PROGRAM IN SYMBOLIC SYSTEMS

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Medicine: Russ B. Altman (Professor), John R. Koza (Consulting Professor)
Music: Jonathan Berger (Associate Professor), Christopher Chafe (Professor), Eleanor Selfridge-Field (Consulting Professor), William L. Verplank (Lecturer)
Neurobiology: Ben Barres (Professor), Jennifer Raymond (Assistant Professor)
Philosophy: Michael Bratman (Professor), Mark Crimmins (Associate Professor), John Etchemendy (Professor), Solomon Feferman (Professor Emeritus), Dagfinn Føllesdal (Professor), David Israel (Consulting Associate Professor), Krista Lawlor (Assistant Professor), Grigori Mints (Professor), Marc Pauly (Assistant Professor), Raymond Perrault (Consulting Associate Professor), John Perry (Professor), Kenneth Taylor (Professor), Johan van Benthem (Professor), Thomas A. Wasow (Professor)
Psychiatry and Behavioral Sciences: Vinod Menon (Associate Professor)
Psychology: Lera Boroditsky (Assistant Professor), Herbert H. Clark (Professor), Anne Fernald (Associate Professor), Susan Johnson (Assistant Professor), Brian Knutson (Assistant Professor), Ellen Markman (Professor), James McClelland (Professor), Michael Ramscar (Assistant Professor), Barbara Tversky (Professor), Anthony Wagner (Associate Professor), Brian Wandell (Professor)
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Symbolic Systems: William Byrne (Consulting Assistant Professor), Todd Davies (Lecturer), Tracy King (Consulting Associate Professor), Pat Langley (Consulting Professor), Jeff Shrager (Consulting Associate Professor), Paul Skokowski (Consulting Professor)
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Courses given in the Program in Symbolic Systems have the subject code SYMBSYS. For a complete list of subject codes, see Appendix.

Both human beings and computers can manipulate symbols. This observation lies at the heart of Symbolic Systems, an interdisciplinary program focusing on the relationship between natural and artificial systems that represent, process, and act on information. Computer programs, natural languages, the human mind, and the Internet embody concepts whose study forms the core of the Symbolic Systems curriculum, such as computation, representation, communication, and intelligence. A body of knowledge and theory has developed around these notions, from disciplines like philosophy, computer science, linguistics, psychology, statistics, neurobiology, and communication. Since the invention of computers, researchers have been working across these disciplines to study questions such as: in what ways are computers and computer languages like human beings and their languages; how can the interaction between people and computers be made easier and more beneficial?

The core requirements of the Symbolic Systems Program (SSP) include courses in symbolic logic, the philosophy of mind, formal linguistics, cognitive psychology, programming, the mathematics of computation, statistical theory, artificial intelligence, and interdisciplinary approaches to cognitive science. These courses prepare students with the vocabulary, theoretical background, and technical skills needed for study and research at the advanced undergraduate and graduate levels. Most of the courses in SSP are drawn from affiliated departments. Courses designed specifically for the program are aimed at integrating and supplementing topics covered by the department-based offerings. The curriculum includes humanistic approaches to questions about language and intelligence, as well as training in science and engineering.

SSP offers both B.S. and M.S. degree programs. Both programs require students to master a common core of required courses, and to choose an area of specialization.

UNDERGRADUATE PROGRAMS

BACHELOR OF SCIENCE

The program leading to a B.S. in Symbolic Systems provides students with a core of concepts and techniques, drawing on faculty and courses from various departments. The curriculum prepares students for advanced training in the interdisciplinary study of language and information, or for postgraduate study in any of the main contributing disciplines. It is also excellent preparation for employment immediately after graduation.

Symbolic Systems majors must complete a core of required courses plus a concentration consisting of six additional courses. All major courses are to be taken for letter grades unless an approved course is offered satisfactory/no credit only. All core courses must be passed with a grade of 'C-' or better. Students who receive a grade lower than this in a core course must alert the program of this fact, so that a decision can be made about whether the student should continue in the major.

CORE REQUIREMENTS

In order to graduate with a B.S. in Symbolic Systems, a student must complete the following requirements. (Please note that some of these courses have other courses as prerequisites. Students are responsible for completing each course's prerequisites before they take it.)

1. *Cognitive Science*: either SYMBSYS 100, Introduction to Cognitive Science, *or* one of the following:
   CS 378. Phenomenological Foundations of Cognition, Language, and Computation
   LINGUIST 280/CS 224N. Natural Language Processing
   PSYCH 131. Language and Thought
   PSYCH 137. Birds to Words: Cognition, Communication, and Language
2. *Computer Programming*:
   a) CS 106A. Programming Methodology, and 106B. Programming Abstractions; *or* 106X. Programming Methodology and Abstractions (Accelerated); *and*
   b) CS 107. Programming Paradigms
3. *Discrete Structures*: CS 103B. Discrete Structures; *or* 103X. Discrete Structures (Accelerated)
4. *Logic*:
   a) PHIL 150. Basic Concepts in Mathematical Logic; *or* 150X. Basic Concepts in Mathematical Logic, *and either* CS 103A. Discrete Mathematics for Computer Science, *or* 103X. Discrete Structures (Accelerated); *and*
   b) PHIL 151. First-Order Logic
5. *Statistics/Probability*: one of the following:
   EE 178. Introduction to Probability and Statistics
   MATH 151. Introduction to Probability Theory
   MSE 120. Probabilistic Analysis
   STATS 110. Statistical Methods in Engineering and the Physical Sciences
   STATS 116. Theory of Probability
   STATS 121. Probability, Induction, Statistics
6. *Philosophical Foundations*:
   a) an introductory course in Philosophy must be taken prior to the required PHIL 80, from among the following:
   PHIL 10. God, Self, and World: An Introduction to Philosophy
   PHIL 20. Introduction to Moral Philosophy
   PHIL 30. Introduction to Political Philosophy
   PHIL 60. Introduction to Philosophy of Science
   PHIL 102. Modern Philosophy, Descartes to Kant
   IHUM 23A,B. The Fate of Reason
   and
   b) PHIL 80. Mind, Matter, and Meaning
7. *Cognitive Psychology*: PSYCH 55. Introduction to Cognition and Brain; *or* PSYCH 40. Introduction to Cognitive Psychology
8. *Formal Linguistics*:
   a) LINGUIST 120. Introduction to Syntax; and one of the following:
   b) LINGUIST 130A. Introduction to Linguistic Meaning,
   or LINGUIST 130B. Introduction to Lexical Semantics,
   or LINGUIST 230A. Introduction to Semantics and Pragmatics
9. *Artificial Intelligence:* CS 121. Introduction to Artificial Intelligence; *or* 221. Artificial Intelligence: Principles and Techniques
10. *Turing Computability:** one of the following:†
    CS 103B. Discrete Structures
    CS 154. Introduction to Automata and Complexity Theory
    PHIL 152. Computability and Logic
    SYMBSYS 100. Introduction to Cognitive Science
11. *Advanced Small Seminar:*† An upper-division, limited-enrollment seminar drawing on material from other courses in the core. Courses listed under Symbolic Systems Program offerings with numbers from SYMBSYS 201 through 209 are acceptable, as are other courses which will be announced at the beginning of each academic year.

* CS 103X does not fulfill this requirement.

† A course taken to fulfill one of these requirements can also be counted toward another requirement, as part of either the core or a student's concentration, but not both (see below).

CONCENTRATION AREAS

In addition to the core requirements listed above, the Symbolic Systems major requires each student to complete a concentration consisting of six courses that are thematically related to each other. Students select concentrations from the list below or design others in consultation with their advisers.

Applied Logic
Artificial Intelligence
Cognitive Science
Computer Music
Decision Making and Rationality
Human-Computer Interaction
Learning
Natural Language
Neurosciences
Philosophical Foundations

MINORS

Students may minor in Symbolic Systems by completing either item 1 or item 2 below.

1. One course in each of the following core areas (please note that several of these courses have prerequisites):
   a) *Cognition*: SYMBSYS 100* *or* PSYCH 40 *or* 55
   b) *Logic and Computation*: PHIL 150 *or* 151, *or* CS 103B, 103X, *or* 154
   c) *Computer Programming*: CS 106B, 106X, *or* 107
   d) *Philosophical Foundations*: SYMBSYS 100* *or* PHIL 80
   e) *Formal Linguistics*: LINGUIST 120, 130A, *or* 130B
   f) *Artificial Intelligence*: CS 121 *or* 221
2. SYMBSYS 100, plus an interdisciplinary SSP concentration listed on the SSP web site at http://symsys.stanford.edu. To qualify, the selection of courses used for the minor must be interdisciplinary; i.e., it must either include courses from at least three departments, or include more than one course from each of two departments.

*SYMBSYS 100 may not be counted for both areas 'a' and 'd'.

UNDERGRADUATE RESEARCH

The program strongly encourages all SSP majors to gain experience in directed research by participating in faculty research projects or by pursuing independent study. In addition to the Symbolic Systems Honors Program (see below), the following avenues are offered.

1. *Summer Internships:* students work on SSP-related faculty research projects. Application procedures are announced in the winter quarter for SSP majors.
2. *Research Assistantships:* other opportunities to work on faculty research projects are typically announced to SSP majors as they arise during the academic year.
3. *Independent Study*: under faculty supervision. For course credit, students should enroll in SYMBSYS 196.

Contact SSP for more information on any of these possibilities, or visit the program's web site at http://www.stanford.edu/dept/symbol. In addition, the Undergraduate Advising and Research office on campus offers numerous grants and scholarships supporting student research projects at all levels; see http://uro.stanford.edu.

HONORS PROGRAM

Seniors in SSP may apply for admission to the Symbolic Systems honors program prior to the beginning of their final year of study. Students who are accepted into the honors program can graduate with honors by completing an honors thesis under the supervision of a faculty member. Course credit for the honors project may be obtained by registering for SYMBSYS 190, Honors Tutorial, for any quarters while a student is working on an honors project. Juniors who are interested in doing an honors project during their senior year are strongly advised to take SYMBSYS 91, Junior Honors Seminar. SYMBSYS 191, Senior Honors Seminar, is recommended for honors students during the senior year. Contact SSP or visit the program's web site for more information on the honors program, including deadlines and policies.

COTERMINAL BACHELOR'S AND MASTER'S DEGREES

Many SSP majors also complete coterminal M.S. or M.A. degrees in affiliated departments. In addition to the Symbolic Systems M.S. program (see below), the Department of Philosophy offers a special Symbolic Systems track for interdisciplinary graduate level work.

For University coterminal degree program rules and University application forms, see http://registrar.stanford.edu/shared/publications.htm#Coterm.

GRADUATE PROGRAMS

The University's basic requirements for the M.S. and Ph.D. degrees are discussed in the "Graduate Degrees" section of this bulletin.

MASTER OF SCIENCE

The M.S. degree in Symbolic Systems is designed to be completed in the equivalent of one academic year by coterminal students or returning students who already have a B.S. degree in Symbolic Systems. Admission is competitive, providing a limited number of students with the opportunity to pursue course and project work, in consultation with a faculty adviser who is affiliated with the Symbolic Systems Program. The faculty adviser may impose requirements beyond those described here.

Admission to the program as a coterminal student is subject to the policies and deadlines described in the "Undergraduate Degrees" section of this bulletin (see "Coterminal Bachelor's and Master's Degrees"). Applicants to the M.S. program are reviewed each quarter during the academic year. Information on deadlines and procedures for applying are available from the program's student services coordinator in the Linguistics Department office (460-127E).

REQUIREMENTS

A candidate for the M.S. degree in Symbolic Systems must complete a program of 45 units. At least 36 of these must be graded units, passed with an average grade of 3.0 (B) or better, and any course taken to fulfill requirements A, B, or C below must be taken for a letter grade unless the course is offered S/NC only. The 45 units may include no more than 21 units of courses from those listed below under Requirements A and B. Furthermore, none of the 45 units to be counted toward the M.S. degree may include units counted toward an undergraduate degree at Stanford or elsewhere. Course requirements are waived only if evidence is provided that similar or more advanced courses have been taken, either at Stanford or another institution. Courses that are waived rather than taken may not be counted toward the M.S. degree.

Each candidate for the M.S. degree must fulfill the following requirements:

REQUIREMENT A

Demonstrated competence in the core requirements for the B.S. degree in Symbolic Systems. Candidates who have gone through the Symbolic Systems undergraduate program satisfy this requirement in the course of the B.S. degree in Symbolic Systems. Other students admitted as candidates for a Symbolic Systems M.S. degree must complete all the Symbolic Systems undergraduate core requirements, with the exception of the advanced small seminar requirement.

REQUIREMENT B

1. Completion of two additional skill requirements:
   a) *Computer Programming:* CS 108, Object-Oriented Systems Design; *and*
   b) *Empirical Methods:* one of the following:
      COMM 206. Communication Research Methods
      COMM 239. Questionnaire Design for Surveys and Laboratory Experiments: Social and Cognitive Perspectives
      COMM 268/368. Experimental Research in Advanced User Interfaces
      LINGUIST 280/CS 224N. Natural Language Processing
      PSYCH 110. Research Methods and Experimental Design
      PSYCH 252. Statistical Methods for Behavioral and Social Science (for 3 or more units)
      PSYCH 253. Statistical Theory, Models, and Methodology (for 3 units)
      STATS 191. Introduction to Applied Statistics
      STATS 200. Introduction to Statistical Inference
      a Statistics course numbered higher than 200
2. Completion of three quarters of the Symbolic Systems Program M.S. Seminar (SYMBSYS 291).

REQUIREMENT C

Completion of an approved specialization track. All tracks of the Symbolic Systems M.S. program require students to do a substantial project. The course requirements for each track are designed to prepare a student to undertake such a project. The nature of the project depends on the student's focus, but may include software development, user testing, or a combination of these. In all cases, a written thesis or paper describing the project is required. The project normally takes three quarters, and work on the project may account for up to 15 units of a student's program. Each track of the SSP M.S. program has its own core requirements, as well as unit requirements from a set of elective courses. The tracks and their requirements are given below.

The Human-Computer Interaction (HCI) Track—The HCI Core: a course in Computer Science numbered 141-179 (excluding 147), *or* CS 241-279 (excluding 247A), *or* CS 295, Software Engineering; *and* CS 147, Introduction to HCI Design; *and* CS 247A, Human-Computer Interaction: Interaction Design Studio*; and* CS 376, Research Topics in Human-Computer Interaction.

For HCI electives, at least 9 additional units of HCI courses, chosen in consultation with the student's adviser. The following are examples of themes around which an elective program might be built: Animation, Business Systems, Computer-Aided Design, Computer Graphics, Data Interfaces, Decision Systems, Design for Disabilities, Design Principles, Dialogue Systems, Digital Art, Digital Media, Education Technology, Game Design, History of Computers, Information Retrieval, Intelligent Interfaces, Interaction Design, Internet Design, Medical Informatics, Multimedia Design, Object-Oriented Design, Philosophy of Computation, Social Aspects of Computing, Usability Analysis, Virtual Reality, and Workplace Computing.

The Natural Language Technology (NLT) Track—For the NLT core, in addition to the courses below, students in the NLT track must complete LINGUIST 280/CS 224N, Natural Language Processing, which can be used as the empirical methods course for Requirement B above.

1) An in-depth theory of English grammar course such as LINGUIST 221A, Foundations of English Grammar
2) A graduate-level semantics course (if not already taken as part of Requirement A) such as LINGUIST 232A, Lexical Semantics, or 230B, Semantics and Pragmatics
3) A two-course sequence in Computational Linguistics:
   LINGUIST 180. Introduction to Computer Speech and Language Processing, *and*
   LINGUIST 283. Programming and Algorithms for Natural Language Processing

The NLT Electives (at least 8 units from the following list):

CS 145. Introduction to Databases
CS 147. Introduction to HCI Design
CS 161. Design and Analysis of Algorithms
CS 221. Artificial Intelligence: Principles and Techniques
CS 222. Knowledge Representation
CS 224M. Multi-Agent Systems
CS 228. Probabilistic Models in Artificial Intelligence
CS 229. Machine Learning
CS 276. Text Retrieval and Web Search
CS 329. Topics in Artificial Intelligence
LINGUIST 205. Phonetics
LINGUIST 221B. Studies in Universal Grammar
LINGUIST 222A. Lexicalist Foundations of Syntax
LINGUIST 224A. Introduction to Formal Universal Grammar
LINGUIST 227A. Research Seminar in Syntax
LINGUIST 230B. Semantics and Pragmatics

LINGUIST 233. Semantics Seminar
LINGUIST 234. Discourse Analysis
LINGUIST 285. Finite State Methods in Natural Language Processing
LINGUIST 282. Human Machine Translation
PHIL 298. Logic, Language, and Information
PSYCH 205. Foundations of Cognition
PSYCH 214. Psycholinguistics
PSYCH 272. Special Topics in Psycholinguistics

The Individually Designed Option—Students wishing to design their own M.S. curriculum in Symbolic Systems must present a project plan as part of their application. This plan must be endorsed by the student's adviser prior to admission to the Symbolic Systems M.S. program. The application must also specify at least 20 units of coursework that the student will take in support of the project.

Students are admitted under this option only if they present well-developed plans whose interdisciplinary character makes them inappropriate for any departmental master's program, but appropriate for Symbolic Systems.

COURSES

SYMBSYS 10. Symbolic Systems Forum—A weekly lecture series, featuring different speakers who report on research of general interest to Symbolic Systems students and faculty. Regular attendance required for credit. May be repeated for credit.
1 unit, Aut, Win, Spr (Davies, T)

SYMBSYS 100. Introduction to Cognitive Science—(Same as LINGUIST 144, PHIL 190, PSYCH 130.) The history, foundations, and accomplishments of the cognitive sciences, including presentations by leading Stanford researchers in artificial intelligence, linguistics, philosophy, and psychology. Overview of the issues addressed in the Symbolic Systems major. GER:DB-SocSci
4 units, Spr (Bresnan, J)

SYMBSYS 145. Cognition in Interaction Design—Interactive systems from the standpoint of human cognition. Topics include skill acquisition, complex learning, reasoning, language, perception, methods in usability testing, special computational techniques such as intelligent and adaptive interfaces, and design for people with cognitive disabilities. Students conduct analyses of real world problems of their own choosing and redesign/analyze a project of an interactive system. GER:DB-SocSci
3 units, Win (Shrager, J)

SYMBSYS 170/270. Decision Behavior: Theory and Evidence—(Graduate students register for 270.) Introduction to the study of judgment and decision making, relating theory and evidence from disciplines such as psychology, economics, statistics, neuroscience, and philosophy. The development and critique of Homo economicus as a model of human behavior, and more recent theories based on empirical findings. Recommended: background in formal reasoning.
3-4 units, Win (Davies, T)

SYMBSYS 205. Systems: Theory, Science, and Metaphor—Systems science explores abstract properties of systems such as network connectivity, complexity, and emergence, with applications in natural, social, and artificial domains. How useful are these theories? Are their claims testable or generalizable? Do they change the way people think and talk? Topics announced during the previous quarter on course web site. Limited enrollment. Prerequisites: Symbolic Systems undergraduate core course in each of philosophy, psychology or linguistics, and computer science.
3 units, Spr (Davies, T)

SYMBSYS 209. Battles Over Bits—The changing nature of information in the Internet age and its relationship to human behavior. Philosophical assumptions underlying practices such as open source software development, file sharing, common carriage, and community wireless networks, contrasted with arguments for protecting private and commercial interests such as software patents, copy protection, copyright infringement lawsuits, and regulatory barriers. Theory and evidence from disciplines including psychology, economics, computer science, law, and political science. Prerequisite: PSYCH 40, 55, 70, or SYMBSYS 202.
3 units, not given this year

RESEARCH

SYMBSYS 91. Junior Honors Seminar—Recommended for juniors doing an honors project during the following year. Defining a topic, choosing an adviser, considering overall goals. Resources at Stanford and some experiences of seniors discussed with guest speakers.
2 units, Win (Davies, T)

SYMBSYS 190. Senior Honors Tutorial—Under the supervision of their faculty honors adviser, students work on their senior honors project. May be repeated for credit.
1-5 units, Aut, Win, Spr, Sum (Staff)

SYMBSYS 191. Senior Honors Seminar—Recommended for seniors doing an honors project. Under the leadership of the Symbolic Systems program coordinator, students meet, discuss, and present their honors project.
2 units, Aut (Davies, T)

SYMBSYS 196. Independent Study—Independent work under the supervision of a faculty member. Can be repeated for credit.
1-15 units, Aut, Win, Spr, Sum (Staff)

SYMBSYS 290. Master's Degree Project
1-15 units, Aut, Win, Spr, Sum (Staff)

SYMBSYS 291. Master's Program Seminar—Enrollment limited to students in the Symbolic Systems M.S. degree program. May be repeated for credit.
1 unit, Aut, Win, Spr (Davies, T)

COGNATE COURSES

See respective department listings for course descriptions and General Education Requirements (GER) information. See degree requirements above or the program's student services office for applicability of these courses to a major or minor program.

BIOSCI 20. Introduction to Brain and Behavior—(Same as HUMBIO 21.)
3 units, Aut (Fernald, R), alternate years, not given next year

BIOSCI 150/250. Human Behavioral Biology—(Same as HUMBIO 160.)
6 units, alternate years, not given this year

COMM 106/206. Communication Research Methods
4-5 units, Spr (Staff)

COMM 169/269. Computers and Interfaces
4-5 units, Win (Nass, C)

COMM 172/272. Psychological Processing of Media
4-5 units, Spr (Reeves, B)

CS 103A. Discrete Mathematics for Computer Science
3 units, Aut (Plummer, R), Win (Johnson, M)

CS 103B. Discrete Structures
3 units, Win (Cain, G), Spr (Johnson, M)

CS 103X. Discrete Structures (Accelerated)
3-4 units, Win (Koltun, V)

CS 106A. Programming Methodology—(Same as ENGR 70A.)
3-5 units, Aut (Young, P), Win (Roberts, E), Spr (Young, P), Sum (Staff)

CS 106B. Programming Abstractions—(Same as ENGR 70B.)
3-5 units, Win (Zelenski, J), Spr (Staff)

CS 106X. Programming Methodology and Abstractions (Accelerated)—(Same as ENGR 70X.)
3-5 units, Aut (Zelenski, J), Win (Cain, G), Sum (Staff)

CS 107. Programming Paradigms
3-5 units, Aut, Spr (Cain, G)

CS 108. Object-Oriented Systems Design
3-4 units, Aut, Win (Parlante, N)

CS 121. Introduction to Artificial Intelligence
3 units, Win (Latombe, J), Sum (Staff)

CS 147. Introduction to Human-Computer Interaction Design
3-4 units, Aut (Winograd, T)

CS 154. Introduction to Automata and Complexity Theory
3-4 units, Aut (Dill, D), Spr (Motwani, R), Sum (Staff)

CS 161. Design and Analysis of Algorithms
3-4 units, Aut (Plotkin, S), Win (Roughgarden, T), Sum (Staff)

CS 193D. Professional Software Development with C++
3 units, not given this year

CS 201. Computers, Ethics, and Social Responsibility
3-4 units, not given this year

CS 205. Mathematical Methods for Robotics, Vision, and Graphics
3 units, Aut (Fedkiw, R)

CS 221. Artificial Intelligence: Principles and Techniques
3-4 units, Aut (Ng, A)

CS 222. Knowledge Representation
3 units, Spr (Shoham, Y; vanBenthem, J)

CS 223A. Introduction to Robotics
3 units, Win (Khatib, O)

CS 223B. Introduction to Computer Vision
3 units, Win (Thrun, S)

CS 224M. Multi-Agent Systems
3 units, Win (Shoham, Y)

CS 227. Reasoning Methods in Artificial Intelligence
3 units, Spr (Nayak, P)

CS 228. Probabilistic Models in Artificial Intelligence
3 units, Win (Koller, D)

CS 229. Machine Learning
3 units, Aut (Ng, A)

CS 247. Human-Computer Interaction Design Studio
3-4 units, Win (Klemmer, S)

CS 249. Object-Oriented Programming from a Modeling and Simulation Perspective
3-5 units, Aut (Linton, M)

CS 276. Text Retrieval and Web Search
3 units, Aut (Manning, C; Prabhakar, R)

CS 378. Phenomenological Foundations of Cognition, Language, and Computation
3-4 units, Win (Winograd, T)

ECON 51. Economic Analysis II
5 units, Win, Sum (Staff)

ECON 137. Information and Incentives
5 units, Spr (Lara, Y)

ECON 160. Game Theory and Economic Applications
5 units, Win (Hammond, P)

ECON 178/278. Neuroeconomics—(Same as PSYCH 278.)
5 units, Spr (Staff)

EDUC 218. Topics in Cognition and Learning: Transfer
3 units, Aut (Schwartz, D)

EDUC 298. Online Communities of Learning
3 units, Spr (Pea, R)

EE 178. Probabilistic Systems Analysis
3 units, Win (El Gamal, A)

EE 376A. Information Theory
3 units, Win (Weissman, I)

ENGR 62. Introduction to Optimization—(Same as MS&E 111.)
4 units, Aut (Van Roy, B), Spr (Goel, A)

LINGUIST 105/205A. Phonetics
4 units, Win (Avelino, H)

LINGUIST 110. Introduction to Phonetics and Phonology
4 units, Spr (Scarborough, R)

LINGUIST 120. Introduction to Syntax
4 units, Aut (Wasow, T)

LINGUIST 124A/224A. Introduction to Formal Universal Grammar
4 units, not given this year

LINGUIST 130A. Introduction to Linguistic Meaning
4 units, Spr (Katz, G)

LINGUIST 130B. Introduction to Lexical Semantics
4 units, Win (Fong, V)

LINGUIST 140/240. Language Acquisition I
4 units, Aut (Clark, E)

LINGUIST 180. Introduction to Computer Speech and Language Processing
4 units, Aut (Jurafsky, D)

LINGUIST 182/282. Human and Machine Translation
4 units, not given this year (Kay, M)

LINGUIST 183/283. Programming and Algorithms for Natural Language Processing
3-4 units, not given this year (Kay, M)

LINGUIST 187/287. Grammar Engineering
1-4 units, Win (Flickinger, D; Oepen, S)

LINGUIST 210A. Phonology
4 units, Aut (Kiparsky, P)

LINGUIST 221A. Foundations of English Grammar
1-4 units, Spr (Sag, I)

LINGUIST 221B. Studies in Universal Grammar
1-4 units, not given this year (Sag, I)

LINGUIST 222A. Foundations of Syntactic Theory I
2-4 units, Aut (Levin, B; Sells, P)

LINGUIST 230A. Introduction to Semantics and Pragmatics
2-4 units, Aut (Katz, G)

LINGUIST 230B. Semantics and Pragmatics
2-4 units, Win (Katz, G)

LINGUIST 232A. Lexical Semantics
2-4 units, Spr (Levin, B)

LINGUIST 241. Language Acquisition II: Pragmatics and Language Acquisition
1-4 units, Win (Clark, E)

LINGUIST 247. Seminar in Psycholinguistics: Models of Human and Machine Speech and Language Processing—(Same as PSYCH 227.)
2-4 units, Win (Jurafsky, D)

LINGUIST 285. Finite State Methods in Natural Language Processing
3-4 units, not given this year (Karttunen, L)

MATH 103. Matrix Theory and Its Applications
3 units, Aut, Win, Spr, Sum (Staff)

MATH 113. Linear Algebra and Matrix Theory
3 units, Aut (Vasy, A), Win (Coffey, J)

MATH 151. Introduction to Probability Theory
3 units, Win (Liu, T)

ME 115. Human Values in Design
3 units, Win (Boyle, B)

MS&E 120. Probabilistic Analysis
5 units, Aut (Shachter, R)

MS&E 121. Introduction to Stochastic Modeling
4 units, Win (Glynn, P)

MS&E 201. Dynamic Systems
3-4 units, Spr (Tse, E)

MS&E 430. Tools for Experience Design
3-4 units, not given this year

MUSIC 151. Psychophysics and Cognitive Psychology for Musicians
4 units, Spr (Berger, J)

MUSIC 220A. Fundamentals of Computer-Generated Sound
2-4 units, Aut (Chafe, C)

MUSIC 220B. Compositional Algorithms, Psychoacoustics, and Spatial Processing
2-4 units, Win (Lopez-Lezcano, F)

MUSIC 250A. HCI Theory and Practice
3-4 units, Aut, Win (Verplank, W)

MUSIC 253. Musical Information: An Introduction
1-4 units, Win (Selfridge-Field, E)

MUSIC 254. Applications of Musical Information: Query, Analysis, and Style Simulation
1-4 units, Spr (Selfridge-Field, E)

NBIO 206. The Nervous System
7-8 units, Win (Clandinin, T)

NBIO 218. Neural Basis of Behavior
4 units, alternate years, not given this year

PHIL 80. Mind, Matter, and Meaning
5 units, Aut (Lawlor, K), Spr (Crimmins, M)

PHIL 102. Modern Philosophy, Descartes to Kant
4 units, Win (Wood, A)

PHIL 143/243. Quine
4 units, not given this year

PHIL 150/250. Basic Concepts in Mathematical Logic
4 units, Aut (Wasow, T)

PHIL 151/251. First-Order Logic
4 units, Win (Pauly, M)

PHIL 152/252. Computability and Logic
4 units, Spr (Pauly, M)

PHIL 154/254. Modal Logic
4 units, Aut (Pauly, M)

PHIL 162/262. Philosophy of Mathematics
4 units, Spr (Mancosu, P)

PHIL 164/264. Central Topics in the Philosophy of Science: Theory and Evidence
4 units, not given this year

PHIL 167B/267B. Philosophy, Biology, and Behavior
4 units, not given this year

PHIL 181/281. Philosophy of Language
4 units, Win (Crimmins, M)

PHIL 184/284. Theory of Knowledge
4 units, Spr (Lawlor, K)

PHIL 186/286. Philosophy of Mind
4 units, Win (Perry, J)

PHIL 187/287. Philosophy of Action
4 units, Spr (Bratman, M)

PHIL 188. Personal Identity
4 units, Aut (Ferrero, L)

PHIL 189. Philosophical Applications of Cognitive Science
4 units, not given this year

PHIL 350A. Model Theory
3 units, not given this year

PHIL 358. Logic, Language, and Information
3 units, Spr (van Benthem, J)

PSYCH 30. Introduction to Perception
3 units, Aut (Wandell, B)

PSYCH 45. Introduction to Learning and Memory
3 units, Spr (Wagner, A)

PSYCH 55. Introduction to Cognition and the Brain
4 units, Win (Boroditsky, L)

PSYCH 70. Introduction to Social Psychology
4 units, Spr (Eberhardt, J; Markus, H)

PSYCH 120. Cellular Neuroscience: Cell Signaling and Behavior—(Same as BIOSCI 153.)
4 units, not given this year

PSYCH 131/262. Language and Thought
4 units, Aut (Clark, H)

PSYCH 137/239A. Birds to Words: Cognition, Communication, and Language—(Same as HUMBIO 145.)
3 units, Win (Fernald, A)

PSYCH 141. Cognitive Development
3 units, Aut (Markman, E)

PSYCH 143. Developmental Anomalies
3 units, Spr (Johnson, S)

PSYCH 202. Cognitive Neuroscience
3 units, Spr (Winawer, J; Witthoft, N)

PSYCH 204A. Computational Neuroimaging
1-3 units, Spr (Wandell, B)

PSYCH 250. High-level Vision
1-3 units, alternate years, not given this year

PSYCH 251. Affective Neuroscience
3 units, Win (Knutson, B)

PSYCH 252. Statistical Methods for Behavioral and Social Sciences—(Same as NENS 202.)
1-6 units, Aut (Thomas, E)

PSYCH 253. Statistical Theory, Models, and Methodology
3 units, Spr (Staff)

PSYCH 272. Special Topics in Psycholinguistics
1-3 units, Spr (Clark, H)

SOC 126/226. Introduction to Social Networks
5 units, Win (Hillmann, H)

STATS 110. Statistical Methods in Engineering and the Physical Sciences
4-5 units, Aut, Sum (Staff)

STATS 116. Theory of Probability
3-5 units, Aut, Spr, Sum (Staff)

STATS 121. Probability, Induction, Statistics
3 units, not given this year

STATS 191. Introduction to Applied Statistics
3-4 units, Win (Zhang, N)

STATS 200. Introduction to Statistical Inference
3 units, Win, Sum (Staff)