COMPUTING AND INFORMATION SCIENCE

ADMINISTRATION

Daniel P. Huttenlocher, dean

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INTRODUCTION

Computing and Information Science (CIS) offers courses and programs campuswide in various academic disciplines in which computing is integral. It is home to the Department of Computer Science, the Department of Statistical Science, the program in Information Science, and interdisciplinary programs in computational biology, computational science and engineering, game design, and computing in the arts.

ACADEMIC PROGRAMS

Computing and Information Science offers the following academic programs through its corresponding colleges.

Computational Biology

See program listing.

Computational Science and Engineering

The CIS program in Computational Science and Engineering (CSE) spans several dozen departments and research areas. The field is application-driven and involves a mix of applied mathematics, numerical analysis, and computer science. Numerous courses are taught throughout the university. Go to www.cis.cornell.edu/cse for a list of courses and associated faculty members.

Computer Science

The Department of Computer Science offers an undergraduate major to students in the College of Arts and Sciences and the College of Engineering, a master of engineering degree, and a Ph.D. See the departmental listings for details.

Computing in the Arts

See the program listing of details about the undergraduate minor.

Game Design

The undeniable popularity of games draws the attention of academia, industry, and even the government on areas of design, development, and social impact. The game industry, like the film industry, is an unmistakable force in entertainment. Like filmmaking, game design can thrive and evolve only with the support of a strong academic foundation. The Game Design minor is offered by the Department of Computer Science for students who anticipate that game design will have a prominent role to play in their academic and professional career. Visit www.cs.cornell.edu/degreeprogs/ugrad/CSMinor/GameDesign Minor/index.htm for minor requirements. To learn about the Game Design Initiative at Cornell (GDIAC), visit gdiac.cis.cornell.edu. Students across colleges are eligible to pursue the Game Design minor.

Information Science

The Department of Information Science offers an undergraduate major to students in the College of Agriculture and Life Sciences, the College of Arts and Sciences, and the College of Engineering, as well as a Ph.D.

Statistical Science

The Department of Statistical Science offers an undergraduate major to students in the College of Arts and Sciences, a master of professional studies, and an M.S./Ph.D.

THE INFORMATION SCIENCE MINOR

A minor in information science is available to students in the Colleges of Agriculture and Life Sciences; Architecture, Art, and Planning (available to Architecture and Planning students only); Arts and Sciences; Engineering; Human Ecology; and the Schools of Hotel Administration and Industrial and Labor Relations. Because of small differences in regulations between the colleges, the requirements may vary slightly, depending on a student's college and, in a few cases, a student's major. Students interested in pursuing the information science minor must initiate the process by sending an e-mail message with their name, college, year of study (e.g., second-semester sophomore), expected graduation date, and (intended) major to minor@infosci.cornell.edu. See www.infosci.cornell.edu/ugrad.html for the most up-to-date description of the minor and its requirements.

Information science is an interdisciplinary field covering all aspects of digital information. The program has three main areas: human-centered systems, social systems, and information systems. Human-centered systems studies the relationship between humans and information, drawing from human-computer interaction and cognitive science. Social systems examines information in its economic, legal, political, cultural, and social contexts. Information systems studies the computer science problems of representing, storing, manipulating, and using digital information.

The minor has been designed to ensure that students have substantial grounding in all three of these areas, as well as in statistics. To this end, the requirements for the undergraduate minor are as follows: All courses must be chosen from the course lists below. In addition, a letter grade of at least C is required; S–U courses are not allowed.

Note: Course credits from institutions other than Cornell may not be counted toward the IS minor. Engineering students must use ENGRD 2700 or CEE 3040. Hotel students must use HADM 2201.

- **Statistics:** one course.
- **Human-centered systems** (human-computer interaction and cognitive science): two courses (for all colleges except Engineering and Hotel); one course (Engineering and Hotel).
- **Social systems** (social, economic, political, cultural, and legal issues): one course.
- **Information systems** (primarily computer science): two courses for all colleges except Hotel. Hotel students need to take one course in this area. Engineering students may not use INFO 1300. CS 2110 may not be used by students who are required to take it for their major.
- **Elective:** one additional course from any component area. Hotel students must take three courses in this category, from the following: HADM 3374, HADM 4474, or AEM 3220. (Engineering students and all computer science majors must select a course from human-centered systems or social systems. Communication majors must select a course outside Communication. Students in other majors should check with their advisors to make sure there are no special departmental restrictions or requirements.)

Statistics

An introductory course that provides a working knowledge of basic probability and statistics and their application to analyzing data occurring in the real world.

Engineering students must take one of the following:

- ENGRD 2700 Basic Engineering Probability and Statistics
- CEE 3040 Uncertainty Analysis in Engineering

Hotel students must take:

- HADM 2201 Hospitality Quantitative Analysis

All other students can meet this requirement with any one of the following:

- MATH 1710 Statistical Theory and Application in the Real World
- STSCI 2010 Introductory Statistics
- AEM 2100 Introductory Statistics
- PAM 2100 Introduction to Statistics
- HADM 2201 Hospitality Quantitative Analysis
- ENGRD 2700 Basic Engineering Probability and Statistics
- BTRY 3010 Statistical Methods I
- SOC 3010 Evaluating Statistical Evidence
- CEE 3040 Uncertainty Analysis in Engineering

- ILRST 3120 Applied Regression Methods
- ECON 3190 Introduction to Statistics and Probability
- PSYCH 3500 Statistics and Research Design

Human-Centered Systems

- COGST 1101 Introduction to Cognitive Science
- PSYCH 2050 Perception
- INFO 2140 Cognitive Psychology
- INFO 2450 Communication and Technology
- PSYCH 2800 Introduction to Social Psychology
- PSYCH 3420 Human Perception: Applications to Computer Graphics, Art, and Visual Display
- INFO 3400 Psychology of Online Relationships
- INFO 3450 Human-Computer Interaction Design
- INFO 3460 Online Communities
- PSYCH 3470 Psychology of Visual Communications
- INFO 3650 Technology and Collaboration
- PSYCH 3800 Social Cognition
- PSYCH 4160 Modeling Perception and Cognition
- INFO 4320 Introduction to Rapid Prototyping and Physical Computing*
- INFO 4400 Advanced Human-Computer Interaction Design
- INFO 4450 Seminar in Computer-Mediated Communication
- INFO 4500 Language and Technology
- DEA 4700 Applied Ergonomic Methods

*INFO 4320 may count toward the minor in Human-Centered Systems or Information Systems but not both.

Social Systems

- INFO 2040 Networks
- STS 2501 Technology in Society
- INFO 2921 Inventing an Information Society
- ECON 3010 Microeconomics*
- SOC 3040 Social Networks and Social Processes
- ECON 3130 Intermediate Microeconomic Theory*
- INFO 3200 New Media and Society
- AEM 3220 Internet Strategy
- INFO 3490 Media Technologies
- INFO 3561 Computing Cultures
- INFO 3660 History and Theory of Digital Art
- ECON 3680 Game Theory*
- STS 4111 Knowledge, Technology, and Property
- INFO 4144 Responsive Environments
- COMM 4280 Communication Law
- INFO 4290 Copyright in the Digital Age
- SOC 4340 Online Social Media and Information Networks
- ORIE 4350 Introduction to Game Theory*
- INFO 4470 Social and Economic Data
- HADM 4489 The Law of the Internet and E-Commerce
- COMM 4650 Mobile Communication in Public Life
- ECON 4760 Decision Theory I
- ECON 4770 Decision Theory II
- INFO 5150 Culture, Law, and Politics of the Internet

*Only one of ECON 3010 and 3130 can be taken for IS credit. Only one of ORIE 4350 and ECON 3680 can be taken for IS credit.

Information Systems

- INFO 1300 Introductory Design and Programming for the Web
- CS 2110 Object-Oriented Programming and Data Structures*
- INFO 2300 Intermediate Design and Programming for the Web*
- CIS 3000 Introduction to Computer Game Design
- INFO 3300 Data-Driven Web Applications
- INFO 4300 Information Retrieval
- INFO 4302 Web Information Systems
- INFO 4307 Learning from Web Data
- CS 4320 Introduction to Database Systems
- INFO 4320 Introduction to Rapid Prototyping and Physical Computing*
- LING 4424 Computational Linguistics
- LING 4474 Introduction to Natural Language Processing
- CS 4620 Introduction to Computer Graphics
- CS 4700 Foundations of Artificial Intelligence
- ORIE 4740 Statistical Data Mining I
- CS 4780 Machine Learning
- ORIE 4800 Information Technology
- ORIE 4810 Delivering OR Solutions with Information Technology
- ORIE 4850 Application of Operations Research and Game Theory to Information Technology
- CS 5150 Software Engineering
- INFO 5300 Architecture of Large-Scale Information Systems
- CS 5430 System Security
- ECE 5620 Fundamental Information Theory
- CS 5780 Empirical Methods in Machine Learning and Data Mining

*The following exceptions apply:

- INFO 1300: Engineering students and Computer Science majors may not use this course for the minor.
- INFO 2300: Computer Science majors may not use this course for the minor.
- CS 2110: Students for whom this is a required major course may not use it for the minor, e.g., Computer Science or Operations Research and Information Engineering majors.

INFO 4320 may count toward the minor as Information Systems or Human-Centered Systems but not both.

COMPUTING AND INFORMATION SCIENCE (CIS) COURSES

CIS 1121 Introduction to MATLAB
Fall, spring. 2 credits. Corequisite: MATH 1110, 1910, or equivalent. No programming experience assumed.
Introduction to elementary computer programming concepts using MATLAB. Topics include problem analysis, development of algorithms, selection, iteration, functions, and arrays. Examples and assignments are chosen to build an appreciation for computational science. The goal is for each student to develop a facility with MATLAB that will be useful in other courses whenever there is a need for computer problem solving or visualization.

CIS 1610 Computing in the Arts (also CS/ENGRI 1610, DANCE 1540, FILM 1750, MUSIC 1465, PSYCH 1650)
Fall. 3 credits.
For description, see CS 1610.

CIS 1620 Visual Imaging in the Electronic Age (also ARCH 3702, ART 1700, CS/ENGRI 1620)
Fall or spring. 3 credits.
For description, see ART 1700.

CIS 3000 Introduction to Computer Game Design
Spring. 4 credits. Prerequisites: at least one of the following, according to student's area of interest (art, music, or programming): Art: ART 2501 or equivalent; Music: CS 111x or INFO 1301–1302, MUSIC 1421 or equivalent; Programming: CS/ENGRD 2110 or equivalent.
Investigates the theory and practice of developing computer games from a blend of technical, aesthetic, and cultural perspectives. Technical aspects of game architecture include software engineering, artificial intelligence, game physics, computer graphics, and networking. Aesthetic and cultural aspects of design include art and modeling, sound and music, history of games, genre analysis, role of violence, gender issues in games, game balance, and careers in the industry. Programmers, artists, and musicians collaborate to produce an original computer game.

CIS 4002 Advanced Projects in Computer Game Design
Fall. 3 credits. Prerequisite: CIS 3000 or permission of instructor.
Project-based follow-up course to CIS 3000. Students work in a multidisciplinary team to develop an original computer game or an application that explores innovative game technology. Students have the goal of submitting their work to a contest or conference. Grading is based on completion of project plans and documentation, teamwork, presentations and demonstrations, class participation, and quality of final projects. Instructional meetings are arranged based on student and instructor schedules.

CIS 4999 Independent Reading and Research
Fall, spring. 1–4 credits.
Independent reading and research for undergraduates.

CIS 5040 Applied Systems Engineering (also CEE 5040, SYSEN 5100, ECE/ORIE 5120, MAE 5910)
Fall. 3 credits. Prerequisites: senior or graduate standing in engineering field; concurrent or recent (past two years) enrollment in group-based project with strong system design component approved by course instructor.
For description, see SYSEN 5100.

CIS 5050 Systems Analysis Architecture, Behavior, and Optimization (also CEE 5050, ECE/ORIE 5130, MAE 5920, SYSEN 5200)
Spring. 3 credits. Prerequisite: Applied Systems Engineering (CEE 5240, ECE 5120, MAE 5910, ORIE 5120, or SYSEN 5100).
For description, see SYSEN 5200.

[CIS 6229 Computational Methods for Nonlinear Systems (also PHYS 7682)
Fall. 4 credits. Enrollment may be limited. Next offered 2011–2012.
For description, see PHYS 7682.]

CIS 7999 Independent Research
Fall, spring. Variable credit. Prerequisite: permission of CIS faculty member.
Independent research or master of engineering project.

COMPUTER SCIENCE

The Department of Computer Science is affiliated with both the College of Arts and Sciences and the College of Engineering. Students in either college may major in computer science. The department is also part of CIS. Its courses are an integral part of CIS's several educational programs.

CS 1109 Fundamental Programming Concepts
Summer. 2 credits. Prerequisite: pre-freshman standing or permission of instructor. Credit may not be applied toward engineering degree. S–U grades only.
Designed for students who intend to take CS 111x but are not adequately prepared for it. Basic programming concepts and problem analysis are studied. An appropriate high-level programming language is used. Students with previous programming experience and students who do not intend to take CS 111x should not take this course.

CS 1110 Introduction to Computing Using Java
Fall, spring, summer. 4 credits. Assumes basic high school mathematics (no calculus) but no programming experience.
Programming and problem solving using Java. Emphasizes principles of software development, style, and testing. Topics include object-oriented concepts, procedures and functions, iteration, arrays, strings, algorithms, exceptions, GUIs (graphical user interfaces). Weekly labs provide guided practice on the computer, with staff present to help. Assignments use graphics and GUIs to help develop fluency and understanding.

CS 1112 Introduction to Computing Using MATLAB
Fall, spring. 4 credits. Corequisite: MATH 1110, 1910, or equivalent. Assumes student is comfortable with mathematics (at level of one semester of calculus) but has no prior programming experience.
Programming and problem solving using MATLAB. Emphasizes the systematic development of algorithms and programs. Topics include iteration, functions, arrays, and MATLAB graphics. Assignments are designed to build an appreciation for complexity, dimension, fuzzy data, inexact arithmetic, randomness, simulation, and the role of approximation.

CS 1114 Introduction to Computing Using MATLAB and Robotics
Spring. 4 credits. Prerequisite: some programming experience.
Honors-level introduction to computer science using camera-controlled robots using MATLAB. Emphasis is on modular design of programs and on fundamental algorithms. Extensive laboratory experiments with cameras and robots, including Sony Aibo. Example projects include controlling a robot by pointing a light stick and making a robot recognize simple colored objects.

CS 1130 Transition to Object-Oriented Programming
Fall, spring. 1 credit. Prerequisite: one course in programming. S–U grades only.
Introduction to object-oriented concepts using Java. Assumes programming knowledge in a language like MATLAB, C, C++, or Fortran. Students who have learned Java but were not exposed heavily to OO are welcome.

CS 1132 Transition to MATLAB
Fall, spring. 1 credit. Prerequisite: one course in programming. S–U grades only.
Introduction to MATLAB and scientific computing. Covers the MATLAB environment, assignment, conditionals, iteration, scripts, functions, arrays, scientific graphics, and vectorized computation. Assumes programming knowledge in a language like Java, C, C++, or Fortran.

CS 1300 Introductory Design and Programming for the Web (also INFO 1300)
Fall. 4 credits.
For description, see INFO 1300.

[CS 1305 Computation and Culture in a Digital Age (also INFO 1305)
Summer. 3 credits. Prerequisite: none at university level; must be high school junior or rising senior. Offered alternate years; offered summer 2011.
Explores ideas and technologies of computing and information science as well as their role in society from legal, historical, and cultural perspectives.]

CS 1610 Computing in the Arts (also CIS/ENGRI 1610, DANCE 1540, FILM 1750, MUSIC 1465, PSYCH 1650)
Fall. 3 credits. Recommended: good comfort level with computers and some of the arts.
Over the centuries, artists in a wide variety of media have employed many approaches to the creative process, ranging from the philosophical to the mechanical to the virtual. This course unravels some of the mysteries going on inside software used for art and music. It looks at ways of breaking things apart and sampling and ways of putting things together and resynthesizing, and explores ideas for creation. This course does not teach software packages for creating art and music. The course complements ART 1701+ and MUSIC 1421+.

CS 1620 Visual Imaging in the Electronic Age (also ARCH 3702, ART 1700, CIS/ENGRI 1620)
Fall. 3 credits.
For description, see ART 1700.

CS 1710 Introduction to Cognitive Science (also COGST 1101, LING 1170, PHIL 1910, PSYCH 1102)
Fall, summer. 3 credits.
For description, see COGST 1101.

CS 2022 Introduction to C
Spring, usually weeks 1–4. 1 credit. Prerequisite: one programming course or equivalent programming experience. Credit granted for both CS 2022 and 2024 only if 2022 taken first. S–U grades only.
Brief introduction to the C programming language and standard libraries. Unix accounts are made available for students wishing to use that system for projects, but familiarity with Unix is not required. Projects may be done using any modern implementation of C. CS 2024 (C++ Programming) includes much of the material covered in 2022. Students planning to take CS 2024 normally do not need to take 2022.

CS 2024 C++ Programming
Fall. 2 credits. Prerequisite: one programming course or equivalent programming experience. Students who plan to take CS 2022 and 2024 must take 2022 first. S–U grades only.
An intermediate introduction to the C++ programming language and the C/C++ standard libraries. Topics include basic statements, declarations, and types; stream I/O; user-defined classes and types; derived classes, inheritance, and object-oriented programming; exceptions and templates. Recommended for students who plan to take advanced courses in computer science that require familiarity with C++ or C. Students planning to take CS 2024 normally do not need to take CS 2022; 2024 includes most of the material taught in 2022.

CS 2042 Unix Tools
Fall, usually weeks 1–4. 1 credit. Prerequisite: one programming course or equivalent programming experience. S–U grades only.
Introduction to Unix, emphasizing tools for file management, communication, process control, managing the Unix environment, and rudimentary shell scripts. Projects assume no previous knowledge of Unix or expertise in any particular language.

CS 2044 Advanced UNIX Programming and Tools
Spring, usually weeks 5–8. 1 credit. Prerequisite: CS 2042 or equivalent. S–U grades only.
Focuses on Unix as a programming environment for people with a basic knowledge of Unix and experience programming in at least one language. Projects cover advanced shell scripts (sh, ksh, csh), Makefiles, programming and debugging tools for C and other languages, and more modern scripting languages such as Perl and Python. Students with little or no experience with Unix should take CS 2042 first.

CS 2110 Object-Oriented Programming and Data Structures (also ENGRD 2110)
Fall, spring, summer. 3 credits. Prerequisite: CS 1110 or CS 1130 or equivalent course in Java or C++.
Intermediate programming in a high-level language and introduction to computer science. Topics include program structure and organization, object-oriented programming (classes, objects, types, sub-typing), graphical user interfaces, algorithm analysis (asymptotic complexity, big "O" notation), recursion, data structures (lists, trees, stacks, queues, heaps, search trees, hash tables, graphs), simple graph algorithms. Java is the principal programming language.

CS 2300 Intermediate Design and Programming for the Web (also INFO 2300)
Spring. 3 credits. Prerequisite: CS 1300 strongly recommended. Must be taken before CS 3300.
For description, see INFO 2300.

CS 2800 Discrete Structures
Fall, spring. 3 credits. Pre- or corequisite: one programming course or permission of instructor.
Covers the mathematics that underlies most of computer science. Topics include mathematical induction; logical proof; propositional and predicate calculus; combinatorics and discrete mathematics; some basic elements of basic probability theory; basic number theory; sets, functions, and relations; graphs; and finite-state machines. These topics are discussed in the context of applications to many areas of computer science, such as the RSA cryptosystem and web searching.

CS 2850 Networks (also ECON/INFO 2040, SOC 2090)
Fall. 4 credits. Prerequisites: none.
For description, see ECON 2040.

CS 3110 Data Structures and Functional Programming
Fall, spring. 4 credits. Prerequisite: CS 2110 and 2111 or equivalent programming experience. Pre- or corequisite: CS 2800. Should not be taken concurrently with CS 3410 or 3420.
Advanced programming course that emphasizes functional programming techniques and data structures. Programming topics include recursive and higher-order procedures, models of programming language evaluation and compilation, type systems, and polymorphism. Data structures and algorithms covered include graph algorithms, balanced trees, memory heaps, and garbage collection. Also covers techniques for analyzing program performance and correctness.

CS 3220 Introduction to Scientific Computation (also ENGRD 3220)
Spring. 3 credits. Prerequisites: CS 1112 or 1132 and MATH 2220, 2230, or 2940.
Introduction to elementary numerical analysis and scientific computation. Topics include interpolation, quadrature, linear and nonlinear equation solving, least-squares fitting, and ordinary differential equations. The MATLAB computing environment is used. Vectorization, efficiency, reliability, and stability are stressed. Includes special lectures on computational statistics.

[CS 3300 Data-Driven Web Applications (also INFO 3300)
Spring. 3 credits. Prerequisite: CS/ENGRD 2110 and (CS 2300 or permission of instructor). CS majors may use only one of the following toward their degree: CS/INFO 3300 or CS 4321. Next offered 2011–2012.
For description, see INFO 3300.]

CS 3410 Computer System Organization and Programming
Spring. 4 credits. Prerequisite: CS 2110 or equivalent programming experience. Should not be taken concurrently with CS 3110.
Introduction to computer organization, systems programming and the hardware/software interface. Topics include instruction sets, computer arithmetic, datapath design, data formats, addressing modes, memory hierarchies including caches and virtual memory, I/O devices, bus-based I/O systems, and multicore architectures. Students learn assembly language programming and design a pipelined RISC processor.

CS 3420 Computer Organization (also ECE 3140)
Spring. 4 credits. Prerequisite: CS 2110 or ENGRD 2300. Should not be taken concurrently with CS 3110.
For description, see ECE 3140.

CS 3740 Computational Linguistics (also COGST 4240, LING 4424)
Fall. 4 credits. Recommended: CS 2042.
For description, see LING 4424.

CS 3758 Autonomous Mobile Robots (also MAE 4180)
Spring. 4 credits. Prerequisite: MAE 3260 or permission of instructor.
For description, see MAE 4180.

CS 3810 Introduction to Theory of Computing
Fall. 3 credits. Prerequisite: CS 2800 or permission of instructor.
Introduction to the modern theory of computing: automata theory, formal languages, and effective computability.

CS 4110 Programming Languages and Logics
Fall. 4 credits. Prerequisite: CS 3110 or permission of instructor.
An introduction to the theory, design, and implementation of programming languages. Topics include operational semantics, type systems, higher-order functions, scope, lambda calculus, laziness, exceptions, side effects, continuations, objects, and modules. Also discussed are logic programming, concurrency, and distributed programming.

[CS 4120 Introduction to Compilers
Fall or spring 3 credits. Prerequisites: CS 3110 or permission of instructor and CS 3410 or 3420. Corequisite: CS 4121. Next offered 2011–2012.]

[CS 4121 Practicum in Compilers
Fall or spring. 2 credits. Corequisite: CS 4120. Next offered 2011–2012.]

CS 4210 Numerical Analysis and Differential Equations (also MATH 4250)
Fall. 4 credits. Prerequisites: MATH 2210 or 2940 or equivalent, one additional mathematics course numbered 3000 or above, and knowledge of programming.
For description, see MATH 4250.

CS 4220 Numerical Analysis: Linear and Nonlinear Problems (also MATH 4260)
Spring. 4 credits. Prerequisites: MATH 2210 or 2940 or equivalent, one additional mathematics course numbered 3000 or above, and knowledge of programming.
Introduction to the fundamentals of numerical linear algebra: direct and iterative methods for linear systems, eigenvalue problems, singular value decomposition. In the second half of the course, the above are used to build iterative methods for nonlinear systems and for multivariate optimization. Strong emphasis is placed on understanding the advantages, disadvantages, and limits of applicability for all the covered techniques. Computer programming is required to test the theoretical concepts throughout the course.

CS 4300 Information Retrieval (also INFO 4300)
Fall. 3 credits. Prerequisite: CS 2110 or equivalent.
For description, see INFO 4300.

CS 4302 Web Information Systems (also INFO 4302)
Spring. 3 credits. Prerequisites: CS 2110 and some familiarity with web site technology.
For description, see INFO 4302.

CS 4320 Introduction to Database Systems
Fall. 3 credits. Prerequisites: CS 3110 (or CS 2110, 2111, and permission of instructor).
Introduction to modern database systems. Concepts covered include storage structures, access methods, query languages, query processing and optimization, transaction management, recovery, database design, XML, and XQuery. The course focuses on the design and internals of modern database systems.

CS 4321 Practicum in Database Systems
Fall. 2 credits. Pre- or corequisite: CS 4320. CS majors may use only one of the following toward their degree: CS/INFO 3300 or CS 4321.
Students build part of a real database system in C++.

CS 4410 Operating Systems
Fall. 3 credits. Prerequisite: CS 3410 or 3420.
Introduction to the logical design of systems programs, with emphasis on multiprogrammed operating systems. Topics include process synchronization, deadlock, memory management, input-output methods, information sharing, protection and security, and file systems. The impact of network and distributed computing environments on operating systems is also discussed.

CS 4411 Practicum in Operating Systems
Fall. 2 credits. Corequisite: CS 4410.
Studies the practical aspects of operating systems through the design and implementation of an operating system kernel that supports multiprogramming, virtual memory, and various input-output devices. All the programming for the project is in a high-level language.

CS 4420 Computer Architecture (also ECE 4750)
Fall. 4 credits. Prerequisites: ENGRD 2300 and CS 3420/ECE 3140.
For description, see ECE 4750.

CS 4620 Introduction to Computer Graphics (also ARCH 3704)
Fall. 3 credits. Prerequisite: CS/ENGRD 2110.
Introduction to the principles of computer graphics in two and three dimensions. Topics include digital images, filtering and anti-aliasing, 2-D and 3-D affine geometry, ray tracing, perspective and 3-D viewing, the graphics pipeline, curves and surfaces, and human visual perception. Homework assignments require some Java programming. May be taken with or without concurrent enrollment in CS 4621.

CS 4621 Computer Graphics Practicum
Fall. 2 credits. Pre- or corequisite: CS 4620.
Provides CS 4620 students with hands-on experience in computer graphics programming on modern graphics hardware. A semester-long project involves building a substantial interactive 3D system. The course uses Java and OpenGL for code development.

CS 4670 Introduction to Computer Vision
Fall or spring. 4 credits. Prerequisites: CS 2110, CS 2800. Offered fall 2010.
An in-depth introduction to computer vision. The goal of computer vision is to compute properties of our world—the 3D shape of an environment, the motion of objects, the names of people or things—through analysis of digital images or videos. The course covers a range of topics, including 3D reconstruction, image segmentation, object recognition, and vision algorithms for the Internet, as well as key algorithmic and optimization techniques, such as graph cuts and non-linear least squares. This course emphasizes hands-on experience with computer vision, with several large programming projects.

CS 4700 Foundations of Artificial Intelligence
Fall. 3 credits. Prerequisites: CS/ENGRD 2110 and CS 2800 (or equivalent).
Challenging introduction to the major subareas and current research directions in artificial intelligence. Topics include knowledge representation, heuristic search, problem solving, natural-language processing, game-playing, logic and deduction, planning, and machine learning.

CS 4701 Practicum in Artificial Intelligence
Fall. 2 credits. Pre- or corequisite: CS 4700.
Project portion of CS 4700. Topics include knowledge representation systems, search procedures, game-playing, automated reasoning, concept learning, reinforcement learning, neural nets, genetics algorithms, planning, and truth maintenance.

CS 4740 Introduction to Natural Language Processing (also COGST 4740, LING 4474)
Spring. 4 credits. Prerequisite: CS 2110.
Computationally oriented introduction to natural language processing, the goal of which is to enable computers to use human languages as input, output, or both. Possible topics include parsing, grammar induction, information retrieval, and machine translation.

CS 4758 Robot Learning (also ECE/MAE 4758)
Spring. 4 credits. Prerequisites: knowledge of basic computer science principles and skills at a level sufficient to write a reasonably nontrivial computer program (e.g., CS 1114 or CS 2110 or CS 3110 or equivalent); any one of the following courses in probability/statistics or signal processing: CS 2800 or ECE 2200 or ECE 3100 or ENGRD 2700 (or equivalent).
Studies the problem of how an agent can learn to perceive its world well enough to act in it, to make reliable plans, and to learn from its own experience. The focus is on algorithms and machine learning techniques for autonomous operation of robots. Topics include filtering and state estimation (Kalman filters, particle filters); Markov decision process; learning (reinforcement and supervised learning); planning and control; perception (vision, sensing). The course has a term project involving physical robots; no final exam.

[CS 4780 Machine Learning
Spring. 4 credits. Prerequisites: CS 2100, CS 2800, or basic probability theory and basic knowledge of linear algebra. Next offered 2011–2012.
Introduces the fundamental set of techniques and algorithms that constitute machine learning as of today.]

CS 4812 Quantum Information Processing (also PHYS 4481/7681)
Spring. 3 credits. Prerequisite: familiarity with theory of vector spaces over complex numbers.
For description, see PHYS 4481.

CS 4820 Introduction to Analysis of Algorithms
Spring, summer. 4 credits. Prerequisites: CS 2800 and 3110.
Develops techniques used in the design and analysis of algorithms, with an emphasis on problems arising in computing applications. Example applications are drawn from systems and networks, artificial intelligence, computer vision, data mining, and computational biology. This course covers four major algorithm design techniques (greedy algorithms, divide-and-conquer, dynamic programming, and network flow), computability theory focusing on undecidability, computational complexity focusing on NP-completeness, and algorithmic techniques for intractable problems (including identification of structured special cases, approximation algorithms, and local search heuristics).

CS 4830 Introduction to Cryptography
Fall. 4 credits. Prerequisites: CS 2800 (or equivalent), mathematical maturity, or permission of instructor.
Introductory course in cryptography. Topics include one-way functions, encryption, digital signatures, pseudo-random number generation, zero-knowledge and basic protocols. Emphasizes fundamental notions and constructions with proofs or security based on precise definitions and assumptions.

[CS 4850 Mathematical Foundations for the Information Age
Spring. 4 credits. Prerequisite: mathematical maturity. Next offered 2011–2012.
Covers the mathematical foundation underlying modeling and searching of the web and other complex networks, discovering trends, data mining, and making recommendations based on user behavior.]

CS 4860 Applied Logic (also MATH 4860)
Fall. 4 credits. Prerequisites: MATH 2220 or 2940, CS 2800 or equivalent (e.g., MATH 3320, 4320, 4340, 4810), and some additional course in mathematics or theoretical computer science.
Propositional and predicate logic, compactness and completeness by tableaux, natural deduction, and resolution. Equational logic. Herbrand Universes and unification. Rewrite rules and equational logic, Knuth-Bendix method, and the congruence-closure algorithm and lambda-calculus reduction strategies. Topics in Prolog, LISP, ML, or Nuprl. Applications to expert systems and program verification.

CS 4999 Independent Reading and Research
Fall, spring. 1–4 credits.
Independent reading and research for undergraduates.

CS 5150 Software Engineering
Fall. 4 credits. Prerequisite: CS 2110 or equivalent experience programming in Java or C++.
Introduction to the practical problems of specifying, designing, and building large, reliable software systems. Students work in teams on projects for real clients. This work includes a feasibility study, requirements analysis, object-oriented design, implementation, testing, and delivery to the client. Additional topics covered in lectures include professionalism, project management, and the legal framework for software development.

[CS 5220 Applications of Parallel Computers
Fall or spring. 4 credits. Prerequisite: course in numerical methods at level of CS 3220 or higher. Next offered 2011–2012.
Models for parallel programming and survey of parallel machines. Existing parallel programming languages, vectorizing compilers, and parallel libraries and toolboxes.]

CS 5300 The Architecture of Large-Scale Information Systems (also INFO 5300)
Spring. 4 credits. Prerequisite: CS/INFO 3300 or CS 4320.
For description, see INFO 5300.

[CS 5412 Cloud Computing
Fall or spring. 4 credits. Prerequisite: CS 4410 or permission of instructor. Next offered 2011–2012.
Focuses on cloud computing, large-scale Internet applications, and other practical issues in designing and implementing trustworthy, scalable distributed software.]

CS 5414 Distributed Computing Principles
Fall. 4 credits. Prerequisite: CS 4410 or permission of instructor.
Studies the abstractions and algorithms that constitute the foundations for implementing concurrent and distributed computing, with emphasis on supporting fault-tolerance. Topics vary to reflect advances in the field but typically include global state snapshots, causality and clocks (logical and physical), agreement and consensus, primary-backup and state-machine replication, quorums, and gossip. Students undertake a substantial software project to put these ideas into practice. Many students obtain additional project credit by co-registering in CS 4999 or 7999.

CS 5420 Parallel Computer Architecture (also ECE 5720)
Fall. 4 credits. Prerequisite: ECE 4750.
For description, see ECE 5720.

CS 5430 System Security
Fall or spring. 4 credits. Prerequisites: CS 4410 or 4450 and familiarity with JAVA, C, or C# programming languages. Offered spring 2011.
Discusses security and survivability for computers and communications networks. Includes discussions of policy issues (e.g., the national debates on cryptography policy) as well as discussions of the technical alternatives for implementing the properties that comprise "trustworthiness" in a computing system. Covers mechanisms for authorization and authentication as well as cryptographic protocols.

[CS 5540 Computational Techniques for Analyzing Clinical Data
Fall or spring. 3 credits. Prerequisites: some programming experience, exposure to introductory statistics and algorithms; or permission of instructor. Next offered 2011–2012.
An overview of the construction and analysis of digital information generated in clinical medicine.]

[CS 5620 Interactive Computer Graphics
Fall or spring. 4 credits. Prerequisite: CS 4620. Next offered 2011–2012.
Methods for interactive computer graphics, targeting applications including games, visualization, design, and immersive environments.]

[CS 5643 Physically Based Animation for Computer Graphics
Fall or spring. 4 credits. Prerequisites: CS/ENGRD 3220 and/or CS 4620 or permission of instructor. Next offered 2011–2012.
Introduces students to common physically based modeling techniques for animation of virtual characters, fluids and gases, rigid and deformable solids, and other systems.]

CS 5722 Heuristic Methods for Optimization (also CEE 5290, ORIE 5340)
Fall. 3 or 4 credits. Prerequisites: CS/ENGRD 2110 or 3220 or CEE/ENGRD 3200, or graduate standing, or permission of instructor.
For description, see CEE 5290.

CS 5846 Decision Theory I (also ECON 4760/6760)
Fall. 4 credits.
For description, see ECON 4760.

CS 6110 Advanced Programming Languages
Spring. 4 credits. Prerequisite: graduate standing or permission of instructor.
Study of programming paradigms: functional, imperative, concurrent, and logic programming. Models of programming languages, including the lambda calculus. Type systems, polymorphism, modules, and other object-oriented constructs. Program transformations, programming logic, and applications to programming methodology.

CS 6210 Matrix Computations
Fall. 4 credits. Prerequisites: MATH 4110 and 4310 or permission of instructor. Offered alternate years.
Stable and efficient algorithms for linear equations, least squares, and eigenvalue problems. Direct and iterative methods are considered. The MATLAB system is used extensively.

[CS 6320 Database Management Systems
Spring. 4 credits. Prerequisite: CS 4320 or permission of instructor. Next offered 2011–2012.
Covers a variety of advanced issues ranging from transaction management to query processing to data mining. Involves extensive paper reading and discussion.]

CS 6410 Advanced Systems
Fall or spring. 4 credits. Prerequisite: CS 4410 or permission of instructor. Offered fall 2010.
Advanced course in systems, emphasizing contemporary research in distributed systems. Topics may include communication protocols, consistency in distributed systems, fault-tolerance, knowledge and knowledge-based protocols, performance, scheduling, concurrency control, and authentication and security issues.

CS 6460 Peer-to-Peer Systems
Spring. 4 credits. Recommended: CS 6410.
Peer-to-peer (P2P) systems, in which clients not only consume resources but also provide their own resources for the use of other clients, have emerged as a new architectural paradigm in distributed computing. This course examines peer-to-peer systems and discusses existing and new applications. Students are expected to perform extensive reading on P2P and build a peer-to-peer system as part of this course.

[CS 6620 Advanced Interactive Graphics
Fall or spring. 4 credits. Prerequisites: CS 4620 and 4621 or 5620 or permission of instructor. Next offered 2011–2012.
State-of-the-art techniques for high-quality rendering techniques used in simulation, games, and movies. Focus is on practical rendering algorithms for graphics applications.]

[CS 6630 Realistic Image Synthesis
Fall or spring. 4 credits. Prerequisites: CS 4620 or equivalent and undergraduate-level understanding of algorithms, probability and statistics, vector calculus, and programming. Next offered 2011–2012.
Advanced course in realistic image synthesis, focusing on the computation of physically accurate images.]

CS 6650 Computational Motion
Fall. 4 credits. Prerequisites: undergraduate-level understanding of algorithms, and some scientific computing. Offered alternate years; offered spring 2011.
Covers computational aspects of motion, broadly construed. Topics include the computer representation, modeling, analysis, and simulation of motion. Students implement several of the algorithms covered in the course and complete a final project.

CS 6670 Computer Vision
Fall or spring. 4 credits. Prerequisites: undergraduate-level understanding of algorithms and MATH 2210 or equivalent. Offered spring 2011.
Introduction to computer vision, with an emphasis on discrete optimization algorithms and on applications in medical imaging. Topics include edge detection, image segmentation, stereopsis, motion and optical flow, active contours, and the Hausdorff distance. Students are required to implement several of the algorithms covered in the course and complete a final project.

[CS 6700 Advanced Artificial Intelligence
Spring. 4 credits. Prerequisite: CS 4700 or permission of instructor. Next offered 2011–2012.
Covers a variety of areas in AI, including knowledge representation, automated reasoning, learning, game-playing, and planning, with an emphasis on computational issues.]

CS 6740 Advanced Language Technologies (also INFO 6300)
Fall or spring. 3 credits. Prerequisite: permission of instructor. Neither CS 4300 nor CS 4740 are prerequisites. Offered fall 2010.
Graduate-level introduction to technologies for the computational treatment of information in human-language form, covering modern natural-language processing (NLP) and/or information retrieval (IR). Possible topics include latent semantic analysis (LSI), clickthrough data for web search, language modeling, text categorization and clustering, information extraction, computational syntactic and semantic formalisms, grammar induction, and machine translation.

CS 6742 Natural Language Processing and Social Interaction
Spring. 3 credits. Prerequisites: CS 2110 or equivalent programming experience; course in artificial intelligence or any relevant subfield (e.g., NLP, information retrieval, machine learning); graduate standing; or permission of instructor.
More and more of life is now manifested online, and much of the digital traces that are left by people, groups, and large entities is increasingly recorded in natural-language format. This course examines the opportunities for natural language processing to contribute to the analysis and construction of socially embedded processes. Possible topics include sentiment analysis, learning social-network structure, analysis of text in political or legal domains, review aggregation systems, analysis of online conversations, and text categorization with respect to psychological categories.

CS 6758 Robot Learning
Spring. 4 credits. Prerequisites: knowledge of basic computer science principles and skills at a level sufficient to write a reasonably nontrivial computer program (e.g., CS 1114 or CS 2110 or CS 3110 or equivalent); any one of the following courses in probability/statistics or signal processing: CS 2800 or ECE 2200 or ECE 3100 or ENGRD 2700 (or equivalent).
Studies the problem of how an agent can learn to perceive its world well enough to act in it, to make reliable plans, and to learn from its own experience. The focus is on algorithms and machine learning techniques for autonomous operation of robots. Topics include filtering and state estimation (Kalman filters, particle filters); Markov decision process; learning (reinforcement and supervised learning); planning and control; perception (vision, sensing). The course has a term project involving physical robots; no final exam.

CS 6780 Machine Learning and Pattern Recognition
Fall. 4 credits. Prerequisites: programming skills (e.g., CS 2110 or CS 3110) and basic knowledge of linear algebra and probability theory (e.g. CS 2800).
Gives a graduate-level introduction to machine learning and statistical pattern recognition and in-depth coverage of new and advanced methods in machine learning. Emphasizes approaches with practical relevance and discusses a number of recent applications of machine learning, such as robotics, data mining, computer vision, text and web data processing. An open research project is a major part of the course. Topics include supervised learning (generative/discriminative learning, bagging/boosting); unsupervised learning (kNN, clustering, dimensionality reduction); online learning; robot learning (reinforcement learning, kalman filters); introduction to graphical models. Masters students are encouraged to take the course.

CS 6782 Probabilistic Graphical Models (also BTRY 6790)
Fall. 4 credits. Prerequisites: probability theory (BTRY 4080 or equivalent), programming and data structures (CS 2110 or equivalent); a course in statistical methods is recommended but not required (BTRY 4090 or equivalent).
For description, see BTRY 6790.

[CS 6784 Advanced Topics in Machine Learning
Fall. 4 credits. Prerequisites: CS 4780 or CS 6780 or equivalent or machine learning course. Next offered 2011–2012.
Extends and complements CS 4780 and 5780, giving in-depth coverage of new and advanced methods in machine learning.]

[CS 6810 Theory of Computing
Fall or spring. 4 credits. Prerequisites: CS 3810 and CS 4820 or 6820 or permission of instructor. Next offered 2011–2012.
Advanced treatment of theory of computation, computational-complexity theory, and other topics in computing theory.]

CS 6820 Analysis of Algorithms
Fall. 4 credits. Prerequisite: CS 4820 or graduate standing.
Methodology for developing and analyzing efficient algorithms. Understanding the inherent complexity of natural problems via polynomial-time algorithms, advanced data structures, randomized algorithms, approximation algorithms, and NP-completeness. Additional topics may include algebraic and number theoretic algorithms, circuit lower bounds, online algorithms, or algorithmic game theory.

[CS 6825 The Science Base for the Information Age
Fall or spring. 4 credits. Prerequisites: none. Next offered 2011–2012.
Covers the evolving science base that supports the flow of ideas in scientific literature, the evolution of social groups in networks, and the extraction of information from the World Wide Web and other unstructured and noisy datasets.]

[CS 6830 Cryptography
Fall or spring. 4 credits. Prerequisites: general ease with algorithms and elementary probability theory, maturity with mathematical proofs (ability to read and write mathematical proofs). Next offered 2011–2012.
Graduate introduction to cryptography. Topics include encryption, digital signatures, pseudo-random number generation, zero-knowledge, and basic protocols. Emphasizes fundamental concepts and proof techniques.]

[CS 6840 Algorithmic Game Theory
Fall or spring. 4 credits. Prerequisite: background in algorithms and graphs at level of CS 4820. No prior knowledge of game theory or economics assumed. Next offered 2011–2012.
Focuses on problems arising from, and motivated by, the Internet and other decentralized computer networks.]

CS 6850 The Structure of Information Networks (also INFO 6850)
Spring. 4 credits. Prerequisite: CS 4820.

CS 6860 Logics of Programs
Fall. 4 credits. Prerequisites: CS 4810, 6810, and (MATH 4810 or CS/MATH 4860).
Topics in logics of programs and program verification. Possible topics include: Floyd/Hoare logic, modal logic, dynamic logic, temporal logic, process logic, automata on infinite objects and their relation to program logics, the Rabin tree theorem, the modal mu-calculus, games and alternating automata, applications to type inference, set constraints, Kleene algebra.

CS 6862 Automated Reasoning and Formal Methods
Spring. 4 credits. Prerequisites: CS 6110 and graduate standing or permission of instructor.
Covers advanced logic applied to reasoning about programs and software systems to show that they meet their formal specifications as well as the basics of automated reasoning systems for formally proving theorems about software.

CS 7090 Computer Science Colloquium
Fall, spring. 1 credit. For staff, visitors, and graduate students interested in computer science. S–U grades only.
Weekly meeting for the discussion and study of important topics in the field.

[CS 7190 Seminar in Programming Languages
Fall, spring. 1 credit. Prerequisite: CS 6110 or permission of instructor. S–U grades only. Next offered 2011–2012.]

CS 7192 Seminar in Programming Refinement Logics
Fall, spring. 4 credits. Prerequisite: permission of instructor.
Topics in programming logics, possibly including type theory, constructive logic, decision procedures, heuristic methods, extraction of code from proofs, and the design of proof-development and problem-solving systems.

CS 7290 Seminar on Scientific Computing and Numerics (also MATH 7290)
Fall, spring. 1 credit. Prerequisites: none.
Talks on various methods in scientific computing, the analysis of their convergence properties and computational efficiency, and their adaptation to specific applications.

CS 7390 Database Seminar
Fall, spring. 1 credit. Prerequisite: permission of instructor. S–U grades only.

CS 7412 Scalable Distributed Consistency: Models and Applications
Spring. 4 credits. Prerequisite: Ph.D. student or permission of instructor.
The emergence of massive cloud computing systems and large enterprise computing solutions provides a serious challenge: the most popular ways of scaling a system abandon consistency guarantees. Yet many applications (e.g. medical, financial) make sense only if we can prove that they do exactly what they should do. Students in this research-oriented course read papers on consistency mechanisms with a goal of understanding what forms of consistency matter and what options make sense in large-scale systems. Students present papers, must participate in discussions, and submit weekly written summaries of the papers and their key findings.

CS 7490 Systems Research Seminar
Fall, spring. 1 credit. S–U grades only.

CS 7594 Seminar on Computational Issues in Medicine
Fall. 1 credit. Prerequisites: none.
An overview of computational issues that arise in the clinical practice of medicine. Topics include the role of IT in clinical practice; medical imaging problems in CT and MR; data mining; clinical decision support; workflow optimization; electronic medical records and health care IT standards. Lectures are given primarily by attending physicians from the Department of Radiology at Weill Cornell Medical College. Open to students at all levels.

CS 7670 Computer Vision Seminar
Fall, spring. 1 credit. Prerequisites: none.
Informal weekly seminar in which current topics in computer vision are discussed.

CS 7690 Computer Graphics Seminar
Fall, spring. 3 credits.

CS 7790 Seminar in Artificial Intelligence
Fall, spring. 4 credits. Prerequisite: permission of instructor. S–U grades only.

CS 7794 Seminar in Natural Language Understanding
Fall, spring. 2 credits.
Informal weekly seminar in which current topics in natural language understanding and computational linguistics are discussed.

CS 7890 Seminar in Theory of Algorithms and Computing
Fall, spring. 4 credits. Prerequisite: permission of instructor. S–U grades only.

CS 7893 Cryptography Seminar
Fall, spring. 1 credit.
Seminar for discussing recent or classical papers in cryptography.

CS 7999 Independent Research
Fall, spring. Prerequisite: permission of a computer science advisor.
Independent research or master of engineering project.

CS 9999 Thesis Research
Fall, spring. Prerequisite: permission of a computer science advisor. S–U grades only.
Doctoral research.

INFORMATION SCIENCE (INFO)

INFO 1300 Introductory Design and Programming for the Web (also CS 1300)
Fall. 3 credits.
The World Wide Web is both a technology and a pervasive and powerful resource in our society and culture. To build functional and effective web sites, students need technical and design skills as well as analytical skills for understanding who is using the web, in what ways they are using it, and for what purposes. In this course, students develop skills in all three of these areas through the use of technologies such as XHTML, Cascading Stylesheets, and PHP. Students study how web sites are deployed and used, usability issues on the web, user-centered design, and methods for visual layout and information architecture. Through the web, this course provides an introduction to the interdisciplinary field of information science.

[INFO 1305 Computation and Culture in a Digital Age (also CS 1305)
Summer. 3 credits. Prerequisite: none at university level; must be high school junior or rising senior. Offered alternate years; next offered 2011.]

INFO 2040 Networks (also ECON 2040, SOC 2090)
Fall. 4 credits.
For description, see ECON 2040.

INFO 2140 Cognitive Psychology (also COGST/PSYCH 2140)
Spring. 4 credits. Limited to 175 students. Prerequisite: sophomore standing. Graduate students, see INFO 6140.
For description, see PSYCH 2140.

INFO 2300 Intermediate Design and Programming for the Web (also CS 2300)
Spring. 3 credits. Prerequisite: INFO 1300 strongly recommended. Must be taken before INFO 3300.
Web programming requires the cooperation of two machines: the one in front of the viewer (client) and the one delivering the content (server). INFO 1300 concentrates almost exclusively on the client side. The main emphasis in INFO 2300 is learning about server side processing. Students begin with a short overview of the PHP server-side scripting language, then look at interactions with databases, learning about querying via the database language SQL. Through a succession of projects, students learn how to apply this understanding to the creation of an interactive, data-driven site via PHP and the MYSQL database. Also considered are technologies such as Javascript and Ajax and techniques to enhance security and privacy. Design and usability issues are emphasized. A major component of the course is the creation of a substantial web site.

[INFO 2310 Topics in Web Programming and Design]

INFO 2450 Communication and Technology (also COMM 2450)
Fall, summer. 3 credits.
For description, see COMM 2450.

INFO 2921 Inventing an Information Society (also AMST/ECE/ENGRG 2980, HIST 2920, STS 2921)
Spring. 3 credits.
For description, see ENGRG 2980.

INFO 2950 Mathematical Methods for Information Science
Spring. 4 credits. Corequisite: MATH 2310 or equivalent.
Teaches basic mathematical methods for information science. Topics include graph theory, discrete probability, Bayesian methods, finite automata, Markov models, and hidden Markov models. Uses examples and applications from various areas of information science such as the structure of the web, genomics, natural language processing, and signal processing.

INFO 3200 New Media and Society (also COMM 3200)
Spring. 3 credits.
For description, see COMM 3200.

[INFO 3300 Data-Driven Web Applications (also CS 3300)
Spring. 3 credits. Prerequisite: CS 2110 and (INFO 2300 or permission of instructor). Next offered 2011–2012.
Introduces students to modern database systems and three-tier application development with a focus on building web-based applications using database systems.]

INFO 3400 Psychology of Online Relationships (also COMM 3400)
Fall. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 3400.

INFO 3450 Human-Computer Interaction Design (also COMM 3450)
Fall. 3 credits. Prerequisite: INFO 2450. May be taken concurrently with INFO 2450.
For description, see COMM 3450.

INFO 3460 Online Communities (also COMM 3460)
Fall. 3 credits.
For description, see COMM 3460.

INFO 3490 Media Technologies (also COMM 3490, STS 3491)
Spring. 3 credits. Offered odd-numbered years.
For description, see COMM 3490.

INFO 3561 Computing Cultures (also STS 3561)
Spring. 4 credits. No technical knowledge of computer use presumed or required.
For description, see STS 3561.

INFO 3650 Technology and Collaboration (also COMM 3650)
Spring. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 3650.

[INFO 3660 History and Theory of Digital Art (also ARTH 3650)
Fall. 4 credits. Next offered 2011–2012.
For description, see ARTH 3650.]

INFO 4144 Responsive Environments
Spring. 4 credits.
For description, see ARTH 4144.

[INFO 4290 Copyright in the Digital Age (also COMM 4290)
Fall. 3 credits. Offered odd-numbered years; next offered 2011–2012.
For description, see COMM 4290.]

INFO 4300 Information Retrieval (also CS 4300)
Fall. 3 credits. Prerequisite: CS/ENGRD 2110 or equivalent.
Studies the methods used to search for and discover information in large-scale systems. The emphasis is on information retrieval applied to textual materials, but there is some discussion of other formats. The course includes techniques for searching, browsing, and filtering information and the use of classification systems and thesauruses. The techniques are illustrated with examples from web searching and digital libraries.

INFO 4302 Web Information Systems (also CS 4302)
Spring. 3 credits. Prerequisites: CS 2110 and some familiarity with web site technology.
Examines the architecture of web information systems such as distributed digital libraries and electronic publishing systems. Many of the topics presented are the subject of current research and development at Cornell, other universities, and in standards organizations such as the World Wide Web Consortium. Course content mixes exploration of current tools for building web information systems such as XML, XSLT, and RDF with broader concepts such as techniques for knowledge representation and description, object models for content representation, and legal and economic impacts of web information. A theme that runs throughout the course is the relationship between traditional information environments, exemplified by libraries, and the distributed information environment of the web.

INFO 4307 Learning From Web Data
Fall. 3 credits. Prerequisites: CS 2110 and INFO 2950, or graduate standing.
Teaches students methods for working with data generated by web applications and services, including web server logs, syndication feeds, and site-specific APIs. Topics include text processing and scripting, data visualization, working with APIs, machine learning and data mining algorithms, and learning tools and toolkits useful for all of the above. The graduate version includes supplemental readings and an emphasis on choosing projects that could lead to publication.

INFO 4320 Introduction to Rapid Prototyping and Physical Computing
Spring. 3 credits. Prerequisites: INFO 1300 or equivalent or permission of instructor. Materials fee: $250.
This class provides an introduction to modern rapid prototyping techniques such as laser cutting, 3D printing and microcontroller programming (such as the Arduino system). Using these tools, small multidisciplinary groups conduct the hardware project of their choice exploring topics as varied as: Universal Access, tangible interfaces, toys, personal or medical assistants and new musical instruments.

INFO 4400 Advanced Human-Computer Interaction Design (also COMM 4400)
Spring. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 4400.

INFO 4450 Seminar in Computer-Mediated Communication (also COMM 4450)
Spring. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 4450.

INFO 4470 Social and Economic Data (also ILRLE 4470)
Spring. 4 credits. Prerequisites: calculus, IS statistics requirement, and one upper-level social science course, or permission of instructor.
Social and economic data drive decisions in public and private organizations, and quality decisions require quality data. This course focuses on data quality—conceptual fit, sampling and nonsampling error, timeliness, geographic detail, and dissemination—as well as legal and ethical issues in the data manufacturing process. Major emphasis is placed on public use microdata files of the U.S. Census Bureau and their role in the allocation of federal funds. These files include the Census of Population and Housing, Current Population Survey, American Housing Survey, Consumer Expenditure Survey, and American Community Survey. The course is appropriate for upper-level undergraduate, professional master's, and doctoral students who will be users of data products, from the public and private sectors; and/or producers of data products for their organizations, working with existing data products from public and proprietary sources, as well as administrative or survey data collected by their organization.

INFO 4500 Language and Technology (also COMM 4500)
Spring. 3 credits. Prerequisite: INFO 2450 or permission of instructor.
For description, see COMM 4500.

INFO 4900 Independent Reading and Research
Fall, spring. 1–4 credits.
Independent reading and research for undergraduates.

INFO 4910 Teaching in Information Science, Systems, and Technology
Fall, spring. Variable credit.
Involves working as a T.A. in a course in the information science, systems, and technology major.

[INFO 5150 Culture, Law, and Politics of the Internet]

INFO 5300 The Architecture of Large-Scale Information Systems (also CS 5300)
Spring. 4 credits. Prerequisite: INFO/CS 3300 or CS 4320.
Deals with the architecture of large-scale information systems, with special emphasis on Internet-based systems. Topics include three-tier architectures, edge caches, distributed transaction management, web services, workflows, performance scalability, and high-availability architectures. The course includes a substantial project in the context of three-tier architectures, involving web servers, application servers, and database systems. Students study and use technologies such as Web Services, .Net, J2EE, ASPs, Servlets, XML, and SOAP.

INFO 6140 Cognitive Psychology (also COGST/PSYCH 6140)
Spring. 4 credits.
For description, see PSYCH 6140.

INFO 6300 Advanced Language Technologies (also CS 6740)
Fall. 3 credits. Prerequisite: permission of instructor. Neither INFO/CS 4300 nor CS 4740 are prerequisites.
For description, see CS 6740 in CIS section.

INFO 6302 Web Information Systems
Spring. 3 credits. Prerequisites: CS 2110 and some familiarity with website technology.
For description, see INFO 4302.

INFO 6307 Learning from Web Data
Fall. 3 credits. Prerequisites: CS 2110 and INFO 2950, or graduate standing.
For description, see INFO 4307.

[INFO 6341 Information Technology in Sociocultural Context (also STS 6341)]

INFO 6400 Human-Computer Interaction Design (also COMM 6400)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 6400.

INFO 6450 Computer-Mediated Communication (also COMM 6450)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 6450.

[INFO 6648 Speech Synthesis by Rule (also LING 6648)
Spring. 4 credits. Prerequisite: LING 4401, 4419, or permission of instructor. Next offered 2011–2012.
For description, see LING 6648.]

INFO 6500 Language and Technology (also COMM 6500)
Spring. 3 credits.
For description, see COMM 6500.

INFO 6850 The Structure of Information Networks (also CS 6850)
Spring. 4 credits. Prerequisite: CS 4820.

INFO 7050 Graduate Seminar
Fall, spring. 2 credits.
Graduate seminar on new research in the field of Information Science.

INFO 7090 IS Colloquium
Fall, spring. 1 credit.
For staff, visitors, and graduate students interested in information science.

INFO 7900 Independent Research
Fall, spring. Variable credit. Prerequisite: permission of an information science faculty member.
Independent research for M.Eng. students and pre–A exam Ph.D. students.

INFO 9900 Thesis Research
Fall, spring. Variable credit. Prerequisite: permission of an information science faculty member.
Thesis research for post–A exam Ph.D. students.

DEPARTMENT OF STATISTICAL SCIENCE

301 Malott Hall
255-8066

M. T. Wells, chair (301 Malott Hall, 255-8801; R. L. Strawderman, director of graduate studies; J. A. Bunge, director of professional programs; J. Abowd, J. Booth, T. DiCiccio, E. Dynkin, T. Fine, Y. Hong, G. Hooker, J. T. G. Hwang, N. Kiefer, P. Li, F. Molinari, M. Nussbaum, P. Protter, S. Resnick, D. Ruppert, G. Samorodnitsky, S. J. Schwager, B. Turnbull, P. Velleman, D. Woodard

STSCI 2100 Introductory Statistics
Fall or spring. 4 credits.
Introduction to the basic concepts of probability, statistics and data analysis. Descriptive methods, normal theory models, and inferential procedures are considered. Topics include basic statistical designs, an introduction to probability, estimation, confidence intervals, tests of significance for a single population mean and proportion, the difference in two population means and proportions, ANOVA, multiple linear regression, and contingency tables.

STSCI 2110 Statistical Methods for the Social Sciences II (also ILRST 2100/5100)
Fall and spring. 4 credits. Prerequisite: ILRST/STSCI 2100 or equivalent introductory statistics course.
For description, see ILRST 2100.

STSCI 2200 Biological Statistics I (also BTRY 3010, NTRES 3130)
Fall. 4 credits. Prerequisite: one semester of calculus.
For description, see BTRY 3010.

STSCI 3100 Statistical Sampling (also ILRST/BTRY 3100)
Fall. 4 credits. Prerequisites: two semesters of statistics.
For description, see ILRST 3100.

STSCI 3200 Biological Statistics II (also BTRY 3020, NTRES 4130)
Spring. 4 credits. Prerequisite: BTRY 3010 or 6010.
For description, see BTRY 3020.

STSCI 4080 Theory of Probability (also BTRY 4080)
Fall. 4 credits. Prerequisites: MATH 1110, 1120, at least concurrent enrollment in 2130 or 2220 or equivalents. Recommended: at least one introductory course in statistical methods.
For description, see BTRY 4080.

STSCI 4090 Theory of Statistics (also BTRY 4090)
Spring. 4 credits. Prerequisites: BTRY 4080 or equivalent and at least one introductory statistics course.
For description, see BTRY 4090.

STSCI 4100 Multivariate Analysis (also ILRST/BTRY 4100)
Spring. 4 credits. Prerequisites: BTRY 3010, some knowledge of matrix algebra. S–U or letter grades.
For description, see ILRST 4100.

STSCI 4110 Statistical Methods III: Categorical Data (also BTRY 6030, ILRST 4110)
Spring. 4 credits. Prerequisite: BTRY 6010 and 6020 or permission of instructor. Offered alternate years.
For description, see ILRST 4110.

STSCI 4120 Statistical Methods IV: Applied Design (also BTRY 6040, ILRST 4140)
Spring. 4 credits. Prerequisites: BTRY 6010 and 6020 or permission of instructor.
For description, see BTRY 6040.

STSCI 4500 Databases and Statistical Computing
Spring. 4 credits. Exposure to multiple linear regression and logistic regression strongly recommended.
The intent of the course is to provide the statistician with the computational tools for statistical research and applications. Topics including random number generation and Monte Carlo methods, regression computations and application to statistical methods of optimization, and sorting.

STSCI 4740 Statistical Data Mining I (also ORIE 4740)
Fall. 4 credits. Prerequisites: ORIE 3500 and MATH 2940 or equivalent; programming experience. Exposure to multiple linear regression and logistic regression strongly recommended.
For description, see ORIE 4740.

STSCI 5010–5020 Applied Statistical Analysis
Two-semester core course for students in master of professional studies (M.P.S.) degree program in applied statistics in Department of Statistical Science.
Prerequisite: enrollment in M.P.S. program.
Consists of a series of modules on various topics in applied statistics. Some modules include guest lectures from practitioners. Parallel with the course, students complete a yearlong, in-depth data analysis project.
5010, fall. 4 credits. Letter grades only. Topics include but are not limited to statistical computing systems, statistical software packages, data management, statistical graphics, and simulation methods and algorithms.
5020, spring. 4 credits. Letter grades only. Topics include but are not limited to sample surveys and questionnaire design, data sources, experimental design, and data mining.

STSCI 6000 Statistics Seminar
Fall and spring. 1 credit. Pre- or corequisite: BTRY 4090 or permission of instructor. S–U grades only.

FACULTY ROSTER

Computing and Information Science (CIS)

Abowd, John, Department of Information Science; School of Industrial and Labor Relations
Albonesi, David, School of Electrical and Computer Engineering
Arms, William, Department of Computer Science; Department of Information Science
Bailey, Graeme, Department of Computer Science; Computing in the Arts Program
Bala, Kavita, Department of Computer Science; Program of Computer Graphics
Bindel, David, Department of Computer Science
Birman, Kenneth, Department of Computer Science
Birnholtz, Jeremy, Department of Information Science; Department of Communication
Blume, Lawrence, Department of Information Science; Department of Economics
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