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

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-graduate-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 2019 or after. Students who entered Fall 2018 and prior should refer to the academic catalog from the year they entered (http://e-catalog.jhu.edu/archive), with the caveat that students who entered in Fall 2017 and prior may follow the new Math Option B (Research Methods I + Design and Analysis) or the old Math Option B (Stats I + Stats II + Research Methods).

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 (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 requirement 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 in Linguistics area (any level)</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course in Neuroscience area (any level)</td>
<td>3-4</td>
<td>3</td>
</tr>
</tbody>
</table>
Excellent in Cognitive Science Award
Each year at Commencement, a cognitive science graduating senior with a stellar academic and research record is selected. The department’s faculty make nominations and the Director of Undergraduate Studies announces the winner. This honor is accompanied by a $500 award.

Minor in Linguistics
A minor in linguistics is available to undergraduates majoring in any department, except for cognitive science majors who choose linguistics as a focal area. Students intending to minor in linguistics should declare their intention, preferably by the beginning of junior year. A grade of C- or better must be earned in all minor requirements.

Linguistics Minor Requirements
Foreign Language
One foreign language through the intermediate level OR two foreign languages at the elementary level.

Linguistics Courses
Six courses in linguistics that fall under the linguistics focal area
Four of the required six linguistics courses must be at the 300-level or above, excluding research and readings.

Graduate 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
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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.690</td>
<td>Directed Readings in Cognitive Science</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.050.839</td>
<td>Research in Cognitive Science</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.360.625</td>
<td>Responsible Conduct of Research (in-person,</td>
<td></td>
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<tr>
<td></td>
<td>unless granted permission by the Director of</td>
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<tr>
<td></td>
<td>Graduate Studies to take online due to</td>
<td></td>
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<tr>
<td></td>
<td>extenuating circumstances)</td>
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</tbody>
</table>

Capstone: Portfolio and Oral Exam - Portfolio will include course assignments, seminar papers, etc. overseen by the faculty mentor, a reading list, and a set of discussion questions. Student will present what has been learned while in the program at an oral presentation before two committee members. Student must pass oral exam to earn MA.

* 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 or equivalent with mentor’s written permission

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.200.657</td>
<td>Advanced Statistical Methods (previously listed as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AS.200.314)</td>
<td>200-level</td>
</tr>
<tr>
<td>AS.050.670</td>
<td>Mathematical Models of Language</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.050.671</td>
<td>Bayesian Inference</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.050.672</td>
<td>Foundations of Neural Network Theory</td>
<td>600-level</td>
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</tbody>
</table>

Lab or Research Seminar: Two courses, 800-level

<table>
<thead>
<tr>
<th>Course</th>
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<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.839</td>
<td>Research in Cognitive Science</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.050.672</td>
<td>Foundations of Neural Network Theory</td>
<td>600-level</td>
</tr>
<tr>
<td>AS.360.625</td>
<td>Responsible Conduct of Research (in-person,</td>
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<td>unless granted permission by the Director of</td>
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<tr>
<td></td>
<td>extenuating circumstances)</td>
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</tbody>
</table>

Additional Courses: Three courses, 600-level or above

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.360.625</td>
<td>Responsible Conduct of Research (in-person,</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>extenuating circumstances)</td>
<td></td>
</tr>
</tbody>
</table>

Capstone: Research Paper and Oral Defense - Paper must be approved by the faculty mentor(s) prior to student’s defense. Student must pass defense to earn MA.

Financial Support
No regular funding is provided to students in the M.A. program, though a one-year (Spring and Fall only) 50% reduction in tuition is offered to
students with JHU bachelors degrees. Students are encouraged to seek funding from both internal and external sources.

**Doctrinal 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:

- **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.

- **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 several 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.

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

**General PhD 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. The Computational Cognitive Science Track (p. ) is more specialized than a Computational Approaches focal area and has different requirements.

**Breadth (One breadth course may be audited in consultation with your adviser.)**

| Cognitive Neuroscience       | AS.050.639 Cognitive Development (or an approved course/seminar on a topic outside the area of language) or AS.050.31 Cognitive Neuropsychology of Visual Perception: The Malfunctioning Visual Brain |
| Philosophy                   | AS.050.671 Bayesian Inference (or Programming (C++, Java, etc.), or equivalent (e.g. computational linguistics)) or AS.050.660 Computational Psycholinguistics |
| Cognitive Psychology/Neuropsychology | AS.050.626 Foundations of Cognitive Science |

**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.

| Language (at least 1 course)       | AS.050.670 Mathematical Models of Language |
| Vision (at least 1 course)         | AS.050.671 Bayesian Inference |

**Basic Computation**

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

| EN.601.675 Machine Learning |
| AS.050.315 Foundations of Neural Network Theory |
| AS.050.672 Foundations of Neural Network Theory |

**Integration**

| AS.050.626 Foundations of Cognitive Science |

**AS.200.657 Advanced Statistical Methods** (previously listed as AS.200.314; to be completed early in the program, preferably the first semester)
and a 12-month stipend. PhD students are also given access to an annual travel/research allowance for eligible expenses. Assuming satisfactory progress toward the Ph.D. degree and continued funding levels, PhD students may expect this support to continue for five years (10 semesters)

In return, graduate students are expected to dedicate their full time and attention to coursework, teaching, research, etc. within the Department of Cognitive Science, forgoing employment outside of the department. Additionally, they are expected to apply for any outside funding (e.g. NSF fellowship, etc.) for which they are eligible as early as their first semester. Students who receive fellowships or grants are to report this information to the Chair and administrative staff of the department. Funds given to any student over and above tuition, mandatory fees and books and equipment may be subject to taxation. For clarification of tax issues, please contact the University Tax Office (443) 997-8688.

There are some internal opportunities for PhD students. For example, students in their third year or beyond may design and instruct an undergraduate course for payment. Such opportunities include Summer (summerprograms.jhu.edu/for-faculty) and Intersession (summerprograms.jhu.edu/program/intersession-program) courses as well as the Dean’s Teaching Fellowship (krieger.jhu.edu/research/graduate/df). All proposed courses must be approved by the student’s advisor(s) and the department chair.

If a PhD student must continue past the summer of his or her fifth year in the program, he or she must obtain non-resident status (homewoodgrad.jhu.edu/academics/graduate-board/new-grad-board-residency-page). The program does not provide PhD students funding past the fifth year and students are responsible for nonresident tuition (studentaffairs.jhu.edu/student-accounts/tuition-fees). The program does not allow students to ‘defer’ funding if they receive a grant/ fellowship in years 1-5.

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

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.

Colin Wilson

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Research Ethics
AS.360.625 Responsible Conduct of Research (encouraged to complete in first year)

Depth: Area of Focus in ComputationCogSci
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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.675</td>
<td>Probabilistic Models of the Visual Cortex</td>
</tr>
<tr>
<td>EN.601.665</td>
<td>Natural Language Processing</td>
</tr>
<tr>
<td>EN.601.769</td>
<td>Events Semantics in Theory and Practice</td>
</tr>
<tr>
<td>EN.601.783</td>
<td>Vision as Bayesian Inference</td>
</tr>
</tbody>
</table>

Teaching Assignments
AS.050.849 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.).)

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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 1</td>
<td>First Research Paper**</td>
<td>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.)</td>
</tr>
<tr>
<td>May 1</td>
<td>Second Research Paper**</td>
<td>Completion of which signals readiness to discuss a career path with an adviser</td>
</tr>
<tr>
<td>May 1</td>
<td>Dissertation Proposal</td>
<td>Due detailing a significant research project and the methods to be used. Student must past oral defense</td>
</tr>
<tr>
<td>Aug. 1</td>
<td>Graduate Board Oral Exam</td>
<td>Defending a Ph.D. Dissertation that presents an original contribution to some area(s) of cognitive science in a format approaching publication standards</td>
</tr>
</tbody>
</table>

* 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.

^ To request a project deadline extension, submit a written request to your advisor(s) and the Director of Graduate Studies. The request should include a proposed new deadline and a narrative explanation of the reasons for the extension and the goals for the new deadline (e.g. what the student will accomplish by the proposed new deadline). This request will become a part of your departmental file.

Financial Support
The department provides competitive levels of funding for PhD students. This funding includes full tuition, student health insurance coverage,
Professor: theoretical phonology, experimental phonology, computational cognitive science.

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

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

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.

Leyla Isik
Claire Booth Luce Assistant Professor: computational cognitive neuroscience, vision, social perception, neural networks

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

Lecturer
Julia Yarmolinskaia
Senior Lecturer: perception and acquisition of second language phonology.

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
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
Associate Professor (Neurology, School of Medicine): monitoring and metacognitive processes over language, selective attention in language production, computational models of language production, aphasia.

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

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

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

Courses
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.

Prerequisites: NA
Corequisites: NA
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 impaired, 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.
Prerequisites: NA
Corequisites: NA
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences

AS.050.202. Introduction to Computational Cognitive Science. 3.0 Credits.
How does the mind work? Cognitive science addresses this question from a multidisciplinary perspective, drawing upon methods and ideas from psychology, neurophysiology, neuroscience, philosophy, linguistics, and computer science. Within this framework, computational cognitive science has two related goals. The first is to create computational models of human cognition, computer programs that simulate certain aspects of the mind. The second is to understand how to produce intelligent behavior in machines, taking cues from humans. The computational frameworks we will discuss include symbolic structured representations, probabilistic inference and artificial neural networks, as applied to concept learning, language and vision. While this class does not have formal prerequisites, some programming experience (e.g., AS 250.205 Introduction to Computing or equivalent) and mathematical preparation (e.g., AS.110.107 Calculus II or equivalent) are essential. An optional, hands-on lab (AS.050.212) is offered to supplement this course. It is highly recommended that students with less extensive computational and mathematical experience register for this lab.
Prerequisites: NA
Corequisites: NA
Instructor(s): T. Linzen
Area: Quantitative and Mathematical Sciences

AS.050.203. Neuroscience: Cognitive. 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. 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.
Prerequisites: NA
Corequisites: NA
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences
AS.050.212. Introduction to Computational Cognitive Science Lab. NA Credit.
This course is a hands-on lab supplement for Introduction to Computational Cognitive Science. While this lab is optional, it is highly recommended to students with less extensive computational and mathematical experience.
Prerequisites: NA
Corequisites: Must be registered for AS.050.202 in order to register for this optional lab.
Instructor(s): T. Linzen
Area: NA
NA.

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 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.
Prerequisites: NA
Corequisites: NA
Instructor(s): G. Legendre
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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 aphantasia (lack of visual imagery).
Prerequisites: AS.050.105 OR AS.050.203 OR AS.080.203
Corequisites: 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
NA.

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 AS.050.240 or instructor's permission.
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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 https://www.leagueforpeople.org/scale.
Prerequisites: A- or Better in AS.050.105 OR AS.050.203 OR AS.080.203 OR AS.050.311 or instructor's permission.
Corequisites: NA
Instructor(s): B. Rapp
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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.
Corequisites: NA
Instructor(s): G. Legendre
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences
NA.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.050.332. Developmental Cognitive Neuroscience. 3.0 Credits.
In-depth examination of the current literature on cognitive development in the context of developmental cognitive 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.
Corequisites: NA
Instructor(s): B. Landau
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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.
Corequisites: NA
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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 with seminar-style lectures and hands-on practice sessions. The course will be organized around a number of corner-stone applications of neural decoding in Cognitive Neuroscience, topics include face recognition, concept knowledge representation, and bridging language model and the brain. In the practice sessions, students will learn to analyze actual neuroimaging data and replicate the published findings with off-the-shelf software. By the end of the course, students will be familiar with the basic methods of neural decoding, and acquire hands-on experience of data analysis. Prior programming knowledge is not required and programming skill per se is not part of the evaluation, yet students are expected to familiarize themselves with the scripting interface and understand the basics through the practice sessions. If an interested student has taken a statistics course comparable to one of the listed prerequisite courses, contact the instructor and include the course number and description.
Prerequisites: EN.553.111 OR EN.553.112[OR EN.550.111 OR EN.550.112 OR EN.550.230 OR EN.550.310 OR EN.550.311 OR Instructor Permission
Corequisites: NA
Instructor(s): Y. Tao
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.348. Language Acquisition. 3.0 Credits.
This course provides an introduction to the fields of first and second language acquisition by looking at questions such as the following: Can the grammar of a native language be learned solely on the basis of noticing statistical correlations among words? How does native language acquisition explain — or is explained by — the universal properties, shared by all languages, of words and grammars? How does being exposed to multiple languages from birth affect language acquisition and what happens when a child is not exposed to any language early in life? Does the same cognitive mechanism guide language learning in children and adults? What factors account for individual differences in ease and ultimate attainment when a second language is learned later in life? Is it possible to become indistinguishable from a native speaker in a foreign language? What changes take place in the brain when a new language is learned? Also offered as AS.050.648.
Prerequisites: AS.050.102 OR AS.050.206 OR AS.050.240
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences
NA.
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 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. Juniors and seniors only. Freshmen and sophomores by permission of instructor only.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Landau
Area: Humanities, Natural Sciences, Social and Behavioral Sciences NA.

AS.050.360. Computational Psycholinguistics. 3.0 Credits.
How do we understand and produce sentences in a language we speak? How do we acquire the knowledge that underlies this ability? Computational psycholinguistics seeks to address these questions using a combination of two approaches: computational models, which aim to replicate the processes that take place in the human mind; and human experiments, which are designed to test those models. The perspective we will take in this class is that the models and experimental paradigms do not only advance our understanding of the cognitive science, but can also help us advance artificial intelligence and language technologies. While computational psycholinguistics spans all levels of linguistic structure, from speech to discourse, our focus in this class will be at the level of the sentence (syntax and semantics). The course will assume familiarity with programming and computational modeling frameworks in cognitive science, as covered by Introduction to Computational Cognitive Science or equivalent. Also offered as AS.050.660. An optional, hands-on lab (AS.050.361) is offered to supplement this course. It is highly recommended that students with less extensive computational and mathematical experience register for this lab.
Prerequisites: (AS.050.102 OR AS.050.202 OR EN.601.465) or Instructor Permission.
Corequisites: NA
Instructor(s): T. Linzen
Area: Natural Sciences, Social and Behavioral Sciences NA.

AS.050.361. Computational Psycholinguistics Lab. NA Credit.
This course is an optional hands-on lab supplement for Computational Psycholinguistics. While this lab is optional, it is highly recommended to students with less extensive computational and mathematical experience.
Prerequisites: NA
Corequisites: Must be registered for AS.050.360 or AS.050.660 in order to register for this optional lab.
Instructor(s): T. Linzen
Area: NA
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences NA.

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. Also offered as AS.050.672.
Prerequisites: AS.110.106 OR AS.110.108
Corequisites: NA
Instructor(s): P. Smolensky
Area: Natural Sciences, Quantitative and Mathematical Sciences NA.

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
Corequisites: NA
Instructor(s): A. Yuille
Area: Quantitative and Mathematical Sciences NA.
AS.050.501. Readings in Cognitive Science/Freshmen. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): NA
Area: NA
NA.

AS.050.502. Readings in Cognitive Science-Freshmen. 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.503. Research in Cognitive Science/Freshmen. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.504. Research Cognitive Science-Freshmen. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.505. Readings in Cognitive Science/Sophomores. 1.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.506. Readings Cognitive Science-Sophomores. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.507. Research in Cognitive Science/Sophomores. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.508. Research Cognitive Science - Sophomores. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

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

AS.050.511. Readings in Cognitive Science/Juniors. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.512. Readings Cognitive Science-Juniors. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.513. Research in Cognitive Science/Juniors. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.515. Readings in Cognitive Science/Seniors. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.516. Readings Cognitive Science - Senior. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.517. Research in Cognitive Science/Seniors. 0.0 - 3.0 Credits.
Research current topics in cognitive science.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.518. Research Cognitive Science - Seniors. 0.0 - 3.0 Credits.
Permission Required.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.599. Research-Cognitive Science. 0.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.

AS.050.617. Semantics I. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.620. Syntax I. NA Credit.
Introduces the basic methods and means of analysis used in contemporary syntax investigations, practicing with data from different languages. Also offered as AS.050.320.
Prerequisites: NA
Corequisites: NA
Instructor(s): G. Legendre
Area: NA
NA.

AS.050.622. Semantics II. NA Credit.
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
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.625. Phonology I. NA Credit.
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.050.325.
Prerequisites: NA
Corequisites: NA
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences
NA.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.050.632. Developmental Cognitive Neuroscience. NA Credit.
In-depth examination of the current literature on cognitive development in the context of developmental cognitive neuroscience. Meets with AS.050.332.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Landau
Area: NA
NA.

AS.050.633. Psycholinguistics. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): E. Atkinson
Area: NA
Writing Intensive.

AS.050.639. Cognitive Development. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: NA
NA.

AS.050.648. Language Acquisition. NA Credit.
This course provides an introduction to the fields of first and second language acquisition by looking at questions such as the following: Can the grammar of a native language be learned solely on the basis of noticing statistical correlations among words? How does native language acquisition explain — or is explained by — the universal properties, shared by all languages, of words and grammars? How does being exposed to multiple languages from birth affect language acquisition and what happens when a child is not exposed to any language early in life? Does the same cognitive mechanism guide language learning in children and adults? What factors account for individual differences in ease and ultimate attainment when a second language is learned later in life? Is it possible to become indistinguishable from a native speaker in a foreign language? What changes take place in the brain when a new language is learned? Recommended Background: An introductory course in linguistics or cognitive psychology.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: NA
NA.

AS.050.658. Language & Thought. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Landau
Area: NA
NA.

AS.050.660. Computational Psycholinguistics. NA Credit.
How do we understand and produce sentences in a language we speak? How do we acquire the knowledge that underlies this ability? Computational psycholinguistics seeks to address these questions using a combination of two approaches: computational models, which aim to replicate the processes that take place in the human mind; and human experiments, which are designed to test those models. The perspective we will take in this class is that the models and experimental paradigms do not only advance our understanding of the cognitive science, but can also help us advance artificial intelligence and language technologies. While computational psycholinguistics spans all levels of linguistic structure, from speech to discourse, our focus in this class will be at the level of the sentence (syntax and semantics). The course will assume familiarity with programming and computational modeling frameworks in cognitive science, as covered by Introduction to Computational Cognitive Science or equivalent. Also offered as AS.050.360. An optional, hands-on lab (AS.050.361) is offered to supplement this course. It is highly recommended that students with less extensive computational and mathematical experience register for this lab.
Prerequisites: NA
Corequisites: NA
Instructor(s): T. Linzen
Area: NA
NA.
AS.050.670. Mathematical Models of Language. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): K. Rawlins
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.671. Bayesian Inference. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): C. Wilson
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.672. Foundations of Neural Network Theory. NA Credit.
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. Recommended course background in Calculus I. Also offered as AS.050.372.
Prerequisites: NA
Corequisites: NA
Instructor(s): P. Smolensky
Area: NA
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): A. Yuille
Area: NA
NA.

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

AS.050.801. Research Seminar in Cognitive Neuropsychology. NA Credit.
Participants in this graduate seminar will read and discuss current research articles in cognitive neuropsychology of vision or language, and present their own research.
Prerequisites: NA
Corequisites: NA
Instructor(s): M. McCloskey
Area: NA
NA.

AS.050.802. Research Seminar in Cognitive Processes. NA Credit.
Permission required. Current issues and ongoing research on human cognition are discussed.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Rapp
Area: NA
NA.

Participants in this seminar will read and discuss current research articles in the fields of cognitive neuroscience, computational neuroscience, machine learning, and artificial intelligence. The seminar will focus on research that provides insights into the representations and algorithms of the human brain, with an emphasis on vision and natural semantic understanding.
Prerequisites: NA
Corequisites: NA
Instructor(s): M. Bonner
Area: NA
NA.

This seminar is on computational models for vision and its interaction with language. For Cognitive Science, computational models, like Deep Nets, offer the possibility of developing computational theories which can be tested on natural, or realistically synthetic images. But Deep Nets by themselves are unable to capture the richness and flexibility of human perception, so we will discuss other classes of model with more compositional structure and ability to represent the physical properties of the 3D world. These will be related to, and motivated by, behavioral and electrophysiological experiments.
Prerequisites: NA
Corequisites: NA
Instructor(s): A. Yuille
Area: NA
NA.
AS.050.811. Research Seminar in Language & Cognition. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Landau
Area: NA
NA.

AS.050.812. Research Seminar in Computational Cognitive Neuroscience. NA Credit.
This seminar will discuss papers and ongoing research in the areas of computational cognitive neuroscience, with a focus on different areas of visual and social perception.
Prerequisites: NA
Corequisites: NA
Instructor(s): L. Isik
Area: NA
NA.

AS.050.814. Research Seminar in Computer Vision. NA Credit.
This seminar is based on topics in computational vision with the option of attending additional subgroup meetings on specific topics.
Prerequisites: NA
Corequisites: NA
Instructor(s): A. Yuille
Area: NA
NA.

AS.050.817. Research Seminar in Semantics. NA Credit.
Prerequisites: NA
Corequisites: NA
Instructor(s): K. Rawlins
Area: NA
NA.

AS.050.818. Research Seminar: AcqLab Meeting. NA Credit.
Participants in this graduate seminar will read and discuss current research articles in language development and present their own research. Permission required.
Prerequisites: NA
Corequisites: NA
Instructor(s): G. Legendre
Area: NA
NA.

AS.050.819. Research Seminar in Psycholinguistics. NA Credit.
Discussion of current computational and experimental research on human language processing.
Prerequisites: NA
Corequisites: NA
Instructor(s): T. Linzen
Area: NA
NA.

AS.050.822. Research Seminar Syntax. NA Credit.
A critical analysis of current issues and debates in theoretical syntax. Discussion of on-going research.
Prerequisites: NA
Corequisites: NA
Instructor(s): G. Legendre
Area: NA
NA.

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

AS.050.826. Research Seminar in Formal Approaches to Cognitive Science. NA Credit.
Readings and research presentations on varying topics in mathematics, computation, and formal linguistics with bearing on cognitive science.
Prerequisites: NA
Corequisites: NA
Instructor(s): C. Wilson
Area: NA
NA.

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

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

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

AS.050.849. Teaching Practicum. NA Credit.
Permission required. Essential for Teaching Assistants.
Prerequisites: NA
Corequisites: NA
Instructor(s): Staff
Area: NA
NA.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): G. Legendre
Area: NA

AS.050.870. Dissertation Research. NA Credit.
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.
Prerequisites: NA
Corequisites: NA
Instructor(s): Staff
Area: NA

Cross Listed Courses

Neuroscience
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.
Corequisites: NA
Instructor(s): D. Boatman
Area: Natural Sciences
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Halberda; L. Feigenson
Area: Social and Behavioral Sciences
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): M. Lopez-Gonzalez
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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.
Prerequisites: NA
Corequisites: NA
Instructor(s): M. Lopez-Gonzalez
Area: Natural Sciences, Social and Behavioral Sciences
NA.

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
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Van Durme; K. Rawlins
Area: NA
NA.
EN.601.783. Vision as Bayesian Inference. 3.0 Credits.
This is an advanced course on computer vision from a probabilistic
and machine learning perspective. It covers techniques such as linear
and non-linear filtering, geometry, energy function methods, markov
random fields, conditional random fields, graphical models, probabilistic
grammars, and deep neural networks. These are illustrated on a
set of vision problems ranging from image segmentation, semantic
segmentation, depth estimation, object recognition, object parsing,
scene parsing, action recognition, and text captioning. [Analysis or
Applications] Required course background: calculus, linear algebra
(AS.110.201 or equiv.), probability and statistics (AS.553.311 or equiv.),
and the ability to program in Python and C++. Background in computer
vision (EN.601.461/661) and machine learning (EN.601.475) suggested
but not required.
Prerequisites: NA
Corequisites: NA
Instructor(s): A. Yuille
Area: NA
NA.