SYMBOLIC SYSTEMS

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Courses offered by the Program in Symbolic Systems have the subject code SYMBSYS and are listed in the "Symbolic Systems (SYMBSYS) Courses" section of this bulletin.

The observation that both human beings and computers can manipulate symbols 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 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 IN SYMBOLIC SYSTEMS

BACHELOR OF SCIENCE IN SYMBOLIC SYSTEMS

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 field of study 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. Some of these courses have other courses as prerequisites; students are responsible for completing each course's prerequisites before they take it.

Cognitive Science: SYMBSYS 100. Introduction to Cognitive Science

1. *Computer Programming:*
   a. CS 106A. Programming Methodology *and* 106B. Programming Abstractions; *or* 106X. Programming Methodology and Abstractions (Accelerated); *and*
   b. CS 107. Programming Paradigms
2. *Logic*:
   c. PHIL 150. Basic Concepts in Mathematical Logic;
   or 150X. Basic Concepts in Mathematical Logic, *and* CS 103. Mathematical Foundations of Computing, 103A. Discrete Mathematics for Computer Science, *or* 103X. Discrete Structures (Accelerated)
   d. PHIL 151. First-Order Logic
3. *Computational Theory:*
   e. CS 103B. Discrete Structures; *or* 103X. Discrete Structures (Accelerated) *or* 103. Mathematical Foundations of Computing
   f. CS 154. Introduction to Automata and Complexity Theory; *or* PHIL 152. Computability and Logic
4. *Probability*: one of the following:
   CS 109. Introduction to Probability for Computer Scientists
   CME 106/ENGR 155C. Introduction to Probability and Statistics for Engineers
   EE 178. Probabilistic Systems Analysis
   MATH 151. Introduction to Probability Theory
   MS&E 120. Probabilistic Analysis
   STATS 110. Statistical Methods in Engineering and the Physical Sciences
   STATS 116. Theory of Probability
5. *Philosophical Foundations:*
   g. 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

   h. PHIL 80. Mind, Matter, and Meaning (WIM)

6. *Cognitive Psychology*: PSYCH 55. Introduction to Cognition and Brain
7. *Language and Mind:* one of the following:
   LINGUIST 1. Introduction to Linguistics
   LINGUIST 140. Language Acquisition I
   PHIL 181. Philosophy of Language
   PSYCH 131. Language and Thought
   PSYCH 137. Birds to Words: Cognition, Communication, and Language
8. *Linguistic Theory*: one of the following:

LINGUIST 120. Introduction to Syntax
LINGUIST 130A. Introduction to Linguistic Meaning
LINGUIST 180. Introduction to Computational Linguistics
LINGUIST 230A. Introduction to Semantics and Pragmatics

9. *Artificial Intelligence*: CS 121. Introduction to Artificial Intelligence, *or* 221. Artificial Intelligence: Principles and Techniques
10. *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 are announced at the beginning of each academic year.

* 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 (see below), but not both.

FIELDS OF STUDY

In addition to the core requirements listed above, the Symbolic Systems major requires each student to complete a field of study 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. The field of study is declared on Axess; it appears on the transcript but not on the diploma.

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

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.

Summer Internships: students work on SSP-related faculty research projects. Application procedures are announced in the winter quarter for SSP majors.

11. *Research Assistantships:* other opportunities to work on faculty research projects are typically announced to SSP majors as they arise during the academic year.
12. *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 see http://symsys.stanford.edu. In addition, the Undergraduate Advising and Research office offers grants and scholarships supporting student research projects at all levels; see http://urp.stanford.edu.

HONORS PRORAM

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 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.

MINOR IN SYMBOLIC SYSTEMS

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

One course in each of the following core areas (please note that several of these courses have prerequisites):

   i. *Cognition*: SYMBSYS 100* *or* PSYCH 40 *or* 55
   j. *Logic and Computation*: PHIL 150 *or* 151, *or* CS 103B, 103X, *or* 154
   k. *Computer Programming*: CS 106B, 106X, *or* 107
   l. *Philosophical Foundations:* SYMBSYS 100* *or* PHIL 80
   m. *Formal Linguistics*: LINGUIST 120, 130A, *or* 130B
   n. *Artificial Intelligence:* CS 121 *or* 221

13. 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: 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'.

COTERMINAL BACHELOR'S AND MASTER'S DEGREES IN SYMBOLIC SYSTEMS

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 PROGRAM IN SYMBOLIC SYSTEMS

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 IN SYMBOLIC SYSTEMS

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, and in two years or less by other students depending upon level of preparation. 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 and Programs" section of this bulletin (see "Coterminal Bachelor's and Master's Degrees"). Applicants to the M.S. program are reviewed each Winter Quarter. Information on deadlines, procedures for applying, and degree requirements are available from the program's student services coordinator in the Linguistics Department office (460-127E) and at http://symsys.stanford.edu/ssp_static?page=masters.html.

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 or show evidence of having passed equivalent courses covering all the Symbolic Systems undergraduate core requirements, with the exception of the advanced small seminar requirement.

REQUIREMENT B

Submission to and approval by the Symbolic Systems Program office of these pre-project research documents:

o. project area statement, endorsed with a commitment from the student's prospective project adviser due no later than May 1 of the academic year prior to the expected graduation year; and

p. qualifying research paper due no later than the end of the Summer Quarter prior to the expected graduation year.

14. Completion of two additional skill requirements:

q. *Computer Programming:* CS 108. Object-Oriented Systems Design; *or* CS 110. Principles of Computer Systems

r. *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. 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

15. 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 it should be academic in nature (contributing to generalizable knowledge) and it should relate to the subject matter of symbolic systems more or equally appropriately as it does to other master's degree programs at Stanford. 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. The thesis must be read and approved for the master's degree in Symbolic Systems by two qualified readers approved by the program, at least one of whom must be a member of the academic council. Each track of the Symbolic Systems 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 as follows.

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 Human-Computer Interaction 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 must complete LINGUIST 280/CS 224N, Natural Language Processing, which can be used as the empirical methods course for Requirement B above.

An in-depth theory of English grammar course such as LINGUIST 221A, Foundations of English Grammar

16. 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

17. A two-course sequence in Computational Linguistics:

s. LINGUIST 180. Introduction to Computer Speech and Language Processing, *and*

t. LINGUIST 283. Programming and Algorithms for Natural Language Processing

For NLT electives, at least 9 additional units of natural language technology courses, chosen in consultation with the student's adviser.

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 course work 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.

COGNATE COURSES

The following is a list of cognate courses that may be applied to the B.S. and M.S. in Symbolic Systems. See respective department listings for course descriptions and General Education Requirements (GER) information.

BIO 20. Introduction to Brain and Behavior (Same as HUMBIO 21)
BIO 150/250. Human Behavioral Biology (Same as HUMBIO 160)
BIO 153. Cellular Neuroscience: Cell Signaling and Behavior
COMM 106/206. Communication Research Methods
COMM 169/269. Computers and Interfaces
COMM 172/272. Media Psychology
CS 21N. Can Machines Know? Can Machines Feel?
CS 51N. Visionaries in Computer Science
CS 74N. Digital Dilemmas
CS 103. Mathematical Foundations of Computing
CS 103A. Discrete Mathematics for Computer Science
CS 103B. Discrete Structures
CS 103X. Discrete Structures (Accelerated)
CS 106A. Programming Methodology (Same as ENGR 70A)
CS 106B. Programming Abstractions (Same as ENGR 70B)
CS 106X. Programming Abstractions (Accelerated) (Same as ENGR 70X)
CS 107. Computer Organization and Systems
CS 108. Object-Oriented Systems Design
CS 109. Introduction to Probability for Computer Scientists
CS 110. Principles of Computer Systems
CS 121. Introduction to Artificial Intelligence
CS 124. From Languages to Information (Same as LINGUIST 180)
CS 147. Introduction to Human-Computer Interaction Design
CS 154. Introduction to Automata and Complexity Theory
CS 157. Logic and Automated Reasoning
CS 161. Design and Analysis of Algorithms
CS 181. Computers, Ethics, and Public Policy
CS 193D. Professional Software Development with C++
CS 204. Computational Law
CS 205A. Mathematical Methods for Robotics, Vision, and Graphics
CS 221. Artificial Intelligence: Principles and Techniques
CS 222. Rational Agency and Intelligent Interaction (Same as PHIL 358)
CS 223A. Introduction to Robotics
CS 223B. Introduction to Computer Vision
CS 224M. Multi-Agent Systems
CS 224N. Natural Language Processing
CS 224S. Speech Recognition and Synthesis
CS 224U. Natural Language Understanding (Same as LINGUIST 188/288)
CS 227. Reasoning Methods in Artificial Intelligence
CS 228. Structured Probabilistic Models: Principles and Techniques
CS 228T. Structured Probabilistic Models: Theoretical Foundations
CS 229. Machine Learning
CS 247. Human-Computer Interaction Design Studio
CS 249A. Object-Oriented Programming from a Modeling and Simulation Perspective
CS 276. Information Retrieval and Web Search (Same as LINGUIST 286)
CS 376. Research Topics in Human-Computer Interaction
CS 377. Topic in Human-Computer Interaction
CS 378. Phenomenological Foundations of Cognition, Language, and Computation
CS 547. Human-Computer Interaction Seminar
ECON 51. Economic Analysis II
ECON 137. Information and Incentives
ECON 160. Game Theory and Economic Applications
EDUC 218. Topics in Cognition and Learning: Play
EDUC 298. Online Communities of Learning
EE 178. Probabilistic Systems Analysis
EE 376A. Information Theory
ENGR 62. Introduction to Optimization (Same as MS&E 111)
ENGR 155C. Introduction to Probability and Statistics for Engineers (Same as CME 106)
ETHICSOC 20. Introduction to Moral Philosophy (Same as PHIL 20)
ETHICSOC 30. Introduction to Political Philosophy (Same as PHIL 30, PUBLPOL 103A)
HPS 60. Introduction to Philosophy of Science (Same as PHIL 60)
HUMBIO 145. Birds to Words: Cognition, Communication, and Language (Same as PSYCH 137/239A)
LINGUIST 1. Introduction to Linguistics
LINGUIST 63N. Translation
LINGUIST 105/205A. Phonetics
LINGUIST 110. Introduction to Phonetics and Phonology
LINGUIST 120. Introduction to Syntax
LINGUIST 124A/224A. Introduction to Formal Universal Grammar
LINGUIST 130A. Introduction to Linguistic Meaning
LINGUIST 130B. Introduction to Lexical Semantics
LINGUIST 133/233. Introduction to Formal Pragmatics
LINGUIST 140/240. Language Acquisition I
LINGUIST 182/282. Human and Machine Translation
LINGUIST 183/283. Programming and Algorithms for Natural Language Processing
LINGUIST 187/287. Grammar Engineering
LINGUIST 210A. Phonology
LINGUIST 210B. Advanced Phonology
LINGUIST 221A. Foundations of English Grammar
LINGUIST 221B. Studies in Universal Grammar
LINGUIST 222A. Foundations of Syntactic Theory I
LINGUIST 226. Binding
LINGUIST 230A. Introduction to Semantics and Pragmatics
LINGUIST 230B. Semantics and Pragmatics
LINGUIST 232A. Lexical Semantics
LINGUIST 235. Semantic Fieldwork
LINGUIST 241. Language Acquisition II
LINGUIST 247. Seminar in Psycholinguistics (Same as PSYCH 227)
LINGUIST 278. Programming for Linguists
LINGUIST 285. Finite State Methods in Natural Language Processing
MATH 103. Matrix Theory and Its Applications
MATH 113. Linear Algebra and Matrix Theory
MATH 151. Introduction to Probability Theory
MATH 162. Philosophy of Mathematics (Same as PHIL 162)
ME 115B. Human Values in Design
MS&E 120. Probabilistic Analysis
MS&E 121. Introduction to Stochastic Modeling
MS&E 201. Dynamic Systems
MUSIC 151. Psychophysics and Cognitive Psychology for Musicians
MUSIC 220A. Fundamentals of Computer-Generated Sound
MUSIC 220B. Compositional Algorithms, Psychoacoustics, and Spatial Processing
MUSIC 250A. HCI Theory and Practice
MUSIC 253. Musical Information: An Introduction
MUSIC 254. Applications of Musical Information: Query, Analysis, and Style Simulation
NBIO 206. The Nervous System
NBIO 218. Neural Basis of Behavior
PHIL 10. God, Self, and World: An Introduction to Philosophy
PHIL 14N. Belief
PHIL 80. Mind, Matter, and Meaning
PHIL 102. Modern Philosophy, Descartes to Kant
PHIL 143/243. Quine
PHIL 150. Basic Concepts in Mathematical Logic
PHIL 151. First-Order Logic
PHIL 152. Computability and Logic
PHIL 154. Modal Logic
PHIL 155. General Interest Topics in Mathematical Logic
PHIL 157. Topics in Philosophy of Logic
PHIL 164. Central Topics in the Philosophy of Science: Theory and Evidence

PHIL 166. Probability: Ten Great Ideas About Chance
PHIL 167B. Philosophy, Biology, and Behavior
PHIL 181. Philosophy of Language
PHIL 184. Theory of Knowledge
PHIL 184B. Philosophy of the Body
PHIL 186. Philosophy of Mind
PHIL 187. Philosophy of Action
PHIL 188. Personal Identity
PHIL 194P. Naming and Necessity
PHIL 194R. Epistemic Paradoxes
PHIL 350A. Model Theory
PHIL 351A. Recursion Theory
PHIL 354. Topics in Logic
PHIL 366. Evolution and Communication
PHIL 387. Practical Rationality
PSYCH 1. Introduction to Psychology
PSYCH 7Q. Language Acquisition
PSYCH 23N. Aping: Imitation, Control, and the Development of the Human Mind
PSYCH 30. Introduction to Perception
PSYCH 45. Introduction to Learning and Memory
PSYCH 50. Introduction to Cognitive Neuroscience
PSYCH 70. Introduction to Social Psychology
PSYCH 75. Introduction to Cultural Psychology
PSYCH 104. Uniquely Human
PSYCH 122S. Introduction to Cognitive and Comparative Neuroscience
PSYCH 131/262. Language and Thought
PSYCH 133. Human Cognitive Abilities
PSYCH 134. Seminar on Language and Deception
PSYCH 141. Cognitive Development
PSYCH 143. Developmental Anomalies
PSYCH 202. Cognitive Neuroscience
PSYCH 204A. Computational Neuroimaging
PSYCH 209/209A. The Neural Basis of Cognition: A Parallel Distributed Processing Approach
PSYCH 209B. Applications of Parallel Distributed Processing Models to Cognition and Cognitive Neuroscience
PSYCH 226. Models and Mechanisms of Memory
PSYCH 232. Brain and Decision Making
PSYCH 246. Cognitive and Neuroscience Friday Seminar
PSYCH 250. High-level Vision
PSYCH 251. Affective Neuroscience
PSYCH 252. Statistical Methods for Behavioral and Social Sciences
PSYCH 253. Statistical Theory, Models, and Methodology
PSYCH 272. Special Topics in Psycholinguistics
SOC 126/226. Introduction to Social Networks
STATS 110. Statistical Methods in Engineering and the Physical Sciences
STATS 116. Theory of Probability
STATS 191. Introduction to Applied Statistics
STATS 200. Introduction to Statistical Inference

SYMBOLIC SYSTEMS (SYMBSYS) COURSES

For information on undergraduate and graduate programs in Symbolic Systems, see the " Symbolic Systems" section of this bulletin.

UNDERGRADUATE COURSES IN SYMBOLIC SYSTEMS

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 (Davies, T), Win (Davies, T), Spr (Davies, T)

SYMBSYS 50. Introduction to Cognitive Neuroscience
(Same as PSYCH 50.) Topics in human neuropsychology. The functional organization of the human nervous system and of brain imaging techniques (MRI, PET). Hemispheric specialization and the brain basis of perception, memory, language, emotion, spatial cognition, and problem solving. Neuropsychological deficits in neurological disorders and their implications in understanding normal function. Recommended: 1 GER:DB-NatSci
4 units, Win (McClure, S)

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 100. Introduction to Cognitive and Information Sciences
(Same as LINGUIST 144, PHIL 190, PSYCH 132.) 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 (Wasow, T; Roberts, E)

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. Decision Behavior: Theory and Evidence
(Same as SYMBSYS 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, not given this year

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 (Staff), Win (Staff), Spr (Staff), Sum (Staff)

SYMBSYS 191. Senior Honors Seminar
Recommended for seniors doing an honors project. Under the leadership of the Symbolic Systems program coordinator, students 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 (Staff), Win (Staff), Spr (Staff), Sum (Staff)

GRADUATE COURSES IN SYMBOLIC SYSTEMS

Primarily for graduate students; undergraduates may enroll with consent of instructor.

SYMBSYS 201. ICT, Society, and Democracy
The impact of information and communication technologies on social and political life. Interdisciplinary. Classic and contemporary readings focusing on topics such as social networks, virtual versus face-to-face communication, the public sphere, voting technology, and collaborative production.

3 units, Spr (Davies, T)

SYMBSYS 206. Topics in the Philosophy of Neuroscience
Does understanding the brain or computational models of the brain allow understanding of the mind? Recent literature on neurophilosophical and neuroskeptical approaches to the mind including perception, neurophenomenology, sensorimotor accounts, computational models, and eliminativism. Prerequisites: PHIL 80, and familiarity with philosophy or neuroscience, or consent of instructor. May be repeated for credit.

3 units, Aut (Skokowski, P)

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

SYMBSYS 270. Decision Behavior: Theory and Evidence
(Same as SYMBSYS 170.) 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, not given this year

SYMBSYS 290. Master's Degree Project

1-15 units, Aut (Staff), Win (Staff), Spr (Staff), 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 (Davies, T), Win (Davies, T), Spr (Davies, T)