http://www.cogsci.jhu.edu

Cognitive science is the study of the human mind and brain, focusing on how the mind represents and manipulates knowledge and how mental representations and processes are realized in the brain. Conceiving of the mind as an abstract computing device instantiated in the brain, cognitive scientists endeavor to understand the mental computations underlying cognitive functioning and how these computations are implemented by neural tissue. Cognitive science has emerged at the interface of several disciplines. Central among these are cognitive psychology, linguistics, and portions of computer science and artificial intelligence; other important components derive from work in the neurosciences, philosophy, and anthropology. This diverse ancestry has brought into cognitive science several different perspectives and methodologies. Cognitive scientists endeavor to unite such varieties of perspectives around the central goal of characterizing the structure of human intellectual functioning. It is this common object of inquiry that integrates traditionally separate disciplines into the unified field of cognitive science.

Programs in cognitive science at Johns Hopkins University reflect the interdisciplinary nature of the subject, requiring the student to approach the study of the mind/brain from several different investigative perspectives. Programs in cognitive science draw on courses offered by several other departments as well.

**Facilities**

The department is located in Krieger Hall. Laboratory and office space is provided for graduate students. The department’s research facilities are provided by the following laboratories:

- Language and Cognition Lab (Landau)
- Language Acquisition Lab (Legendre)
- Computational Psycholinguistics Lab (Linzen)
- Cognitive Neuroscience Lab (McCloskey)
- Cognitive and Brain Sciences Lab (Rapp)
- Semantics Lab (Rawlins)
- Computational Linguistics Lab (Smolensky)
- Phonetics/Phonology Lab (Wilson)
- Computational Cognition, Vision, and Learning Group (Yuille)
- Integrated Experimental/Theoretical Grammar Research (IGERT) Lab and Library

Department members also conduct research in the F.M. Kirby Center for Functional Brain Imaging at the Kennedy Krieger Institute and in other laboratories at Johns Hopkins School of Medicine.

**Undergraduate Programs**

Our cognitive science undergraduate program reflects the interdisciplinary nature of the field, allowing students to approach the study of the mind and brain from multiple perspectives. Students gain broad knowledge of the field as a whole, plus a greater depth of the understanding in two of the sub-disciplines within the field. Training emphasizes not only learning about the principal theories and evidence, but also development of the conceptual and practical skills needed for understanding and conducting theoretical and empirical work in the field.

Our department offers a B.A. in Cognitive Science as well as a Linguistics Minor (p. 3).

**B.A. in Cognitive Science**

Also see Requirements for a Bachelor’s Degree (http://e-catalog.jhu.edu/undergrad-students/academic-policies/requirements-for-a-bachelors-degree).

**Cognitive Science Major Requirements**

The required courses for cognitive science majors are divided into five general areas, as described below. The program is structured so as to ensure some exposure to each of the five areas. In addition, it provides in-depth training in two of the areas, deemed focal areas, chosen by the student. Majors in cognitive science thus acquire a broad perspective which will enable them to situate particular research disciplines within the overall study of the mind/brain.

**Areas of Focus:** Students must take courses in all five focal areas; however, two focal areas must be chosen in which a greater selection of courses is required. The three focal areas not chosen may be referred to as ‘non focal’ areas for advising purposes. Courses offered by our department and other affiliated departments (e.g., Departments of Psychological and Brain Sciences, Philosophy, Computer Science, Neuroscience, etc.) may be used to satisfy the requirements for these areas. Examples of courses that satisfy the requirements for each area can be found on our website. (http://cogsci.jhu.edu/undergraduate/cognitive-science-major) However, please note that courses change over time, and some courses are not offered every year. The Director of Undergraduate Studies (http://advising.jhu.edu/completing-your-degree/directors-of-undergraduate-studies) can answer questions about which courses qualify for each focal area.

- Cognitive Psychology/Neuropsychology
- Linguistics
- Computational Approaches to Cognition
- Neuroscience
- Philosophy of Mind

**B.A. Coursework**

The below requirements are for students who entered in Fall 2018 or after. Students who entered prior to Fall 2018 should refer to the academic catalog from the year they entered (http://e-catalog.jhu.edu/archive). Students who entered prior to Fall 2018 may follow the new Math Option B or the old Math Option B.

**Introductory Course**

| AS.050.101 | Cognition |

**Two Focal Areas, see areas above**

- Four courses in each of the two selected focal areas. Research, readings, and practica courses do not qualify.
- At least two courses in each focal area must be at the 300-600 level.*

**Three ‘Non-Focal’ Areas**

- One course at any level from each of the three non-focal areas. Research, readings, and practica courses do not qualify.

**Additional Upper-Level Elective Courses**

- Nine credits at the 300-600 level, chosen from any of the five areas or other cognitive science offerings.*

**Math Requirement (Option A or B)**

Math Option A: Any two of the following courses:
**Sample Program**

The below sample program demonstrates how a student with the focal areas (p. 1) of **Cognitive Psychology/Neuropsychology** and **Linguistics** might complete the Cognitive Science major requirements in four years. In this scenario, the student has not placed out of any foreign language requirements. Each student’s path through the program will have variation depending on the two focal areas they choose to pursue within the major.

**Freshman**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.101 Cognition</td>
<td>3</td>
<td>Course in Neuroscience area (any level)</td>
<td>3</td>
</tr>
<tr>
<td>Course in Linguistics area (any level)</td>
<td>3-4</td>
<td>Entry-level foreign language course</td>
<td>3-4</td>
</tr>
</tbody>
</table>

**Sophomore**

| Course in Computational Approaches to Cognitive Science area (any level) | 3-4 | Course in Cognitive (Neuro)Psychology area (any level) | 3 |
| Course in Cognitive (Neuro)Psychology area (any level) | 3 AS.200.201 Design Analysis for Experimental Psychology | 4 |
| AS.200.200 Research Methods in Experimental Psychology | 4 Intermediate language course | 3-4 |

**Intermediate language course**

<table>
<thead>
<tr>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>3-4</td>
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</tbody>
</table>

**Junior**

| Course in Philosophy of Mind area (any level) | 3 Cognitive Science elective (300-level or above) | 1-4 |
| Course in Linguistics area (any level) | 3-4 Cognitive Science elective (300-level or above) | 3-4 |

**Senior**

| Course in Linguistics area (300-level or above) | 3-4 Cognitive Science elective (300-level or above) | 1-4 |
| Cognitive Science elective (300-level or above, including research, readings, practica) | 1-4 Course in Cognitive (Neuro)Psychology area (300-level or above) | 3-4 |

<table>
<thead>
<tr>
<th>Credits</th>
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<tbody>
<tr>
<td>4-8</td>
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</table>

Total Credits: 53-71

**Practicum in Language Disorders**

In addition to having numerous research opportunities year-round, our department also offers AS.050.318 Practicum in Language Disorders-Community Based Learning (also listed as AS.080.400 Research Practicum: Language Disorders-Community Based Learning in the Department of Neuroscience) to its majors. Each fall and spring semester two qualified upperclassmen may enroll in this practicum and have the unique opportunity to learn about adult aphasias, be trained in supportive communication techniques, and work as a communication partner with an individual with aphasia throughout the semester at SCALE (http://www.scalebaltimore.org), a local aphasia support non-profit organization.

**Departmental Honors**

To receive Honors in Cognitive Science, graduating seniors must have a major GPA of 3.5 or higher and complete an Honors Clearance (http://advising.jhu.edu/student-roadmap/seniors/honors) with the department’s Director of Undergraduate Studies (http://advising.jhu.edu/completing-your-degree/directors-of-undergraduate-studies)’s approval. Only courses directly applied to a student’s cognitive science major, including math and foreign language requirements, will be included in
Below. As the capstone event for a student’s completion of the program, MA students are expected to take a research ethics course (AS.360.625 Responsible Conduct of Research). See the coursework requirements below. As the capstone event for a student’s completion of the program, he/she must produce a portfolio of accomplishments from the program (e.g., course assignments, seminar papers) overseen by the faculty adviser, prepare a reading list and set of discussion questions, and present what has been learned from the year of study at an Oral Presentation supervised by two faculty members.

**MA Course Track Requirements**

| Coursework: Seven courses, 600 or above |
| Lab or Research Seminars: Two courses, 800-level |
| Directed Readings and/or Research: Three courses taken throughout the program, including one during Intersession. Below are the course numbers: |
| AS.050.690 Directed Readings in Cognitive Science |
| AS.050.839 Research in Cognitive Science |
| AS.360.625 Responsible Conduct of Research |
| Capstone: Portfolio and Oral Exam |

* Up to three courses may be substituted by 300/400-level courses with a mentor’s written permission.

**Research Track:** Students in this track must complete 12 courses. Students must work on full-time research overseen by their faculty adviser and must complete maintain a B- or better in all coursework. Additionally, MA students are expected to take a research ethics course (AS.360.625 Responsible Conduct of Research). See the course requirements below. At the end of the program, a student in the research track must produce and defend research paper that is approved by the faculty adviser.

**MA Research Track Requirements**

| Formal Methods or Statistics course: One of the following |
| Lab or Research Seminar: Two courses, 800-level |
| Directed Readings in Cognitive Science (Four courses. Students register in this research course each term: fall, intersession, spring and summer.) |
| Additional Courses: Three courses, 600-level or above |
| Capstone: Research Paper and Oral Defense |

**Gender Programs**

(For precise and up-to-date information on these M.A. and Ph.D. graduate programs, visit www.cogsci.jhu.edu/graduate.)

**Masters of Art Program**

**MA Requirements for Admission**

This intensive, one-year M.A. program is intended to appeal to students who have undergraduate degrees in linguistics, psychology, computer science, neuroscience, and other sub-disciplines of cognitive science. Prominent in this program is the emphasis of faculty mentorship of the students during the application period and throughout the duration of the program. There are two distinct tracks in the M.A. program: Course Track and Research Track. Besides traditional required admissions materials, the Research Track is the only track that has a coursework prerequisite: three credits of undergraduate research or equivalent. Please visit the link at the beginning of this section to find more detailed information on the program and specific admissions requirements.

**MA Degree Requirements**

Completion of this M.A. program strengthens the qualifications of students who will be applying for Ph.D. programs and also provides career opportunities in areas including science writing, research coordinator, human factors IT, and community college teaching, among others.

Courses may not be double-counted. Each course may only be used to satisfy a single degree requirement, even if it may qualify for more than one requirement.

**Course Track:** Students in this track must complete 12 courses with a grade of B- or better. See the course requirements below. Additionally, MA students are expected to take a research ethics course (AS.360.625 Responsible Conduct of Research). See the coursework requirements below. As the capstone event for a student’s completion of the program, he/she must produce a portfolio of accomplishments from the program (e.g., course assignments, seminar papers) overseen by the faculty adviser, prepare a reading list and set of discussion questions, and present what has been learned from the year of study at an Oral Presentation supervised by two faculty members.

**MA Course Track Requirements**

| Lab or Research Seminars: Two courses, 800-level |
| Directed Readings and/or Research: Three courses taken throughout the program, including one during Intersession. Below are the course numbers: |
| AS.050.690 Directed Readings in Cognitive Science |
| AS.050.839 Research in Cognitive Science |
| AS.360.625 Responsible Conduct of Research |
| Capstone: Portfolio and Oral Exam |

* Up to three courses may be substituted by 300/400-level courses with a mentor’s written permission.

**Research Track:** Students in this track must complete 12 courses. Students must work on full-time research overseen by their faculty adviser and must complete maintain a B- or better in all coursework. Additionally, MA students are expected to take a research ethics course (AS.360.625 Responsible Conduct of Research). See the course requirements below. At the end of the program, a student in the research track must produce and defend research paper that is approved by the faculty adviser.

**MA Research Track Requirements**

| Formal Methods or Statistics course: One of the following |
| Lab or Research Seminar: Two courses, 800-level |
| Directed Readings in Cognitive Science (Four courses. Students register in this research course each term: fall, intersession, spring and summer.) |
| Additional Courses: Three courses, 600-level or above |
| Capstone: Research Paper and Oral Defense |

**Financial Support**

No regular funding is provided to students in the M.A. program, though a 50% reduction in tuition is offered to students with JHU undergraduate degrees. Students will be encouraged to seek funding from both internal and external sources.

**Doctoral Program**

**PhD Requirements for Admission**

A program of study leading to the Ph.D. degree is open to students with a bachelor's or master's degree in cognitive science or one of the several areas that contribute to it. Prospective doctoral students would be well advised to take courses in cognitive psychology, linguistics, and computer science. Some preparation in the foundations of contemporary neuroscience is also an asset, as is training in the philosophical issues surrounding the study of mind and consciousness. However, there
are no fixed prerequisites (in the form of specific required courses) for admission to the doctoral program. The Department of Cognitive Science invites inquiries from students who are prepared in any of the related fields and who are interested in extending their work to the broader study of the mind/brain.

**PhD Degree Requirements**
The Department of Cognitive Science's Ph.D. requirements consist of coursework, foreign language competence, teaching experience, and research papers. The requirements are designed to meet the following goals:

- **Depth:** Students become expert in their primary area of research interest and also are prepared so that they will be competitive for academic positions in one of the traditional disciplines. Students take 8 - 10 advanced courses that the student, in conjunction with his/her advisory committee, determines to be important for achieving expertise in a chosen research area and marketplace competitiveness in one of the traditional areas: cognitive psychology/neuropsychology, computer science or linguistics.

- **Breadth:** Students develop the ability to understand, appreciate and critically evaluate work in the various sub-disciplines of cognitive science by taking a selection of courses, two each in the areas of cognitive psychology/neuropsychology, computation and linguistics and one each in philosophy and cognitive neuroscience. Students may place out of breadth courses based on undergraduate coursework and (for certain courses) based on examination. It is not uncommon for a student to place out of two breadth requirements.

- **Integration:** Students learn to integrate theory and method across sub-disciplines through specially-designed integrative courses and regular seminars involving the entire department.

**Cognitive Science**

**Depth: Area of Focus**
8 to 10 courses, selected in conjunction with adviser(s), to achieve depth in a chosen research area and marketplace competitiveness: (neuro)psychology, linguistics, or computational approaches.

*Computational approaches should not be confused with the Computational Cognitive Science Track, which is more specialized and has a separate set of requirements.

**Research Ethics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.360.625</td>
<td>Responsible Conduct of Research (encouraged to complete in the first year)</td>
</tr>
</tbody>
</table>

**TA Assignments**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.849</td>
<td>Teaching Practicum (5 semesters. Students register for each term they are assigned to an instructor as a TA. Each instructor has a distinct Teaching Practicum section. Students are not generally expected to TA in their first semester or in the last two semesters of residency (5th year).)</td>
</tr>
</tbody>
</table>

**Computational Cognitive Science Track Requirements**
Courses may not be double-counted. Each course may only be used to satisfy a single degree requirement, even if it may qualify for more than one requirement.

**Breadth**

3-4 courses in the Department of Cognitive Science that collectively develop sophistication in theoretical and (human) experimental approaches to cognitive science. At least one course must be in each language and vision.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language (at least 1 course)</td>
<td></td>
</tr>
<tr>
<td>Vision (at least 1 course)</td>
<td></td>
</tr>
</tbody>
</table>

**Basic Computation**

Three courses. Below are some examples of courses that apply:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.670</td>
<td>Mathematical Models of Language</td>
</tr>
<tr>
<td>AS.050.671</td>
<td>Bayesian Inference</td>
</tr>
<tr>
<td>AS.050.672</td>
<td>Foundations of Neural Network Theory</td>
</tr>
<tr>
<td>EN.601.675</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>EN.601.776</td>
<td>Machine Learning: Data to Models</td>
</tr>
</tbody>
</table>

**Integration**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.626</td>
<td>Foundations of Cognitive Science</td>
</tr>
<tr>
<td>AS.050.860</td>
<td>Professional Seminar in Cognitive Science (or AS.050.850 Departmental Seminar or other department-wide seminar explicitly offered in lieu of either of these)</td>
</tr>
</tbody>
</table>

**Research Ethics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.360.625</td>
<td>Responsible Conduct of Research (encouraged to complete in the first year)</td>
</tr>
</tbody>
</table>

**Depth: Area of Focus in Computation CogSci**

6-8 courses selected in conjunction with advisor(s) to achieve depth and expertise in CCS. Adviser may consult with Director of Graduate Studies. Below are some examples of courses that apply:
Research Papers & Dissertation
Emphasis is placed on producing two research papers prior to writing a dissertation. These two research papers are typically presented at conferences and often lead to separate journal publications. Students are encouraged to incorporate the two research papers into their dissertation.

Nov. 1 (2nd year)  
First Research Paper*, completion of which typically marks achievement of an M.A. within the Ph.D. program. (Some additional coursework may be required to complete the MA.)

May 1 (3rd year)  
Second Research Paper*, completion of which signals readiness to discuss a career path with an adviser

May 1 (4th year)  
Dissertation Proposal due detailing a significant research project and the methods to be used. Student must pass oral defense.

Aug. 1 (5th year)  
Graduate Board Oral Exam defending a Ph.D. Dissertation that presents an original contribution to some area(s) of cognitive science in a format approaching publication standards

* The two research papers must each employ a different research methodology within cognitive science, e.g., theoretical linguistics and psychology, supervised by two appropriate faculty members.

Financial Support
The department provides competitive levels of funding for Ph.D. students covering tuition and living expenses. Research expenses, including some support for travel to present papers at scholarly meetings, are also provided. If a student maintains an academic good standing, funding is extended up to five years of total support. Students are encouraged to apply for external graduate fellowship opportunities (NSF, NIH, DoD, etc.). As funded entities, our graduate students are expected to engage in full-time research during the summer months and the January intersession in addition to their regular coursework, TA responsibilities, and participation in academic departmental talks and events.

For current faculty and contact information go to http://cogsci.jhu.edu/}

Faculty
Chair  
Géraldine Legendre  
Professor: syntax, optimality theory, Romance and Balkan morphology and syntax, acquisition of syntax.

Professors  
Barbara Landau  
Dick and Lydia Todd Faculty Development Professor: language acquisition, cognitive development, spatial representation, acquisition of the lexicon.

Michael McCloskey  
Professor: cognitive neuropsychology, vision, spatial and lexical representation, foundations of cognitive science.

Brenda Rapp  
Professor: cognitive neuropsychology, spelling, spoken language production, spatial frames of reference, reading and neural bases of recovery of function

Paul Smolensky  
Krieger-Eisenhower Professor of Cognitive Science: grammatical theory, neural networks, optimality theory.

Alan Yuille  
Bloomberg Distinguished Professor: computational models of vision, mathematical models of cognition, and artificial intelligence and neural networks.

Associate Professors  
Kyle Rawlins  
Associate Professor: natural language semantics and pragmatics, the syntax/semantics interface, syntax.

Colin Wilson  
Associate Professor: theoretical phonology, experimental phonology, computational cognitive science.

Assistant Professors  
Michael Bonner  
Assistant Professor: cognitive neuroscience, computational neuroscience, vision, semantic memory, navigation, machine learning, artificial intelligence, neural networks, statistical modeling of neural representations.

Tal Linzen  
Assistant Professor: human sentence comprehension, computational psycholinguistics.

Professor Emeritus  
Luigi Burzio  
theoretical phonology, morphology, and syntax, Romance linguistics.

Secondary Appointments  
Marina Bedny  
Assistant Professor (Psychological and Brain Sciences): brain development and plasticity, cognitive neuroscience, concepts.

Howard Egeth  
Professor (Psychological and Brain Sciences): perception, attention, cognition, psychology, law.

Lisa Feigenson  
Professor (Psychological and Brain Sciences): cognitive development, numerical cognition.

Charles Firestone  
Assistant Professor (Psychological and Brain Sciences): how perception enables and incorporates sophisticated processing typically associated with higher-level cognition.

Jonathan Flombaum
Associate Professor (Psychological and Brain Sciences): visual perception, attention, cognition.

Steven Gross
Associate Professor (Philosophy): philosophy of language, philosophy of mind, metaphysics.

Justin Halberda
Professor (Psychological and Brain Sciences): cognitive development, reasoning, language acquisition.

Joint Appointments
Dana Boatman
Professor (Neurology and Otolaryngology, School of Medicine): speech perception, auditory processing disorders, auditory neurophysiology.

John Desmond
Professor (Neurology, School of Medicine): neuroimaging, transcranial magnetic stimulation methods to investigate neural correlates of behavior.

Jason Eisner
Professor (Computer Science, Whiting School of Engineering): computational linguistics (syntax and phonology), natural language processing, statistical machine learning, programming language design.

Barry Gordon
Professor of Therapeutic Cognitive Neuroscience (Neurology, School of Medicine): cognitive neurology, cognitive neuroscience, language, aphasia, memory, amnesia and memory disorders, autism, computational models of cognition, and cognitive disorders.

Argye Hillis-Trupe
Professor (Neurology, School of Medicine): language impairments in acute stroke, hemi-spatial neglect after stroke, relationship between cognitive impairments and regions of hypoperfused brain.

Nazbanou "Bonnie" Nozari
Assistant Professor (Neurology, School of Medicine): monitoring and metacognitive processes over language, selective attention in language production, computational models of language production, aphasia.

Kyrama Tsapkini
Assistant Professor (Neurology, School of Medicine): language--combining cognitive science, psychology, neural science approaches.

Benjamin Van Durme
Assistant Research Professor (Computer Science, Whiting School of Engineering; Senior Research Scientist, Human Language Technology Center of Excellence): natural language processing, specifically semantics; streaming/randomized algorithms.

Lecturer
Julia Yarmolinskaya
Lecturer (Center for Language Education): perception and acquisition of second language phonology.

For current course information and registration go to https://sis.jhu.edu/classes/

Courses
AS.050.101. Cognition. 3.0 Credits.
Introductory course exploring the study of human mental processes within the field of cognitive science. Drawing upon cognitive psychology, cognitive neuropsychology, cognitive neuroscience, linguistics, and artificial intelligence, the course examines theory, methods, and major findings in work on vision, reasoning, and language.
Instructor(s): T. Linzen
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.102. Language and Mind. 3.0 Credits.
Introductory course dealing with theory, methods, and current research topics in the study of language as a component of the mind. What it is to "know" a language: components of linguistic knowledge (phonetics, phonology, morphology, syntax, semantics) and the course of language acquisition. How linguistic knowledge is put to use: language and the brain and linguistic processing in various domains. Cross-listed with Neuroscience and Psychology.
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.105. Introduction to Cognitive Neuropsychology. 3.0 Credits.
When the brain is damaged or fails to develop normally, even the most basic cognitive abilities (such as the ability to understand words, or perceive objects) may be disrupted, often in remarkable ways. This course explores a wide range of cognitive deficits, focusing on what these deficits can tell us about how the normal brain works. Topics include brain anatomy and causes of brain damage, reading and spelling deficits, unilateral spatial neglect, hemispheric disconnection, cortical plasticity, and visual perception of location and orientation. Students read primary sources: journal articles that report deficits and discuss their implications.
Instructor(s): M. McCloskey
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.107. Language and Advertising. 3.0 Credits.
Advertising pervades our culture; interactions with advertising are an unavoidable fact of modern life. This class uses tools from linguistics and cognitive science to analyze these interactions, and understand the impact of advertising on its viewers. A central theme is to treat ads as communicative acts, and explore the consequences -- what can theories of communication (from linguistics, psychology, and philosophy) tell us about ads? How do ads use central features of human cognition to accomplish their aims? Do ads manipulate, and if so, how successfully? The theories of communication we explore include Gricean pragmatics, theories of speech acts, linguistic theories of presuppositions, and more. Students will collect, analyze, and discuss advertisements in all mediums.
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences.
AS.050.128. Freshmen Seminar: Born to Talk: Language in the Human Mind. 3.0 Credits.
Human infants learn their native language in less than 5 years with no direct teaching from adults. This mysterious fact is the basis of the modern study of language as a cognitive and computational system. In this seminar we will review major findings about how children learn the sound system, words, and grammar of their first language, focusing on how the evidence reveals the role of biological structures and environmental influences on language development. Weekly readings will include summary texts, original research articles, and coverage of language science in the popular media. Although language development is a topic of real importance to parents, educators, and policy-makers, it is often difficult to disseminate findings in a way that the public can understand. In weekly writing assignments, students will practice “translating” scientific reasoning for a general audience. Freshman Seminar
Instructor(s): S. Lewis
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.202. Introduction to Computational Cognitive Science. 3.0 Credits.
This course is an introduction to computational approaches to the study of the mind. The approaches discussed include symbolic structured representations, probabilistic inference and artificial neural networks, as applied to concept learning, language and reasoning. Some programming experience (e.g., AS 250.205.01 Introduction to Computing or equivalent) and mathematical preparation (e.g., AS.110.107 Calculus II or equivalent) are highly recommended.
Instructor(s): T. Linzen
Area: Quantitative and Mathematical Sciences.

AS.050.203. Cognitive Neuroscience: Exploring the Living Brain. 3.0 Credits.
This course surveys theory and research concerning how mental processes are carried out by the human brain. Currently a wide range of methods of probing the functioning brain are yielding insights into the nature of the relation between mental and neural events. Emphasis will be placed on developing an understanding of both the physiological bases of the techniques and the issues involved in relating measures of brain activity to cognitive functioning. Methods surveyed include electrophysiological recording techniques such as EEG, ERP, single/multiple unit recording and MEG; functional imaging techniques such as PET and fMRI; and methods that involve lesioning or disrupting neural activity such as cortical stimulation, animal lesion studies, and the study of brain-damaged individuals. (Co-listed as AS.080.203 in Neuroscience.) It's strongly recommended that students have background in one of the following courses: AS.050.101 OR AS.050.105 OR AS.200.141.
Instructor(s): Staff
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.206. Bilingualism. 3.0 Credits.
Do children get confused when they grow up exposed to more than one language? Is it possible to forget one's native language? Are the first and second language processed in different areas of the brain? How does brain damage impact the different languages of a polyglot? Does knowing a second language affect non-linguistic cognitive processing? This course will address questions such as these through an exploration of mental and neural processes underlying bilingual and multilingual language processing.
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.235. Theory of Mind and the Development of Language. 1.0 Credit.
The course offers an overview of recent research on language and social cognition. It focuses on Theory of Mind (ToM) and the development of language. Theory of Mind is the ability to attribute mental states to oneself and others and to understand that others have beliefs, desires, and intentions that are different from one's own. The development of human language is closely related to the development of ToM.
Instructor(s): A. Tamm
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.240. World of Language. 3.0 Credits.
This hands-on course exposes students to the fascinating variety – and uniformity – to be found among the world's 6000 languages through group lectures on a variety of topics as well as actual linguistic fieldwork conducted in small groups with a native speaker of a language unknown to the participants. This course is a good preparation for upper-division linguistics courses.
Instructor(s): G. Legendre
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.312. Cognitive Neuroimaging Methods in High-Level Vision. 3.0 Credits.
This course is an advanced seminar and research practicum course. It will provide the opportunity to learn about fMRI methods used in the field of vision science and for students to have hands-on experience to develop, design and analyze a research study on topics in the cognitive neuroscience field of high-level vision. In the first part of the course students will read recent fMRI journal papers and learn about common fMRI designs and analysis methods; in the second part of the course students will conduct a research study as a group to address a research question developed from readings. Students are expected to write a paper in a journal article format at the end of the course and to present their results in front of the class. Research topics will vary but with special focus on topics in object, scene and space recognition. Cross-listed with Neuroscience and Psychology. Instructor’s permission required.
Instructor(s): S. Park
Area: Natural Sciences, Social and Behavioral Sciences.

When we think about our ability to see, we tend to think about our eyes, but in fact vision happens mostly in the brain. This course explores the remarkable perceptual deficits that occur when the visual regions of the brain are damaged or fail to develop normally, focusing on what these perceptual malfunctions tell us about normal visual perception. Topics include visual system anatomy and physiology; functional specialization in the lower visual system as revealed by cerebral achromatopsia (color blindness resulting from brain damage) and akinetopsia (impaired motion perception); cortical plasticity in the visual system; spatial deficits in perception and action; and the implications of high-level visual deficits, including prosopagnosia (impaired face recognition), Charles Bonnet syndrome (complex visual hallucinations in blind areas of the visual field), blindsight (accurate responding to visual stimuli despite apparent inability to see them), and Anton’s syndrome (denial of blindness).
Prerequisites: AS.050.105 OR AS.050.203 OR AS.080.203 OR AS.050.101 OR AS.200.110 OR AS.200.211 or instructor’s permission.
Instructor(s): M. McCloskey
Area: Natural Sciences, Social and Behavioral Sciences.
AS.050.317. Semantics I. 3.0 Credits.
This is an introduction to the study of meaning in natural language. We address the conceptual and empirical issues in semantic theory and introduce some formal machinery that has been developed to deal with such problems. After discussing foundational questions, we turn to formal semantics and pragmatics, as well as their interfaces with syntax and the lexicon. Specific topics include presupposition, type-driven composition, quantification, lexical aspect, argument structure, and lexical representations of meaning.
Prerequisites: AS.050.107 OR AS.050.102 or instructor's permission.
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.318. Practicum in Language Disorders- Community Based Learning. 2.0 Credits.
This course provides the opportunity to learn about adult aphasias, language disorders which are one of the most common consequences of stroke. You will receive training in supportive communication techniques and work as a communication partner with an individual with aphasia for two hours per week. Three class meetings for orientation and reading assignments will be held on campus; training and practicum will be conducted at a local aphasia support center. Independent mode of transportation required. Co-listed as AS.080.400 in Neuroscience. Additional information can be found on the Department of Neuroscience's website: http://krieger.jhu.edu/neuroscience/academics/practicums/practicum-in-language-disorders. Interested students should contact the instructor. Find out more about the practicum site at http://www.scalebaltimore.org.
Prerequisites: A- or Better in AS.050.105 OR AS.050.203 OR AS.080.203 OR AS.050.311 or instructor's permission.
Instructor(s): B. Rapp
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.320. Syntax I. 3.0 Credits.
Introduces the basic methods and means of analysis used in contemporary syntax investigations, practicing with data from different languages. Also offered as AS.050.620.
Prerequisites: AS.050.102 OR AS.050.240 or equivalent/see instructor.
Instructor(s): G. Legendre
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.325. Phonology I. 3.0 Credits.
An introduction to the basic principles underlying the mental representation and manipulation of language sounds and their relation to human perception and vocal articulation: how units of sound are both decomposable into elementary features and combined to form larger structures like syllables and words. The role of rules and constraints in a formal theory of phonological competence and in accounting for the range of variation among the world’s languages. Also offered as AS.050.625.
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.326. Foundations of Cognitive Science. 3.0 Credits.
This course explores general issues and methodologies in cognitive science through the reading of classic works (from Plato and Kant through Skinner and Turing) and recent research articles to begin construction of a coherent picture of many seemingly divergent perspectives on the mind/brain. Recent brain-based computational models serve to focus discussion. Also offered as AS.050.626.
Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.050.328. Introduction to Neuronal Computation. 3.0 Credits.
This course provides a broad survey of current research in computational neuroscience. We will begin with foundational questions in the context of biophysical neurons, and then turn to explore current state of research into the brain's information processing capabilities. We will work both on lectures and hands-on exercises. This is an exciting time to learn about the current state of research in the field of computational neuroscience. Please see course prerequisites. Meets with AS.050.632.
Prerequisites: AS.050.101 OR AS.050.339 OR AS.200.132 OR AS.050.105 OR Instructor's Permission.
Instructor(s): B. Landau
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.333. Psycholinguistics. 3.0 Credits.
This course provides a broad survey of current research on language processing in adult native speakers and language learners. Topics include speech perception, word recognition, and sentence production and comprehension. We will discuss the nature of representations that are being constructed in real-time language use, as well as how the mental procedures for constructing linguistic representations could be studied by various behavioral and physiological measures. Also offered as AS.050.633.
Prerequisites: AS.050.102 OR AS.050.240 OR AS.050.317 OR AS.050.320 OR AS.050.325 or instructor's permission.
Instructor(s): E. Atkinson
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.050.339. Cognitive Development. 3.0 Credits.
This is a survey course in developmental psychology designed for individuals with some basic background in psychology or cognitive science, but little or none in development. The course is strongly theoretically oriented, with emphasis on issues of nature, and development psychology as well as relevant empirical evidence. The principle focus will be early development, i.e., from conception through middle childhood. The course is organized topically, covering biological and prenatal development, perceptual and cognitive development, the nature and development of intelligence, and language learning.
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences.

Neuroimaging provides a fascinating, versatile window into how the brain instantiates the mind. In this class we will survey both structural and functional neuroimaging techniques. This course will be a small-classroom, computer-based lab course. Each meeting will be a mix of lecture and hands-on exercises. This is an exciting time to learn about the current state of neuroimaging, and this course will be well suited for the beginner who is merely curious as well as for well initiated who are eager to explore further ways to study the mind via neuroimaging.
Prerequisites: (AS.050.203 OR AS.080.203 OR AS.050.101 OR AS.050.105 OR AS.200.141) AND (EN.550.111 OR EN.550.211 OR AS.230.205 or EN.550.113 OR EN.550.230 OR EN.550.310 OR EN.550.311 OR EN.550.420 OR EN.550.413 OR AS.280.345 OR AS.200.314 OR EN.560.348)
Instructor(s): J. Purcell
Area: Natural Sciences, Social and Behavioral Sciences.
AS.050.344. Writing Matters: Written Language and the Brain. 3.0 Credits.
Written language is undoubtedly one of humanity's greatest inventions, providing the basis for most all other human innovations. What are the capacities of the human mind that enable written language? How does literacy change the brain? Do differences in writing systems affect how humans learn and process written language? These and other questions will be addressed by examining evidence from experimental studies of individuals with typical written language processing, as well as neuropsychological studies of brain-injured individuals. Throughout the course you will build and revise a cognitive architecture, a theory of how humans process written language, based on the current understanding of the cognitive and neural bases of literacy.
Prerequisites: AS.050.101 OR AS.050.105 OR AS.050.203 OR AS.080.203 OR AS.200.141 or instructor’s permission.
Instructor(s): R. Wiley
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.345. Cognitive and Neural Basis of Executive Control. 3.0 Credits.
This course discusses the concept of executive control, a general class of functions that support more specialized cognitive operations such as language and problem solving, and their neural underpinning. Discussion will include classification of executive functions, relationship to working memory, domain-generality or specificity of executive control functions, and experimental, neural, and computational approaches to exploring components of executive control, with a special emphasis on the role of cognitive control in the processing of language. The goal of this course is two-fold: to teach students the basic knowledge regarding cognitive and neural mechanisms of executive control, and more importantly to encourage them to put that knowledge to use by asking them to think critically about the readings, to participate in interactive discussions with questions they bring in each week based on the readings assigned for that week, and finally to propose one well thought-out question at the end of the semester and to write a short proposal on how to explore that question. As such, the course puts little emphasis on memorization and a strong emphasis on analytical abilities and integration.
Prerequisites: AS.200.207[C] OR AS.050.333[C] OR EN.550.111[C]
Instructor(s): N. Nozari
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.346. Decoding the Brain: Multivariate Analysis in Cognitive Neuroscience. 3.0 Credits.
Neural decoding through Machine Learning has become an ever-important tool for neuroscientists to understand how the brain processes information. This course introduces students to this exciting field by combining seminar style lectures and hands-on practice sessions. The course will be organized around a number of corner-stone applications in cognitive neuroscience, including face recognition, neural representation of word meaning, decoding mental states. During the practice sessions, students will learn to replicate the published findings with off-the-shelf software (prior programming knowledge could be helpful not required). By the end of the course, the students will have the principal methods and applications of neural decoding, and will acquire hands-on experience and practical skills of data analysis.
Prerequisites: EN.553.111 OR EN.553.112 OR EN.550.111 OR EN.550.112 OR equivalent.
Instructor(s): Y. Tao
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.358. Language & Thought. 3.0 Credits.
Have you ever wondered about the relationships between language and thought? Philosophers, linguists, psychologists, evolutionary theorists and cognitive scientists have too and this course will survey the current thinking on this matter. Classical papers such as those by Whorf and Sapir, more recent philosophical papers by people such as Fodor and Dennett, and recent empirical work by linguists and psychologists on the relationship between language and thinking in development and in adults will be covered. Discussions will focus on the theoretically possible relationships between language and thought and the empirical data that speak to these. Juniors and seniors only. Freshmen and sophomores by permission of instructor only.
Instructor(s): B. Landau
Area: Humanities, Natural Sciences, Social and Behavioral Sciences.

AS.050.370. Mathematical Models of Language. 3.0 Credits.
This course will be devoted to the study of formal systems that have proven useful in the cognitive science of language. We will discuss a wide range of mathematical structures and techniques and demonstrate their applications in theories of grammatical competence and performance. A major goal of this course is bringing students to a point where they can evaluate the strengths and weaknesses of existing formal theories of cognitive capacities, as well as profitably engage in such formalization, constructing precise and coherent definitions and rigorous proofs. Also offered as AS.050.670.
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.371. Bayesian Inference. 3.0 Credits.
This course introduces techniques for computational modeling of aspects of human cognition, including perception, categorization, and induction. Possible topics include maximum likelihood and Bayesian inference, structured statistical models (including hierarchical and graphical models), nonparametric models. The course emphasizes the close connections among data analysis, theory development, and modeling, with examples drawn from language and vision. Also offered as AS.050.671.
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.372. Foundations of Neural Network Theory. 4.0 Credits.
Introduction to continuous mathematics for cognitive science, with applications to biological and cognitive network models: real and complex numbers, differential and integral multi-variable calculus, linear algebra, dynamical systems, numerical optimization. Meets with AS.050.672.
Prerequisites: AS.110.106 OR AS.110.108
Instructor(s): P. Smolensky
Area: Natural Sciences, Quantitative and Mathematical Sciences.
AS.050.373. Neural-Network Modeling of Learning, Language and Cognition. 3.0 Credits.
Connectionism is an approach to Artificial Intelligence computation inspired by how the brain, a network of neurons, works. A connectionist model (or artificial neural network) is a collection of simple processing units that are massively interconnected with each other, and that represents knowledge in its connection pattern. Each processing unit has highly limited computational power but the collection of units as a whole has great computational power (as strong as the Turing machine). Connectionist models have been used to study diverse aspects of human cognition: attention, pattern recognition, memory, categorization, language processing, learning, and decision making. In this seminar, students will learn important concepts, principles, algorithms, and practical skills in connectionist modeling by actually doing connectionist modeling. Students will first play with toy problems to learn various types of connectionist modeling techniques, and will then carry out a team research project. In addition to practical skills, students will learn to be explicit about their assumptions and reasoning when making their (conceptual or implemented) models and to make new observable predictions that can be tested in experiments. Recommended Course Background: Experience with some programming language. Exceptions can be made by seeking instructor's permission.
Instructor(s): P. Cho
Area: Natural Sciences, Quantitative and Mathematical Sciences.

AS.050.375. Probabilistic Models of the Visual Cortex. 3.0 Credits.
The course gives an introduction to computational models of the mammalian visual cortex. It covers topics in low-, mid-, and high-level vision. It briefly discusses the relevant evidence from anatomy, electrophysiology, imaging (e.g., fMRI), and psychophysics. It concentrates on mathematical modeling of these phenomena taking into account recent progress in probabilistic models of computer vision and developments in machine learning, such as deep networks.
Prerequisites: AS.110.106 OR AS.110.108
Instructor(s): A. Yuille
Area: Quantitative and Mathematical Sciences.

AS.050.501. Readings in Cognitive Science/Freshmen. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.502. Readings in Cognitive Science-Freshmen. 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.503. Research in Cognitive Science/Freshmen. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.504. Research Cognitive Science-Freshmen. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.505. Readings in Cognitive Science/Sophomores. 1.0 - 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.506. Readings Cognitive Science-Sophomores. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.507. Research in Cognitive Science/Sophomores. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.508. Research Cognitive Science - Sophomores. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.509. Cognitive Science Internship. 1.0 Credit.
Research current topics in cognitive science.
Instructor(s): B. Rapp.

AS.050.511. Readings in Cognitive Science/Juniors. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.512. Readings Cognitive Science-Juniors. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.513. Research in Cognitive Science/Juniors. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.514. Research Cognitive Science - Juniors. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.515. Readings in Cognitive Science/Seniors. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.516. Readings Cognitive Science - Senior. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.517. Research in Cognitive Science/Seniors. 3.0 Credits.
Research current topics in cognitive science.
Instructor(s): Staff.

AS.050.518. Research Cognitive Science - Seniors. 0.0 - 3.0 Credits.
Permission Required.
Instructor(s): Staff.

AS.050.599. Research-Cognitive Science. 0.0 - 3.0 Credits.
Instructor(s): Staff.

Instructor's permission required. (Also offered as AS.050.312.)
Instructor(s): S. Park
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.617. Semantics I.
Also offered as AS.050.317. This is an introduction to the study of meaning in natural language. We address the conceptual and empirical issues in semantic theory and introduce some formal machinery that has been developed to deal with such problems. After discussing foundational questions, we turn to formal semantics and pragmatics, as well as their interfaces with syntax and the lexicon. Specific topics include presupposition, type-driven composition, quantification, lexical aspect, argument structure, and lexical representations of meaning.
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.620. Syntax I.
Also offered as AS.050.320.
Instructor(s): G. Legendre.
AS.050.622. Semantics II.
Co-taught with AS.050.322. This course extends the material in AS.050.317 to cover advanced but central topics in semantic and pragmatic theory, focusing on intensional semantics (especially possible world semantics and situation semantics). Empirical domains of interest in this class include modality, tense, grammatical aspect, conditionals, attitude and speech reports, questions, and free choice phenomena. Three core theoretical issues addressed in this class are the nature of a compositional account of the above intensional phenomena, the representations of possibilities involved, and the role of the syntax/semantics/pragmatics interface in such an account.
Prerequisites: AS.050.617
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.625. Phonology I.
Also offered as AS.050.325. An introduction to the basic principles underlying the mental representation and manipulation of language sounds and their relation to human perception and vocal articulation: how units of sound are both decompositional into elementary features and combined to form larger structures like syllables and words. The role of rules and constraints in a formal theory of phonological competence and in accounting for the range of variation among the world's languages. Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

Also offered as AS.050.326. This course explores general issues and methodologies in cognitive science through the reading of classic works (from Plato and Kant through Skinner and Turing) and recent research articles to begin construction of a coherent picture of many seemingly divergent perspectives on the mind/brain. Recent brain-based computational models serve to focus discussion.
Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

Also offered as AS.050.332. See description. In-depth examination of the current literature on cognitive development in the context of developmental cognitive neuroscience.
Instructor(s): B. Landau.

Also offered as AS.050.333. This course provides a broad survey of current research on language processing in adult native speakers and language learners. Topics include speech perception, word recognition, and sentence production and comprehension. We will discuss the nature of representations that are being constructed in real-time language use, as well as how the mental procedures for constructing linguistic representations could be studied by various behavioral and physiological measures.
Instructor(s): E. Atkinson
Writing Intensive.

Also offered as AS.050.339. This is a survey course in developmental psychology designed for individuals with some basic background in psychology or cognitive science, but little or none in development. The course is strongly theoretically oriented, with emphasis on issues of nature, and development psychology as well as relevant empirical evidence. The principle focus will be early development, i.e., from conception through middle childhood. The course is organized topically, covering biological and prenatal development, perceptual and cognitive development, the nature and development of intelligence, and language learning.
Instructor(s): J. Yarmolinskaya.

Also offered as AS.050.345. This course discusses the concept of executive control, a general class of functions that support more specialized cognitive operations such as language and problem solving, and their neural underpinning. Discussion will include classification of executive functions, relationship to working memory, domain-generality or specificity of executive control functions, and experimental, neural, and computational approaches to exploring components of executive control, with a special emphasis on the role of cognitive control in the processing of language. The goal of this course is two-fold: to teach students the basic knowledge regarding cognitive and neural mechanisms of executive control, and more importantly to encourage them to put that knowledge to use by asking them to think critically about the readings, to participate in interactive discussions with questions they bring in each week based on the readings assigned for that week, and finally to propose one well thought-out question at the end of the semester and to write a short proposal on how to explore that question. As such, the course puts little emphasis on memorization and a strong emphasis on analytical abilities and integration.
Instructor(s): N. Nozari.

AS.050.658. Language & Thought.
Have you ever wondered about the relationships between language and thought? Philosophers, linguists, psychologists, evolutionary theorists and cognitive scientists have too and this course will survey the current thinking on this matter. Classical papers such as those by Whorf and Sapir, more recent philosophical papers by people such as Fodor and Dennett, and recent empirical work by linguists and psycholinguists on the relationship between language and thinking in development and in adults will be covered. Discussions will focus on the theoretically possible relationships between language and thought and the empirical data that speak to these.
Instructor(s): B. Landau.

Also offered as AS.050.370. This course will be devoted to the study of formal systems that have proven useful in the cognitive science of language. We will discuss a wide range of mathematical structures and techniques and demonstrate their applications in theories of grammatical competence and performance. A major goal of this course is bringing students to a point where they can evaluate the strengths and weaknesses of existing formal theories of cognitive capacities, as well as profitably engage in such formalization, constructing precise and coherent definitions and rigorous proofs.
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences.
AS.050.671. Bayesian Inference.
Also offered as AS.050.371. This course introduces techniques for computational modeling of aspects of human cognition, including perception, categorization, and induction. Possible topics include maximum likelihood and Bayesian inference, structured statistical models (including hierarchical and graphical models), nonparametric models. The course emphasizes the close connections among data analysis, theory development, and modeling, with examples drawn from language and vision.
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences.

AS.050.672. Foundations of Neural Network Theory.
Also offered as AS.050.372. Introduction to continuous mathematics for cognitive science, with applications to biological and cognitive network models: real and complex numbers, differential and integral multi-variable calculus, linear algebra, dynamical systems, numerical optimization.
Instructor(s): P. Smolensky.

The course gives an introduction to computational models of the mammalian visual cortex. It covers topics in low-, mid-, and high-level vision. It briefly discusses the relevant evidence from anatomy, electrophysiology, imaging (e.g., fMRI), and psychophysics. It concentrates on mathematical modelling of these phenomena taking into account recent progress in probabilistic models of computer vision and developments in machine learning, such as deep networks. Also offered as AS.050.375. Co-listed with Computer Science as EN.601.485.
Instructor(s): A. Yuille.

Directed readings on current topics in cognitive science. Instructor approval required.
Instructor(s): Staff.

AS.050.800. Directed Readings.
Guided independent readings in special fields of cognitive science.
Instructor(s): P. Smolensky.

Participants in this graduate seminar will read and discuss current research articles in cognitive neuropsychology of vision or language, and present their own research.
Instructor(s): M. McCloskey.

Permission required. Current issues and ongoing research on human cognition are discussed.
Instructor(s): B. Rapp.

A specialized research seminar for individuals researching language acquisition, cognitive development and the interface between language and cognition. Students must actively carry out empirical or theoretical research in these areas. Permission required.
Instructor(s): B. Landau.

AS.050.814. Research Seminar in Computer Vision.
This course covers advanced topics in computational vision. It discusses and reviews recent progress and technical advances in topics such as object recognition, scene understanding, and image parsing.
Instructor(s): A. Yuille.

Instructor(s): K. Rawlins.

Participants in this graduate seminar will read and discuss current research articles in language development and present their own research. Permission required.
Instructor(s): G. Legendre.

Discussion of current computational and experimental research on human language processing.
Instructor(s): T. Linzen.

A critical analysis of current issues and debates in theoretical syntax. Discussion of on-going research.
Instructor(s): G. Legendre.

AS.050.825. Research Seminar in Optimality Theory.
A specialized research seminar on constraint based theories of human language, including Optimality Theory, Harmonic Grammar, and Maximum Entropy models.
Instructor(s): G. Legendre.

Readings and research presentations on varying topics in mathematics, computation, and formal linguistics with bearing on cognitive science.
Instructor(s): C. Wilson.

AS.050.827. Research Seminar in Language Acquisition.
Focus is on current research in acquisition of syntax.
Instructor(s): G. Legendre.

This seminar will read on-going and recent papers on the cognitive neuroscience research of vision. Permission required.
Instructor(s): S. Park.

Topics range from mathematical analysis of neural networks to computational studies of linguistic structure. Focus is ongoing research and current literature.
Instructor(s): P. Smolensky.

AS.050.832. Research In Language Processes.
Current Topics in Human Language Processing, with discussion of recent developments in theory and experimental study. Permission required.
Instructor(s): A. Omaki.

Current topics in any area of cognitive science, including language and vision, with discussion of recent developments in theory, experimental study, and computational modeling.
Instructor(s): Staff.

AS.050.849. Teaching Practicum.
Permission required. Essential for Teaching Assistants.
Instructor(s): Staff.

Instructor permission required. Addresses professional issues such as research ethics, success on the job market and in an academic career, teaching and mentoring and differing professional standards in the sub-disciplines of cognitive science.
Instructor(s): G. Legendre.
Independent study. Intended for graduate students who have completed all degree requirements except for their dissertation but must remain or return to residency status in order to fulfill other obligations. Advisor or department approval required
Instructor(s): Staff.

Cross Listed Courses

Neuroscience
AS.080.203. Neuroscience: Cognitive. 3.0 Credits.
This course surveys theory and research concerning how the human brain carries out mental processes. The sections of this course correspond with the sections listed for AS.050.203. All sections will meet together on exams day and guest lecture days. Co-listed as AS.050.203 in Cognitive Science. It’s strongly recommended that students have background in one of the following courses: AS.050.101 OR AS.050.105 OR AS.200.141.
Instructor(s): Staff
Area: Natural Sciences, Social and Behavioral Sciences.

AS.080.320. The Auditory System. 3.0 Credits.
This course will cover the neuroanatomy and neurophysiology of the human auditory system from the ear to the brain. Behavioral, electrophysiological, and neuroimaging methods for assessing peripheral and central auditory function will be discussed. Acquired and developmental disorders of auditory function will be reviewed using clinical case studies.
Prerequisites: AS.080.305 OR AS.080.203 OR AS.050.203 OR AS.200.141 OR AS.020.312 or permission of the instructor.
Instructor(s): D. Boatman
Area: Natural Sciences.

Psychological Brain Sciences
AS.200.336. Foundations of Mind. 4.0 Credits.
An interdisciplinary investigation into the innateness of concepts: perception, number, language, and morality, physics discussed. Evidence from animals, infants, patients, brains. Students collect data in sections investigating claims from the readings. Cross-listed with Cognitive Science and Philosophy.
Instructor(s): J. Halberda; L. Feigenson
Area: Social and Behavioral Sciences.

Music
AS.376.371. Introduction to Music Cognition. 3.0 Credits.
What underlies our aesthetic response to music? How and why are we able to identify certain sounds as music? To what extent are music and natural language similar? What is it about music that evokes such powerful emotions such as happiness and sadness? What is unique to musical creativity? Examining such questions from cognitive science, neuroscience, psychology, and philosophical perspectives, this course explores relevant research and theory in the emerging domain of music perception and cognition. Students will complete a final research paper on the topic of their choice that integrates the course material.
Instructor(s): M. Lopez-Gonzalez
Area: Natural Sciences, Social and Behavioral Sciences.

AS.376.372. Topics in Music Cognition. 3.0 Credits.
This course explores the similarities and differences between music and language, the effects of musical training on cognitive development, and the expressive power of music, with an introduction to music and its role in film. We will read relevant research and theory on these topics from cognitive science, neuroscience, psychology, musicology, and philosophical perspectives.
Instructor(s): M. Lopez-Gonzalez
Area: Natural Sciences, Social and Behavioral Sciences.

Computer Science
EN.601.769. Events Semantics in Theory and Practice. 3.0 Credits.
This course explores selected topics in the nature of event representations from the perspective of cognitive science, computer science, linguistics, and philosophy. These fields have developed a rich array of scientific theories about the representation of events, and how humans make inferences about them -- we investigate how (and if) such theories could be applied to current research topics and tasks in computational semantics such as inference from text, automated summarization, veridicality assessment, and so on. In addition to classic articles dealing with formal semantic theories, the course considers available machine-readable corpora, ontologies, and related resources that bear on event structure, such as WordNet, PropBank, FrameNet, etc.. The course is aimed to marry theory with practice: students with either a computational or linguistic background are encouraged to participate.
[Applications]
Instructor(s): B. Van Durme; K. Rawlins.