

# INDIANA UNIVERSITY

University Graduate School  
2005-2006  
Academic Bulletin

## Cognitive Science

College of Arts and Sciences  
Bloomington

### Interim Director

Richard Shiffrin\* (Psychology)

### Departmental E-mail

cogsci@indiana.edu

### Departmental URL

www.cogs.indiana.edu

## Graduate Faculty

(An asterisk [\*] denotes membership in the University Graduate School faculty with the endorsement to direct doctoral dissertations.)

### Arthur F. Bentley Professor

Elinor Ostrom\* (Political Science, Public and Environmental Affairs)

### College Professor of Cognitive Science and of Computer Science

Douglas Hofstadter\* (History and Philosophy of Science, Philosophy, Psychology)

### Rudy Professor

James T. Townsend\* (Psychology)

### Luther Dana Waterman Professor

Richard M. Shiffrin\* (Psychology)

### Professors

Colin Allen (History and Philosophy of Science), Geoffrey Bingham\* (Psychology), Arthur Bradley\* (Optometry), Jerome Busemeyer\* (Psychology), Donald Cunningham\* (Education), Thomas Duffy\* (Education), J. Michael Dunn\* (Informatics), Russell Fazio\* (Psychology), Steven Franks\* (Linguistics, Slavic Languages and Literature), Preston Garraghty\* (Psychology), Judith Gierut\* (Speech and Hearing Sciences), Robert Goldstone\* (Psychology), Andrew Hanson\* (Computer Science), Diane Kewley-Port\* (Speech and Hearing Sciences), John Kruschke\* (Psychology), Annie Lang\* (Telecommunications), David Leake\* (Computer Science), Frank Lester Jr.\* (Education), Daniel Maki\* (Mathematics), David McCarty\* (Philosophy), David MacKay\* (Business, Geography), Michael McRobbie\* (Computer Science), Harold Morris\* (Health, Physical Education, and Recreation), Lawrence Moss\* (Mathematics), Robert Nosofsky\* (Psychology), Richard Olshavsky\* (Business), Christopher Peebles\* (Anthropology), David Pisoni\* (Psychology), Robert Port\* (Linguistics, Computer Science), Yvonne Rogers\* (Informatics), Steven Sherman\* (Psychology), Linda Smith\* (Psychology), Joseph Steinmetz\* (Psychology), Esther Thelen\* (Psychology), Larry Thibos\* (Optometry), William Timberlake\* (Psychology), Charles Watson\* (Emeritus, Speech and Hearing Sciences, Psychology), Wayne Winston\* (Business)

University Graduate School  
Kirkwood Hall 111  
Indiana University  
Bloomington, IN 47405  
(812) 855-8853

Contact: grdschl@indiana.edu

### **Associate Professors**

Joyce Alexander\* (Education), Sasha Barab\* (Education), Thomas Busey (Psychology), Kenneth de Jong\* (Linguistics), Joseph Farley\* (Psychology), Thomas Foster\* (English), Michael Gasser\* (Computer Science, Cognitive Science), Lisa Gershkoff-Stowe\* (Speech and Hearing Sciences), Eric Isaacson\* (Music), Emilia Martins\* (Biology), Jonathan W. Mills\* (Computer Science), Kelly Mix (Psychology), Jared Mostafa\* (Information Science), Laura Murray (Speech and Hearing Sciences), John Paolillo\* (Information Science), Jonathan Plucker\* (Educational Psychology), Gregory Rawlins\* (Computer Science), Julie Stout (Psychology)

### **Assistant Professors**

Karen I. Kirk\* (Otolaryngology), Robert F. Potter\* (Telecommunications), Uta Priss (School of Library and Information Sciences)

### **Associate Scientist**

Gary Kidd\* (Speech and Hearing Sciences)

## **Associate Faculty**

### **Professors**

Kathleen Bardovi-Harlig\* (Linguistics), Curtis Bonk\* (Education), Phil Connell (Speech and Hearing Sciences, Linguistics), William Corsaro\* (Sociology), James Craig\* (Psychology), Stuart Davis\* (Linguistics), Daniel Dinnsen\* (Linguistics, Speech and Hearing Sciences), George von Furstenberg\* (Economics), Daniel Friedman\* (Computer Science), Roy Gardner\* (Economics), S. Lee Guth\* (Emeritus, Psychology, Optometry), Jeffrey Hart\* (Political Science), Beverly Hartford\* (Linguistics), Eugene Kintgen\* (English), Eugene McGregor Jr.\* (Public and Environmental Affairs, Political Science), Philip Podsakoff\* (Business), Paul Purdom\* (Computer Science), Charles Reigeluth\* (Education), Maynard Thompson (Mathematics), Dirk Van Gucht\* (Computer Science), Arlington Williams II\* (Economics)

### **Associate Professors**

J. Clancy Clements\* (Spanish and Portuguese), Theodore Frick\* (Education), Ed Hirt\* (Psychology), Marianne Kielian-Gilbert\* (Music), Yoshihisa Kitagawa (Linguistics), Timothy O'Connor\* (Philosophy), Thomas Schwen\* (Education), Dennis Senchuk\* (Philosophy, Education), Frederick Unverzagt (Medical and Molecular Genetics, Medical Neurobiology)

### **Assistant Professors**

Katy Borner (Information Science), Rowan Candy (Optometry), Florin Cutu (Computer Science), Julia Fox (Telecommunications), Jason Gold (Psychology), Thomas W. James\* (Psychology), Hugh Kelley (Economics), Sharlene Newman\* (Psychology), Leah Savion (Philosophy), Olaf Sporns (Psychology, Neuroscience), Jonathan Weinberg (Philosophy), Chen Yu\* (Psychology)

### **Graduate Advisor**

Professor Michael Gasser\*, Computer Science, Lindley Hall 230H, (812) 855-7078

## **Degrees Offered**

Doctor of Philosophy and Joint Doctor of Philosophy in Cognitive Science and Another Discipline

## **Program Information**

The Cognitive Science Program comprises an interdisciplinary research program and a doctoral degree program. Students carry out intensive research projects in state-of-the-art computer-based laboratories. There are two Ph.D. degree options, a standalone Ph.D. in Cognitive Science and a joint Ph.D. in Cognitive Science and another discipline, for example, psychology, computer science, philosophy, linguistics, or speech and hearing sciences. The program is designed to train students in theory development and model building (mathematical, formal, and computer simulation models), in empirical research, and in the development of the conceptual framework and technical skills for successful careers in research, teaching, business, and government.

## **Doctor of Philosophy Degree**

### **Admission Requirements**

Admission is by approval of the program's graduate admission committee. Applicants should have an undergraduate major in Cognitive Science, Psychology, Computer Science, Philosophy, Linguistics, Biology, or Anthropology; basic computer programming skills; and basic knowledge of mathematics for science, including calculus and statistics. In exceptional cases the programming or mathematics admission requirements may be waived and satisfied while pursuing graduate study.

### **Course Requirements**

A minimum of 90 credit hours, including the core courses COGS Q520 (3 cr.), COGS Q530 (3 cr.), COGS Q540 (3 cr.), COGS Q550 (3 cr.), COGS Q551 (3 cr.), and COGS Q560 (3 cr.) and selections totaling at least 16 credit hours from offerings listed in the Program in Cognitive Science or cross-listed with other departments, divisions, or programs. A maximum of 6 of these 16 credit hours may come from pure research courses (COGS Q799, COGS Q899, or the equivalent in another department). On the basis of their undergraduate background, students may be exempted from no more than one of the core courses. Students must also register for at least four semesters in the Colloquium Series course COGS Q733. In one of these semesters, the only for which credit is received, each student will be expected to give a lecture on his or her independent research as a part of the Colloquium Series.

Each student will also select a Content Specialization, an area of study that can be approached from the perspectives of the different disciplines within cognitive science. The list of available Content Specializations currently includes Language and Speech, Modeling, Dynamical Systems, Logic, and Human-Computer Interaction, but new Specializations will be added to this list in 2004-5. Contact the program for an up-to-date list. Each Content Specialization has a designated faculty member in charge of maintaining a list of required and recommended courses. Students must complete at least five courses in their specialization, and these courses must be taken in at least two different departments. The Content Specialization should normally be selected by the end of the student's second year in the program, and the courses selected must be approved by the student's advisory committee.

### **Minor Requirement**

Students must complete a minor in another department or program. Courses counting toward the minor may also count toward the student's Content Specialization. The minor should normally be completed by the beginning of the student's fourth year.

### **Qualifying Examination**

In consultation with his or her advising committee, each student will select topics for three qualifying papers. Two of these topics are expected to be within the student's Content Specialization, and these should address at least two of the different methodological approaches to the content area. The third paper can deal with a topic in any other area of cognitive science. These papers will be evaluated by the committee, and the student will defend the papers orally before the committee. The student will normally write the papers during the summer following his or her second year in the program and defend them at the beginning of the following fall semester. Students failing the qualification examination may retake it once.

## **Joint Doctor of Philosophy Degree in Cognitive Science and Another Discipline**

### **Admission Requirements**

Acceptance into the Joint Cognitive Science Ph.D. program is contingent upon admission into another degree-granting program at Indiana University Bloomington, hereafter referred to as the "originating discipline" or "originating department." Students must apply to the originating department, informing it that they also intend to join the Joint Cognitive Science Ph.D Program.

## **Course Requirements**

A minimum of 90 credit hours, of which 32 credit hours must be in courses listed or cross-listed in cognitive science, including COGS Q520 (3 cr.), COGS Q530 (3 cr.), COGS Q540 (3 cr.), COGS Q550 (3 cr.), COGS Q551 (3 cr.), COGS Q733: three semesters at 0 credits and one semester at 1 credit when the required colloquium is given by the student, and at least 6 credit hours not in the originating discipline and not among the Q-courses. (It is expected that most students will place out of one of the required courses on the basis of work toward a previous degree; for example, students with a degree in computer science would not be expected to take COGS Q530.) The 6 outside credit hours may not be taken in pure research courses (the equivalent of COGS Q799 and COGS Q899). The 32 credit hours may include a maximum of 6 credit hours in pure research courses (COGS Q799, COGS Q899, or the equivalent in originating departments). Strong encouragement is given to interdisciplinary diversification. Note that courses may count toward the requirements of both cognitive science and the originating department.

## **Tool-Skills Requirement**

Statistics PSY-K300 or PSY-K310 or the equivalent.

## **Qualifying Examination**

There are two options for the qualifying examination: (a) an examination in the originating discipline and a separate comprehensive examination in cognitive science (these may be taken at separate times); or (b) a joint examination covering relevant areas of both the originating discipline and cognitive science, as determined by the advisory committee, and with permission of both the originating discipline and the Cognitive Science Program. The cognitive science examination is normally taken after completion of the cognitive science course requirements. The examination may be repeated only once.

## **Public Colloquium**

The student must give a colloquium as part of the COGS Q733 colloquium series advertised at large to the university community, and covering some aspect of the student's research in cognitive science. The research covered may be from any stage of the student's career, including (but not restricted to) the thesis research.

## **Final Examination**

The public and oral defense of the dissertation will be conducted jointly with the student's originating discipline.

## **Ph.D. Minor in Cognitive Science**

Graduate students obtaining a Ph.D. in another discipline may find that that discipline gives them the option of taking a minor in cognitive science. To obtain such a minor, students must satisfy the following requirements: (a) obtain approval from the Cognitive Science Program; and (b) complete COGS Q540; one of the following: COGS Q530, COGS Q560, or COGS Q550; at least two semesters of COGS Q733; and at least 6 other credit hours in cognitive science courses not in the originating discipline.

## **Certificates in Cognitive Science**

The Cognitive Science Program is extremely broad, ranging from psychology to business to anthropology to computer science, to name just a few. Students in other disciplines may elect to focus on an area or areas within the broad range of cognitive science. Certificates are open to students upon request; several different cognitive science certificate programs are described in the following pages. Note that certificates are not required for a joint Ph.D. degree. The student will inform the cognitive science office, the student's cognitive science advisor, and the certificate director of an intent to pursue a certificate.

## **General Requirements for Certificates**

1. As soon as the student decides to pursue a certificate, a written proposal must be submitted to the Certificate Steering Committee giving a detailed course of study. The proposal may be a revised draft of an earlier proposal not approved, or an alteration of a previously approved proposal, and may contain a request for a revision of any of the stated requirements.

2. The proposal must be approved by the Certificate Steering Committee. The student must file a copy of the approved proposal with the Cognitive Science Program office.
3. The Certificate Steering Committee must attest that the approved course of study has been completed successfully. At this time, the University Graduate School will be notified of the certificate completion. Ideally, requirements and course work for certificates should be completed at the time of nomination to candidacy.
4. The certificate is awarded upon completion of requirements 1 through 3 and completion of the joint Ph.D. Achievement of the certificate will be noted on official transcripts.

## **Certificate in Dynamical Systems in Cognitive Science**

Students will develop an understanding of problems introduced by a dynamical perspective on cognitive phenomena and of the theoretical and methodological means of addressing those problems as found in dynamical systems. Each student will apply this understanding and analysis to a content area of their choice including study of perception, cognition, motor behavior, neural networks, language, and development.

### **Specific Requirements**

1. Prerequisites. Students should have taken courses in calculus (two to three semesters) at the very least. In addition, courses in differential equations, linear algebra, and (point set) topology would be helpful.
2. Required course. Students must take COGS Q580 Introduction to Dynamical Systems in Cognitive Science.
3. Additional advanced electives. Students must complete an additional four courses selected from among the following: COGS Q550 Models in Cognitive Science; PSY-P651 Perception/Action; HPSC-X755 Philosophical Issues in Chaos and Nonlinear Dynamics; LING-L541 Phonetics; LING-L641 Advanced Phonetics; PHIL-P561 Philosophy of Mind; CSCI-B551 Element of Artificial Intelligence; CSCI-B552 Knowledge-Based Computation; CSCI-B553 Biomorphing Computation; CSCI-B651 Natural Language Processing; CSCI-B652 Computer Models of Symbolic Learning; CSCI-B657 Computer Vision; CSCI-B659 Topics in Artificial Intelligence; PSY-P717 Evolutionary Basis of Learning; PSY-P615 Developmental Psychology; PSY-P657 Theories of Development; COGS Q750 Neural Networks as Models of Cognition; HPSC-X755 Fractals.
4. Qualifying exams. At least one question on dynamical systems must be included on the student's qualifying exams.
5. Dissertation. The student's dissertation must include application of dynamical systems to the specific problem under study.

## **Certificate in Human-Computer Interaction**

### **Requirements for the Cognitive Science Certificate in HCI (12 cr.)**

Students will demonstrate proficiency in a broad range of courses involving the applied cognitive analysis of human-computer interaction (HCI). The program will emphasize the theoretical and methodological issues associated with designing and evaluating cognitively compatible user interfaces to interactive technologies.

### **Specific Requirements**

1. The student must submit a written proposal to the Certificate Steering Committee giving a detailed course of study. The proposal may be a revised draft of an earlier proposal, or an alteration of a previously approved proposal, and may contain a request for a revision of any of the stated requirements. The proposal must be approved by the Steering Committee. Students must take SLIS L542 Introduction to HCI (or equivalent).
2. Students for the Cognitive Science Certificate must complete an additional four courses selected from among the following to ensure courses are taken from at least two departments other than the student's home department:  
**CSCI A546 User Interface Programming**  
**CSCI B581 Advanced Computer Graphics**

**CSCI B582 Image Synthesis**  
**CSCI B665/B666 Software Engineering Management/Implementation**  
**CSCI B669 Topics in Database and Information Systems**  
**CSCI B689 Topics in Graphics and Human Computer Interaction**  
**SLIS L578 User Interface Design for Information Systems**  
**SLIS L642 Information Usage and the Cognitive Artifact**  
**SLIS L697 Advanced Topics in Information Systems**  
**EDUC P544 Applied Cognition and Learning Strategies**  
**CSCI P565-566 Software Engineering I-II**  
**EDUC R685 Human-Computer Interface Design**  
**EDUC P600 Topical Seminar in Learning Cognition and Instruction**  
**EDUC P544 Applied Cognition and Learning Strategies**

**SPHS S522 Digital Signal Processing**  
**BUS S601 MIS Research Topics in Applications Systems Design**  
**BUS S602 MIS Research Topics in Administration and Technology**  
**TEL T571 Applied Emotional and Cognitive Psychology Theory**  
**TEL T602 Seminar in Processes and Effects: The Information Processing of Media**

3. The student's dissertation must address issues related to human-computer interaction.

The Cognitive Science Certificate in HCI is awarded upon completion of the above requirements and completion of the requirements for the Ph.D. (either as a joint major in Cognitive Science and a home department, or as a Cognitive Science minor and a major in a home department).

## **Certificate in Language and Speech**

Students will demonstrate proficiency in a broad range of topics that focus on issues related to language and speech. The program of study will emphasize mastery of language structure, language processing, and computational approaches to linguistic analysis. An independent research project exploring some facet of language and speech will be required.

### **Specific Requirements**

1. Students must complete at least five approved graduate courses in the area of language and speech.
2. Courses in language and speech must be taken in at least two different departments.
3. Courses must include at least one dealing with language structure and at least one dealing with language processing or acquisition. Courses in language structure include most linguistics courses, PHIL-P520, and PHIL-P720. Courses in processing and acquisition include PSY-P623, CSCI-B651, SPHS-S530, and periodic seminars on language-related topics in these departments.
4. Students must demonstrate familiarity with computer modeling of cognitive processes. This requirement can be met through course work (COGS Q580, PSY-P556, or various courses in computer science, including CSCI-B551, CSCI-B552, CSCI-B553, CSCI-B651, and CSCI-B652) or through a written report of research which includes a computer program written by the student. This report could be a master's or Ph.D. thesis.
5. The student's cognitive science qualifying examination must include at least one section on a topic in language and speech.
6. The student's dissertation must address issues related to language and speech.

## **Certificate in Logic, Language, and Computation**

The area covered by this certificate is applied logic, i.e., logic as applied to information processing. It is an area of research which is of increasing importance in artificial intelligence and computer science. Students will demonstrate their mastery of courses having to do with symbolic information processing.

### **Specific Requirements**

The requirements include at least 18 credit hours of course work (including research and seminars). At least two courses must be taken outside the student's home department. Each proposal for certification would need to demonstrate both breadth and depth in the general area of logic, language, and computation.

1. Prerequisites. Students should demonstrate mathematical maturity by having taken one or more courses in the following: set theory, discrete mathematics, abstract algebra, linear algebra, topology, and mathematical logic.
2. Students must take PHIL P505 and PHIL P506 Logical Theory I-II, or demonstrate equivalent knowledge of completeness for first-order logic, together with the Gödel incompleteness and undecidability results. If students demonstrate knowledge of this material, they may take other courses from the lists of advanced courses given below.
3. Students must select at least two or more advanced courses from a list that includes CSCI B501 Theory of Computing; CSCI B510 Introduction to Applied Logic; PHIL P550 Systems of Modal Logic; PHIL P551 Philosophy and the Foundations of Mathematics; PHIL P552 Philosophy of Logic; LING-L626 Semantics of Natural Language; LING L640 Quantitative Linguistics; MATH M682 Model Theory; and MATH M583 Set Theory.
4. Students must take a research seminar, either one generally designated as such (e.g., PHIL P750 Seminar Logic, PHIL-P751 Seminar Logic, or MATH M781-782 Selected Topics in Mathematical Logic), or another seminar approved by the Logic Certificate Committee.
5. Students will be expected to take active part in the weekly Logic Seminar.
6. The student's dissertation must address issues in the general area of logic, language, and computation.

### **Certificate in Modeling in Cognitive Science**

Students will demonstrate their mastery with a broad selection of courses involving mathematical and computer simulation approaches to modeling, with a specialization in at least one area of modeling, and with a research project involving modeling. The program will emphasize both basic techniques and applications in particular content areas.

### **Specific Requirements**

1. Students must fulfill 18 credit hours of courses in the modeling area. Required course: COGS Q550 Models in Cognitive Science, and at least five additional courses in modeling (15 credits minimum).
2. These courses must demonstrate both breadth and specialization, and a grasp of both methods and applications. The course options given below provide examples of courses currently appropriate to accomplish these goals.

The courses should include at least one course in basic techniques and methods (PSY P605 Introduction to Mathematical Psychology; COGS Q580 Introduction to Dynamic Systems in Cognitive Science; MATH M447- MATH M448 Mathematical Models and Applications; PHIL P550 Systems of Modal Logic); and at least one course in applications (COGS Q750 Neural Networks as Models of Cognition; CSCI B651 Natural Language Processing; CSCI B652 Computer Models of Symbolic Learning; LING L611 Models of Linguistic Structure; PSY P648 Choice Behavior).

The selected courses must be taken from at least two departments excluding courses listed only in the Cognitive Science Program. These courses may not include a course whose content consists almost entirely of a research project (such courses and projects are separately covered below).

3. Students must demonstrate a grasp of modeling in research, either through course work (COGS Q689 Computer Simulation Project; PSY P556 Independent Computer Project), or through a written report of research involving modeling (includes master's or Ph.D. projects).
4. The Ph.D. qualifying examination in the Cognitive Science Program must contain at least one section on a modeling-related topic.
- 5.

## Courses

**COGS Q520 Mathematics and Logic for Cognitive Science (3 cr.)** Covers the mathematical backgrounds of contemporary work in cognitive science. Includes basic material on both the symbolic and connectionist approaches: machines, logics, networks, games, and probability.

**COGS Q530 Programming Methods in Cognitive Science (3 cr.)** P: some programming experience. An introduction to computer programming methods for artificial intelligence and computer simulation of cognitive models. Emphasis on the necessary data structures and their applications to cognitive science. Programming projects may be related to state-space search for problem solving and game playing, production systems, and cognitive modeling tasks including memory models and neural simulations.

**COGS Q540 Philosophical Foundations of the Cognitive and Information Sciences (3 cr.)** Causal issues: cognitive architecture, physical embodiment, neuroscience, networks, dynamic systems. Semantic issues: meaning, interpretation, representation, information flow. The role of both in language, logic, reasoning, action, perception, learning, categorization, and consciousness. Emphasis on writing, analysis, and exposition.

**COGS Q550 Models in Cognitive Science (3 cr.)** P: Q530 and Q560. An introduction to modeling in various areas of cognitive science, including computer simulation models of complex cognition, models within artificial intelligence, models based on neural mechanisms and networks, and formal and mathematical models in areas such as psychology, linguistics, and philosophy.

**COGS Q551 The Brain and Cognition (3 cr.)** An introduction to neural mechanisms underlying complex cognition, and a survey of topics in neuroscience related to cognition. It provides a solid background in human biopsychology.

**COGS Q560 Experimental Methods in Cognitive Science (3 cr.)** Specific goals of this course include: a) an understanding of experimental design and the resources for future studies; b) an understanding of converging measures and programmatic research; c) discussion of current controversies in experimental design; and d) hands-on experience designing, conducting, and critiquing experiments.

**COGS Q580 Introduction to Dynamic Systems in Cognitive Science (3 cr.)** Introduction to linear and nonlinear dynamic systems including catastrophe and chaos theory. Main aspects include: 1) understanding the basic quantitative theory and techniques of dynamic systems, 2) illustration of major concepts and systems behavior with the aid of computer graphics and numerical software and 3) examples from cognitive science.

**COGS Q689 Computer Simulation Project (3 cr.)** The student will develop and test a computer simulation of some aspect of cognition. The student will produce a working, documented computer program, and a paper describing both the workings of the program and tests of the program (either theoretical tests, tests of the program against data, or both).

**COGS Q700 Seminar in Cognitive Science (3 cr.)** Intensive study of specific topics in cognitive science. Topics and instructors will change regularly. May be repeated.

**COGS Q733 Colloquium Series (0-1 cr.)** Three semesters at zero credits and one semester at one credit when the required colloquium is given by the student. The class will meet every week. At some meetings, invited speakers will present colloquia; at others students will present their own work. Each student will be required to make a presentation at least once during the year the course is taken for credit.

**COGS Q750 Neural Networks as Models of Cognition (3 cr.)** Topical seminar featuring analysis of models based on neural networks. Will usually feature extensive exploration of one or more examples of models of this type.



**COGS Q799 Readings and Research in Cognitive Science (1-3 cr.)** Tutorial research and study in specialized topics in cognitive science.

**COGS Q899 Dissertation Research (1-12 cr.)** Dissertation research in specialized topics in cognitive science.

## **Cross-Listed Courses**

The following courses may be used to satisfy the credit hour requirements of the Cognitive Science Program. Additional courses whose content in a given year is sufficiently relevant to cognitive science (including seminars, new courses, or courses with topical content) may also be used to satisfy the requirements, conditional upon acceptance by the Cognitive Science Program of a petition including justification.

### **Anthropology**

**ANTH L580 Semiotics and Human Ethology (2 cr.)**

**ANTH L840 Ethnolinguistic Seminar (1-2 cr.)**

### **Kelley School of Business**

**BUS S505 Introduction to Management Information Systems (3 cr.)**

**BUS S535 Advanced Topics in Management Information Systems (3 cr.)**

**BUS S560 Management Information Systems Design and Applications (3 cr.)**

**BUS S600 Research Design and Methods in Management Information Systems (3 cr.)**

**BUS S601 Management Information Systems Research: Topics in Application Systems Development (3 cr.)**

**BUS S602 Management Information Systems Research: Topics in Administration and Technology (3 cr.)**

### **Computer Science**

**CSCI B501 Theory of Computing (3 cr.)**

**CSCI B502 Computational Complexity (3 cr.)**

**CSCI B510 Introduction to Applied Logic (3 cr.)**

**CSCI B521 Programming Language Principles (3 cr.)**

**CSCI B522 Programming Language Foundations (3 cr.)**

**CSCI B551 Elements of Artificial Intelligence (3 cr.)**

**CSCI B552 Knowledge-Based Computation (3 cr.)**

**CSCI B553 Biomorphonic Computation (3 cr.)**

**CSCI B621 Advanced Concepts in Programming Languages (3 cr.)**

**CSCI B622 Programming Language Type Systems (3 cr.)**

**CSCI B651 Natural Language Processing (3 cr.)**

**CSCI B652 Computer Models of Symbolic Learning (3 cr.)**

**CSCI B657 Computer Vision (3 cr.)**

**CSCI B659 Topics in Artificial Intelligence (1-6 cr.)**

### **Economics**

**ECON E626 Game Theory (3 cr.)**

### **School of Education**

**EDUC H650 Theory of Knowledge and the Educational Process (3 cr.)**

**EDUC P530 Instructional Psychology (3 cr.)**

**EDUC P540 Learning and Cognition in Education (3 cr.)**

**EDUC P544 Applied Cognition and Learning Strategies (3 cr.)**

**EDUC P550 Cognition and Semiotics (3 cr.)**

**EDUC P591 Cognitive Assessment and Intervention (3 cr.)**

**EDUC P600 Topical Seminar in Learning, Cognition, and Instruction (3 cr.)**

**EDUC P640 Thinking and Learning in Social Contexts (3 cr.)**

**EDUC R542 Instructional Graphics Design (3 cr.)**

**EDUC R561 Evaluation and Change in the Instructional Development Process (3 cr.)**

**EDUC R586 Practicum in Instructional Systems Technology (1-3 cr.)**

**EDUC R611 Instructional Technology Foundations (1 cr.)**  
**EDUC R622 Learning Environments Design (3 cr.)**  
**EDUC R630 Learner Analysis in the Instructional Technology Process (3 cr.)**  
**EDUC R695 Topical Inquiry Seminar in Instructional Systems Technology (3 cr.)**  
**EDUC Y530 Topics in Computer Analysis of Educational Data (1-3 cr.)**

#### **Folklore and Ethnomusicology**

**FOLK F714 Paradigms of Ethnomusicology (3 cr.)**  
**FOLK F722 Colloquium in Theoretical Folklore/Ethnomusicology (3 cr.)**  
**FOLK F738 Psychological Issues in Folklore (3 cr.)**

#### **French and Italian**

**FRIT F576 French Linguistics I (Phonology) (3 cr.)**  
**FRIT F577 French Linguistics II (Syntax and Semantics) (3 cr.)**  
**FRIT F580 Introduction to French Applied Linguistics (3 cr.)**  
**FRIT F603-F604 History of the French Language (3 cr.)**  
**FRIT F670 Phonological Structure of French (3 cr.)**  
**FRIT F671 Syntactic Structure of French (3 cr.)**  
**FRIT F672 French Sociolinguistics and Dialectology (3 cr.)**  
**FRIT F673 Topics in the Learning and Teaching of French (3 cr.)**  
**FRIT F675 Studies in French Linguistics (3 cr.)**  
**FRIT F676 Structure and Sociolinguistics of Haitian Creole (3 cr.)**  
**FRIT F677 French Lexicology and Lexicography (3 cr.)**  
**FRIT F678 French Morphology (3 cr.)**

#### **School of Health, Physical Education, and Recreation**

**HPER K542 Neuromuscular Control of Movement (3 cr.)**

#### **History and Philosophy of Science**

**HPSC X551 Survey of the Philosophy of Science (3 cr.)**  
**HPSC X552 Modern Philosophy of Science (3 cr.)**  
**HPSC X755 Special Topics in the Philosophy of Science (2-5 cr.)**

#### **Informatics**

**INFO I590 Topics in Informatics (When Appropriate)**

#### **School of Library and Information Science**

**SLIS L542 Introduction to Human-Computer Interaction (HCI) (3 cr.)**  
**SLIS L570 Online Information Retrieval (3 cr.)**  
**SLIS L578 User Interface Design for Information Systems (1-3 cr.)**  
**SLIS L597 Topics in Library and Information Science (1-4 cr.)**  
**SLIS L642 Information Usage and the Cognitive Artifact (3 cr.)**

#### **Linguistics**

**LING L503 Survey of Linguistics I (3 cr.)**  
**LING L530 Introduction to Historical Linguistics (3 cr.)**  
**LING L541 Introductory Phonetics (4 cr.)**  
**LING L542 Phonological Analysis (3 cr.)**  
**LING L543 Syntactic Analysis (3 cr.)**  
**LING L544 Morphological Analysis (3 cr.)**  
**LING L545 Computation and Linguistic Analysis (3 cr.)**  
**LING L611 Models of Linguistic Structure (3 cr.)**  
**LING L614 Alternative Syntactic Theories (3 cr.)**  
**LING L625 Bilingualism and Language Contact (3 cr.)**  
**LING L630 Lexicology (3 cr.)**  
**LING L641 Advanced Phonetics (3 cr.)**  
**LING L642 Advanced Phonological Description (3 cr.)**

LING L643 Advanced Syntax (3 cr.)  
LING L645 Advanced Natural Language Processing (3 cr.)  
LING L710 Seminar in Acoustic Phonetics (4 cr.)  
LING L712 Seminar in Phonology (4 cr.)  
LING L714 Seminar in Syntax (4 cr.)  
LING L780 Seminar in Structural Semantics (4 cr.)  
LING T522 Survey of Applied Linguistics (3 cr.)  
LING T532 Second-language Acquisition (3 cr.)  
LING T632 Current Research in Second-Language Acquisition (3 cr.)  
LING T711 Seminar in Applied Linguistics (4 cr.)

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