linguistics to look at the child's conception of objects, number, space, language, agency, morality and the social world. We will look at which aspects of knowledge are uniquely human, which are shared with other animals, and how this knowledge changes as children develop

PSYC GU4281 The Psychology of Curiosity. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: PSYC UN1001 or equivalent introductory psychology course

Prerequisites: PSYC UN1001 or equivalent introductory psychology course What is curiosity and how do we study it? How does curiosity facilitate learning? This course will explore the various conceptual and methodological approaches to studying curiosity and curiosity-driven learning, including animal and human studies of brain and behavior

PSYC GU4287 DECISION ARCHITECTURE. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (PSYC UN2235) or an equivalent course on judgment and decision making ,AND the instructor's permission

Prerequisites: (PSYC UN2235) or an equivalent course on judgment and decision making ,AND the instructor's permission This course reviews current research in the domain of decision architecture: the application of research in cognitive and social psychology to real-world situations with the aim of influencing behavior. This seminar will discuss recent and classic studies, both of decision theory and of applied decision research, to explore the effectiveness—as well as the limitations—of a selection of these behavioral “nudges.”

PSYC GU4289 THE GAMES PEOPLE PLAY: PSYCH OF STRAT DEC. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (PSYC UN2235) or equivalent course on judgment and decision-making

Prerequisites: (PSYC UN2235) or equivalent course on judgment and decision-making A seminar course exploring strategic decision making (also known as behavioral game theory). This course examines the psychology underlying situations in which outcomes are determined by choices made by multiple decision makers. The prime objective will be to examine the use of experimental games to test psychological theories

PSYC GU4430 Learning and the Brain (Seminar). 4 points.

Prerequisites: courses in introductory psychology and/or neuroscience, and the instructor's permission.

What are the neural mechanisms that support learning, memory, and choices? We will review current theories in the cognitive neuroscience of human learning, discuss how learning and decision making interact, and consider the strengths and weaknesses of two influential methods in the study of human brain and behavior—functional imaging and patient studies.

PSYC GU4435 NON-MNEMONIC FUNC OF MEMORY SYSTEMS. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (PSYC UN1010) or equivalent introductory course in neuroscience or cognitive psychology

Prerequisites: (PSYC UN1010) or equivalent introductory course in neuroscience or cognitive psychology The past decade has produced an extraordinary amount of evidence that challenges the classic view of a “medial temporal lobe memory system”, namely, the idea that the medial temporal lobe plays a necessary role in long-term memory but not other cognitive functions. This course will introduce these challenges to the traditional perspective by exploring functions of the so-called memory system in domains outside of long-term memory

SOAR AV4000 SOUND:Music, Math, and Mind. 3.00 points.

This course is a detailed and hands-on (ears-on) exploration of the fundamental physical, physiological, and psychological aspects of sound. Topics covered include sound waves and their physical nature, the propagation and speed of sound in different mediums, geological and other non-living sound sources, animal and insect sound generating strategies, sound perception mechanisms and abilities in different species, the physiology of human hearing and the structure of the human ear, psycho-acoustics and human sound perception, sonic illusions and tricks of the ear. In-class experiments and research make up the majority of the class. Each student will design and lead at least one experiment/demo session. Students also respond to creative weekly prompts about sound topics on courseworks. We also have visits with a number of special guests during the term