Donald Bren School of Information and Computer Sciences

Hal S. Stern, Dean
6210 Donald Bren Hall
Academic Counseling: (949) 824-5156
http://www.ics.uci.edu/

Overview

The Donald Bren School of Information and Computer Sciences (Bren ICS) embodies excellence, creativity, and collaborative innovation in computer science and information technology. As the only independent computing school in the University of California system, it is well-positioned to continue its tradition of exploring and advancing the boundaries of a broad, multidisciplinary field on a global scale.

A $20-million endowment from The Irvine Company Chairman Donald Bren drives the School’s vigorous recruitment and retention of distinguished faculty scholars. The faculty have extensive training in traditional computer science, as well as engineering, mathematics and statistics, and the social sciences. The School’s stand-alone structure, as opposed to being part of an engineering school, enables the faculty to take the broadest possible view of computer science and information technology. This breadth is reflected in the diverse set of academic degree options for undergraduate and graduate students, some of which are interdisciplinary and jointly administered with other academic units.

The School’s three departments, Computer Science, Informatics, and Statistics, fuel a wide range of instructional and research efforts including design of algorithms and data structures; computer architecture and embedded computer systems; networked and distributed systems; systems software; social and mobile computing; artificial intelligence, machine learning and data mining; computer games and virtual worlds; databases and information retrieval; computer graphics and visualization; bioinformatics, computational biology and genomics; computer-supported cooperative work, human-centered computing and human-computer interaction; security and privacy; software engineering; managerial and social aspects of computing technology; and statistics. The vibrant Bren School community continues to explore innovative topics ranging from building complete computer systems on chips smaller than a human fingernail to developing user interface systems that allow workers on opposite sides of the world to collaborate effectively. Bren School research continues to focus on how computing and information technology can be used to solve a broad set of real-world problems such as improving how first responders communicate during a crisis, optimizing transportation systems, analyzing data to expedite biological research, and improving network security.

Faculty are active participants and leaders of numerous research institutes spanning computer science, including the Institute for Genomics and Bioinformatics; Institute for Software Research; Center for Computer Games and Virtual Worlds; Center for Embedded Computer Systems; California Institute for Telecommunications and Information Technology (Calit2); Center for Machine Learning and Intelligent Systems; Center for Organizational Research; Center for Research on Information Technology and Organizations; Genetic Epidemiology Research Institute; Center for Pervasive Communications and Computing; Laboratory for Ubiquitous Computing and Interaction; Secure Computing and Network Center; Institute for Mathematical Behavioral Sciences; Center for Ethnography; Institute for Transportation Studies; and Ada Byron Research Center.

Faculty and student-driven research in the Bren School is supported through a variety of grants, gifts, and contracts from public and private institutions such as the State of California, the U.S. Department of Education, various U.S. defense agencies, the National Science Foundation, the National Institutes of Health, NASA, and various companies, including Adobe, The Aerospace Corporation, Apple, Boeing, Disney, Experian, Google, Hewlett-Packard, IBM, Intel, Microsoft, Samsung, and Yahoo! Since 2001, ICS has received nearly $100 million in extramural funding, in addition to the recent $20-million endowment.

Faculty and alumni of the Bren School of ICS have contributed some of computing’s most significant advancements, including revolutionizing computer-aided drafting techniques; the creation of the current Hypertext Transfer Protocol (HTTP/1.1); development of the Internet standards for HTTP and Uniform Resource Identifiers (URI); the founding of the Apache HTTP Server Project that produces the software for over 60 percent of public Internet Web sites; and the creation of the Domain Name System (DNS) that translates Web and e-mail addresses into the numeric system used to route information along the Internet.

The Bren School is committed to increasing diversity in the computing and information technology fields. The Ada Byron Research Center was created in 2003 to address research and outreach topics aimed at increasing the participation of women and other underrepresented populations in computer science, engineering, digital media, and related information technology areas. The School is an active partner of the National Center for Women & Information Technology, whose overarching goal is parity in the professional information technology workforce.

Degrees

<table>
<thead>
<tr>
<th>Business Information Management</th>
<th>B.S.</th>
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<tbody>
<tr>
<td>Computer Game Science</td>
<td>B.S.</td>
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<tr>
<td>Computer Science</td>
<td>B.S., M.S., Ph.D.</td>
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<tr>
<td>Computer Science and Engineering</td>
<td>B.S.</td>
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<tr>
<td>Informatics</td>
<td>B.S.</td>
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<tr>
<td>Information and Computer Science</td>
<td>B.S., M.S., Ph.D.</td>
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<tr>
<td>Networked Systems</td>
<td>M.S., Ph.D.</td>
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<tr>
<td>Software Engineering</td>
<td>B.S., M.S., Ph.D.</td>
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<tr>
<td>Statistics</td>
<td>M.S., Ph.D.</td>
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1 Offered jointly with The Paul Merage School of Business. See the Interdisciplinary Studies (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies) section of the Catalogue for information.

2 Offered jointly with The Henry Samueli School of Engineering. See the Interdisciplinary Studies (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies) section of the Catalogue for information.

Undergraduate Program

A Bren School of ICS undergraduate education is a blend of scholarship, science, technology, and practical application that forms an excellent foundation for professional life.

The basis of the undergraduate program is a set of fundamental courses in mathematics and computer science, supplemented by general education
courses from other academic disciplines. A premium is placed on both communication and quantitative skills. Students start early with hands-on experience with advanced computing systems, and intense use of computer and network technologies continues throughout the undergraduate program. Students study data organization, algorithm design and analysis, design and organization of hardware and network systems, software engineering, artificial intelligence, social aspects of system design and use, and management of technology. In the process, students work with state-of-the-art hardware and software technologies, and learn several contemporary programming languages.

The Donald Bren School of Information and Computer Sciences offers seven majors: Business Information Management (BIM), offered jointly with The Paul Merage School of Business; Computer Game Science (CGS); Computer Science (CompSci); Computer Science and Engineering (CSE), offered jointly with The Henry Samueli School of Engineering; Informatics (IN4MATX); Information and Computer Science (ICS); and Software Engineering (SE). There are also programs of study leading to minors in Bioinformatics, Digital Information Systems, Health Informatics, Informatics, Information and Computer Science, and Statistics.

**B.S. in Business Information Management** (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/businessinformationmanagement) . The undergraduate Business Information Management (BIM) major seeks to educate students to understand and apply the theories and concepts of a broad, integrated curriculum covering computing (computer science, informatics, and software); business fundamentals (accounting, finance, marketing, strategy, and operations); and analytical methods (mathematics, statistics, economics, management science, and decision analysis). The fundamentals of information and computer science provide the foundation for understanding and evaluating the technology through which most of the business information is gathered and presented; while the business fundamentals provide a background and context in which information and its analysis will be applied. The major is administered by the Donald Bren School of Information and Computer Sciences and is a collaborative, interdisciplinary degree program between the Bren School and The Paul Merage School of Business.

**B.S. in Computer Game Science** . The Computer Game Science (CGS) major combines a solid foundation in computer science with a focus on designing, building, and understanding computer games and other forms of interactive media. The fundamentals of information and computer science, along with course work in mathematics, statistics, physics, and film and media studies, provide students with the concepts and tools to study a wide scope of computer game technologies. The major emphasizes design, collaboration, and the understanding of computer games and related technologies and media in a social and cultural context.

**B.S. in Computer Science** (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departmentofcomputersciences) . The Computer Science major emphasizes the principles of computing that underlie our modern world, and provides a strong foundational education to prepare students for the broad spectrum of careers in computing. This major can serve as preparation for either graduate study or a career in industry. Students receive a solid background in low-level architecture and systems; middle-level infrastructure, algorithms, and mathematical foundations. This is a highly flexible degree that allows students to explore a broad range of topics in modern computing. In order to achieve some focus in their upper-division studies, students are required to satisfy the requirements for one of the eight specializations: Algorithms, Architecture and Embedded Systems, Bioinformatics, Information, Intelligent Systems, Networked Systems, Systems and Software, and Visual Computing. Additional electives can be used to satisfy a second specialization or obtain a broader understanding of the field.

**B.S. in Computer Science and Engineering** (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/computerscienceandengineering) . This program is designed to provide students with the fundamentals of computer science, both hardware and software, and the application of engineering concepts, techniques, and methods to both computer systems engineering and software system design. The Computer Science and Engineering (CSE) major gives students access to multidisciplinary problems in engineering with a focus on total systems engineering. Students learn the computer science principles that are critical to development of software, hardware, and networking of computer systems. From that background, engineering concepts and methods are added to give students exposure to circuit design, network design, and digital signal processing. Elements of engineering practice include a systems view, manufacturing and economic issues, and multidisciplinary engineering applications. The program is administered jointly by the Department of Computer Science in the Bren School of ICS and the Department of Electrical Engineering and Computer Science in The Henry Samueli School of Engineering.

**B.S. in Informatics** (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics) . Within the overall discipline of information and computer science, the Informatics (IN4MATX) major is concerned with the relationship between what is inside the computer and what is outside. The Informatics major addresses the broad set of issues surrounding design, ranging from initial requirements gathering to estimating and measuring the impact of alternative solutions—all from a multidisciplinary perspective that includes computer science, information science, organizational science, social science, and cognitive science. Students pursuing the B.S. in Informatics complete a specialization in one of two areas: human-computer interaction, or organizations and information technology.

**B.S. in Information and Computer Science** . The degree in Information and Computer Science is an individually designed degree. Students must submit a proposal for a four-year plan of study along with a rationale for why the proposed plan is a well-motivated set of courses that does not fit into any of the existing ICS majors. Students submitting proposals are strongly encouraged to follow the lower-division requirements for one of the Bren School majors (or provide a rationale for why this is not appropriate) and should include at least 48 units of upper-division ICS, Computer Science, Informatics, or Statistics courses. Proposals must be approved by the ICS Associate Dean for Student Affairs.

**B.S. in Software Engineering** . The Software Engineering major prepares students to be productive members of software engineering teams in a variety of application domains, with focus on the domains of major importance within each decade. It combines a solid foundation in computer science with knowledge of how to engineer modern software systems, and how to function within teams. Course work in mathematics and statistics provides students the basis for rigorous thinking; course work in the foundations of computer science provides students the basis for computational thinking; course work in topics of software engineering prepares students for the production of software; project courses prepare students for the practice of software development. The major emphasizes the design and implementation of large software systems.
Honors

Honors at graduation, e.g., *cum laude*, *magna cum laude*, *summa cum laude*, are awarded to approximately the top 12 percent of the graduating seniors. A general criterion is that a student must have completed at least 72 units in residence at the University of California. The student's cumulative record at the end of the final quarter is the basis for consideration of awarding Latin Honors. Other important factors are considered (see Honors Recognition (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/divisionofundergraduateeducation/#honorsopportunitiestext)).

Careers

Graduates of the Donald Bren School of Information and Computer Sciences pursue a variety of careers. Many graduates specify, design, and develop a variety of computer-based systems comprised of software and hardware in virtually every application domain, such as aerospace, automotive, biomedical, consumer products, engineering, entertainment, environmental, finance, investment, law, management, manufacturing, and pharmacology. Graduates also find jobs as members of research and development teams, developing advanced technologies, designing software and hardware systems, and specifying, designing, and maintaining computing infrastructures for a variety of institutions. Some work for established or start-up companies while others work as independent consultants. After a few years in industry, many move into management or advanced technical positions. Many students also use the undergraduate major as preparation for graduate study in computer science or another field (e.g., medicine, law, engineering, management).

Admissions

To ensure admission consideration for the fall quarter, students should be sure to file their application by November 30 of the prior year. The selection criteria include grades, test scores, and other considerations.

Transfer Student Policy

Transfer requirements vary by major.

Business Information Management (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/businessinformationmanagement)

Computer Game Science

Computer Science (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschooolofinformationandcomputersciences/departamentoftocomputerscience)

Computer Science and Engineering (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/computerscienceandengineering)

Informatics (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschooolofinformationandcomputersciences/departamentoftoinformatics)

Information and Computer Science

Software Engineering

NOTE TO TRANSFER APPLICANTS: These majors require a series of lower-division courses, and prerequisites constrain the order in which they can be taken. Junior-level transfer students who must complete a significant part of this sequence may find that it will take longer than two years at UCI to complete their degree. Java and C++ are used in the curriculum; therefore, transfer students should plan to learn these languages by studying on their own or by completing related programming courses prior to their first quarter at UCI.

Change of Major

Students interested in changing their major to one offered by the School should contact the ICS Student Affairs Office for more information and assistance. Information is also available at http://www.changeofmajor.uci.edu.

Major and minor restrictions: Click on the “Major/Minor Restrictions” tab at the top of this page.

Special Programs and Courses

The Bren School of ICS Honors Program

The Bren School of ICS Honors Program provides selected upper-division students an opportunity to carry out a research project under the direction of a faculty member in the School. Eligible students participate in the ICS Honors Seminar (I&C SCI H197), which provides an introduction to the range of current faculty research. Each student then affiliates with an ICS faculty advisor who agrees to supervise a minimum of two quarters of research. The participating student prepares a final written research report and submits a copy for review to both the faculty advisor and the Honors Program advisor. Successful completion of the Honors Program earns the student a certificate and medal from the School. Further, a notation of successful completion is added to the student's transcript. For more information about course requirements, application procedures, and deadlines visit http://www.ics.uci.edu/ugrad/honors/index.php, or contact the Student Affairs Office at (949) 824-5156.

Other Opportunities

Bren School of ICS undergraduates may complement their educational experience by participating in other programs. Information about the following programs is available elsewhere in the Catalogue and via the program Web sites: Campuswide Honors Program, Undergraduate Research Opportunities Program, Education Road Program, and Student Achievement Guided by Experience (SAGE Scholars).

Concentration: Engineering and Computer Science in the Global Context

The globalization of the marketplace for information technology services and products makes it likely that Bren ICS graduates will work in multicultural settings or be employed by companies with extensive international operations, or customer bases. The goal of the concentration is to help students develop and integrate knowledge of the history, language, and culture of a country or geographic region outside the United States, through course work both at UCI and an international host campus, followed by a technology-related internship in the host country.

All Bren School majors in good standing may propose an academic plan that demonstrates the ability to complete the concentration (a minimum of eight courses) and other requirements for graduation in a reasonable time frame. It is expected that a student’s proposal will reflect a high degree of planning that includes the guidance of academic counselors and those at the UCI Study Abroad Center regarding course selection, as well as considerations related to internship opportunities, housing, and financial aid. Each student’s proposed program of study must be approved by the Bren School of ICS Associate Dean for Student Affairs. The Associate Dean will be available to assist qualified students with the development of a satisfactory academic plan, as needed.

The concentration consists of the following components:
1. A minimum of eight courses at UCI or at the international campus with an emphasis on the culture, language (if applicable and necessary), history, literature of the country that corresponds to the international portion of the program, international law, international labor policy, global issues, global institutions, global conflict and negotiation, and global economics;
2. A one- or two-semester sequence of technical courses related to the major and, possibly, culture, history, and literature courses taken at an international university;
3. A two-month or longer technical internship experience in the same country as the international educational experience.

More information about the requirements for the concentration is available in the Bren ICS Student Affairs Office.

**Undergraduate Major in Business Information Management (BIM)**

This program is administered jointly by the Bren School of ICS and The Paul Merage School of Business. For information, see the Interdisciplinary Studies (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/businessinformationmanagement) section of the Catalogue.

**Requirements for the B.S. Degree in Business Information Management**

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree).

Major Requirements: See the Interdisciplinary Studies (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/businessinformationmanagement) section of the Catalogue.

**Undergraduate Major in Computer Game Science**

The Computer Game Science major gives students a strong foundation in introductory information and computer science, an extensive education in technologies and design practices associated with computer games, and an opportunity to focus in two areas of particular interest to the student. Students who complete the major will be able to create interactive and human-centered game designs; implement games using skills in modeling, graphics, software engineering, hardware architectures, human interfaces, and aesthetics; and evaluate games and game technology for their use in education, art, and social change.

**Career Paths.** A wide variety of careers and graduate programs are open to Computer Game Science (CGS) graduates. The video game industry is comparable in size to the film and music industries, and job growth projections are strong for people with strong technical backgrounds. Many other fields, including mobile software development, interactive entertainment, and training and education software have demand for similar skill sets and knowledge. CGS graduates are well-trained in computer science, and can thus pursue graduate programs or any career that involves designing, implementing, evaluating, or interacting with computer-based systems.

**Admissions**

Freshman Applicants: See the Undergraduate Admissions section.

**Transfer Applicants:**

Junior-level applicants who satisfactorily complete course requirements will be given preference for admission. Applicants must satisfy the following requirements:

1. Complete one year of approved college-level math, preferably courses in calculus equivalent to UCI’s MATH 2A-MATH 2B; if not available, two semester courses equivalent to other major-related math courses are acceptable.
2. Complete one year of transferable computer science courses* with at least one course involving concepts such as those found in Java, Python, Scheme, C++, or other object-oriented or high-level programming language.

Transfer applicants to the Computer Game Science major should be aware that several lower-division courses must be taken at UCI; therefore, the minimum time to degree completion will exceed two years.

*NOTE: Additional computer science courses beyond the two required are strongly recommended, particularly those that align with the major(s) of interest. Java and C++ are used in the curriculum; therefore, transfer students should plan to learn these languages by studying on their own or by completing related programming courses prior to their first quarter at UCI.

**Requirements for the B.S. Degree in Computer Game Science**

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree).

Major Requirements:

**Lower-division**

A. Select one of the two groups of courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>I&amp;C SCI 21</td>
<td>Introduction to Computer Science I</td>
</tr>
<tr>
<td>I&amp;C SCI 22</td>
<td>Introduction to Computer Science II</td>
</tr>
<tr>
<td>I&amp;C SCI 45C</td>
<td>Programming in C/C++ as a Second Language</td>
</tr>
<tr>
<td>I&amp;C SCI 46</td>
<td>Data Structure Implementation and Analysis</td>
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or

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<th>Course Code</th>
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<tbody>
<tr>
<td>I&amp;C SCI 31</td>
<td>Introduction to Programming</td>
</tr>
<tr>
<td>I&amp;C SCI 32</td>
<td>Programming with Software Libraries</td>
</tr>
<tr>
<td>I&amp;C SCI 33</td>
<td>Intermediate Programming</td>
</tr>
<tr>
<td>I&amp;C SCI 45C</td>
<td>Programming in C/C++ as a Second Language</td>
</tr>
<tr>
<td>I&amp;C SCI 46</td>
<td>Data Structure Implementation and Analysis</td>
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B. Complete:

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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>I&amp;C SCI 51</td>
<td>Introductory Computer Organization</td>
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C. Complete:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>IN4MATX 43</td>
<td>Introduction to Software Engineering</td>
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or

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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>I&amp;C SCI 52</td>
<td>Introduction to Software Engineering</td>
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D. Complete:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MATH 2A</td>
<td>Single-Variable Calculus</td>
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<tr>
<td>MATH 2B</td>
<td>Single-Variable Calculus</td>
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</tbody>
</table>
I&C SCI 6N  or MATH 3A  Introduction to Linear Algebra  
I&C SCI 6B  Boolean Algebra and Logic  
I&C SCI 6D  Discrete Mathematics for Computer Science  
STATS 67  Introduction to Probability and Statistics for Computer Science  

E. Complete:  
I&C SCI 60  Computer Games and Society  
I&C SCI 61  Game Systems and Design  
I&C SCI 62  Game Technologies and Interactive Media  

F. Complete:  
PHYSICS 3A  Basic Physics  

G. Complete:  
FL&M&MDA 85A  Introduction to Film and Visual Analysis  

Upper-division  
A. Computer Game Science Core Requirements  
I&C SCI 160  Graphics Processors and Game Platforms  
I&C SCI 161  Game Engine Lab  
I&C SCI 167  Multiplayer Game Systems  
I&C SCI 168  Multiplayer Game Project  
I&C SCI 169A-169B  Capstone Game Project I and Capstone Game Project II  
and select two of the following:  
I&C SCI 162  Modeling and World Building  
I&C SCI 163  Mobile and Ubiquitous Games  
I&C SCI 166  Game Design  

B. Computer Science Core  
COMPSCI 112  Computer Graphics  
COMPSCI 171  Introduction to Artificial Intelligence  

C. Select one of the following:  
COMPSCI 122A  Introduction to Data Management  
IN4MATX 113  Requirements Analysis and Engineering  
IN4MATX 121  Software Design I  
IN4MATX 131  Human Computer Interaction  

D. CGS Elective Courses:  
Five additional courses chosen from those listed in E  

E. At least three of the 16 upper-division courses satisfying A–D must be in the same Bren ICS track.  

Bren ICS Tracks:  

Algorithms  
COMPSCI 161  Design and Analysis of Algorithms  
COMPSCI 162  Formal Languages and Automata  
COMPSCI 163  Graph Algorithms  
COMPSCI 164  Computational Geometry and Geometric Modeling  
COMPSCI 165  Project In Algorithms And Data Structures  
COMPSCI 171  Introduction to Artificial Intelligence  
COMPSCI 174  Bioinformatics  
COMPSCI 175  Project in Artificial Intelligence  
COMPSCI 177  Applications of Probability in Computer Science  
COMPSCI 178  Machine Learning and Data-Mining  
COMPSCI 179  Algorithms for Probabilistic and Deterministic Graphical Models  

Computational Biology  
COMPSCI 183  Introduction to Computational Biology  
COMPSCI 184A  Representations and Algorithms for Molecular Biology  
COMPSCI 184B  Probabilistic Modeling of Biological Data  
COMPSCI 184C  Computational Systems Biology  

Computer Graphics and Vision  
COMPSCI 111  Digital Image Processing  
COMPSCI 112  Computer Graphics  
COMPSCI 114  Projects in Advanced 3D Computer Graphics  
COMPSCI 116  Computational Photography and Vision  
COMPSCI 117  Project in Computer Vision  

Computer Networks  
COMPSCI 131  Parallel and Distributed Computing  
COMPSCI 132  Computer Networks  
COMPSCI 133  Advanced Computer Networks  
COMPSCI 134  Computer and Network Security  
COMPSCI 137/IN4MATX 124  Internet Applications Engineering  

Databases  
COMPSCI 121/IN4MATX 141  Information Retrieval  
COMPSCI 122A  Introduction to Data Management  
COMPSCI 122B  Project in Databases and Web Applications  
COMPSCI 125  Next Generation Search Systems  

Hardware  
COMPSCI 145A  Embedded Computing Systems  
COMPSCI 151  Digital Logic Design  
COMPSCI 153  Logic Design Laboratory  
COMPSCI 154  Computer Design Laboratory  

Human-Computer Interaction  
IN4MATX 131  Human Computer Interaction  
IN4MATX 132  Project in Human-Computer Interaction Requirements and Evaluation  
IN4MATX 133  User Interaction Software  
IN4MATX 134  Project in User Interaction Software  

Operating Systems  
COMPSCI 143A  Principles of Operating Systems  
COMPSCI 143B  Project in Operating System Organization  
COMPSCI 144  High-performance Computers and Program Optimization
## Programming Languages and Compilers

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<tr>
<th>Course</th>
<th>Description</th>
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<tbody>
<tr>
<td>COMPSCI 146</td>
<td>Programming in Multitasking Operating Systems</td>
</tr>
<tr>
<td>IN4MATX 101</td>
<td>Concepts in Programming Languages I (same as COMPSCI 141)</td>
</tr>
<tr>
<td>IN4MATX 102</td>
<td>Concepts of Programming Language II</td>
</tr>
<tr>
<td>COMPSCI 142A</td>
<td>Compilers and Interpreters</td>
</tr>
<tr>
<td>COMPSCI 142B</td>
<td>Language Processor Construction</td>
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## Project Management

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<tbody>
<tr>
<td>IN4MATX 151</td>
<td>Project Management</td>
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<tr>
<td>IN4MATX 161</td>
<td>Social Analysis of Computerization</td>
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<tr>
<td>IN4MATX 162W</td>
<td>Organizational Information Systems</td>
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## Simulation and Optimization

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<tbody>
<tr>
<td>COMPSCI 115</td>
<td>Computer Simulation</td>
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<tr>
<td>COMPSCI 168</td>
<td>Network Optimization</td>
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<tr>
<td>COMPSCI 169</td>
<td>Introduction to Optimization</td>
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## Social Impacts of Computing

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<tr>
<td>IN4MATX 161</td>
<td>Social Analysis of Computerization</td>
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<tr>
<td>IN4MATX 162W</td>
<td>Organizational Information Systems</td>
</tr>
<tr>
<td>IN4MATX 163</td>
<td>Project in the Social and Organizational Impacts of Computing</td>
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## Software Design

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<tr>
<td>IN4MATX 121</td>
<td>Software Design I</td>
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<tr>
<td>IN4MATX 122</td>
<td>Software Design II</td>
</tr>
<tr>
<td>IN4MATX 123</td>
<td>Software Architecture</td>
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## Software Engineering

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<tr>
<td>IN4MATX 113</td>
<td>Requirements Analysis and Engineering</td>
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<tr>
<td>IN4MATX 115</td>
<td>Software Testing, Analysis, and Quality Assurance</td>
</tr>
<tr>
<td>IN4MATX 124</td>
<td>Internet Applications Engineering (same as COMPSCI 137)</td>
</tr>
</tbody>
</table>

## Non-Track Courses (some of these courses have prerequisites that are not part of the CGS major):

## Computer Game Science

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 21</td>
<td>I&amp;C SCI 22</td>
</tr>
<tr>
<td>I&amp;C SCI 60¹</td>
<td>I&amp;C SCI 61</td>
</tr>
<tr>
<td>MATH 2A</td>
<td>MATH 2B</td>
</tr>
<tr>
<td>WRITING 39B</td>
<td>WRITING 39C</td>
</tr>
</tbody>
</table>

## Business Management

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGMT 101</td>
<td>Management Science</td>
</tr>
<tr>
<td>MGMT 102</td>
<td>Managing Organizational Behavior</td>
</tr>
<tr>
<td>MGMT 105</td>
<td>Introduction to Marketing</td>
</tr>
<tr>
<td>MGMT 154</td>
<td>International Marketing</td>
</tr>
<tr>
<td>MGMT 155</td>
<td>Brand Management</td>
</tr>
</tbody>
</table>

## Cognitive Science

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYCH 130A</td>
<td>Perception and Sensory Processes</td>
</tr>
<tr>
<td>PSYCH 131A</td>
<td>Vision</td>
</tr>
<tr>
<td>PSYCH 131B</td>
<td>Hearing</td>
</tr>
<tr>
<td>PSYCH 135M</td>
<td>The Mind/Body Problem</td>
</tr>
<tr>
<td>PSYCH 140C</td>
<td>Cognitive Science</td>
</tr>
</tbody>
</table>

## Sample Program of Study — Computer Game Science

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>I&amp;C SCI 21</td>
<td>I&amp;C SCI 22</td>
<td>I&amp;C SCI 46</td>
</tr>
<tr>
<td></td>
<td>I&amp;C SCI 60¹</td>
<td>I&amp;C SCI 61</td>
<td>I&amp;C SCI 62</td>
</tr>
<tr>
<td></td>
<td>MATH 2A</td>
<td>MATH 2B</td>
<td>I&amp;C SCI 6B</td>
</tr>
<tr>
<td></td>
<td>WRITING 39B</td>
<td>WRITING 39C</td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>I&amp;C SCI 45C</td>
<td>I&amp;C SCI 6D</td>
<td>I&amp;C SCI 52</td>
</tr>
<tr>
<td></td>
<td>MATH 6G</td>
<td>I&amp;C SCI 160</td>
<td>I&amp;C SCI 161</td>
</tr>
<tr>
<td></td>
<td>I&amp;C SCI 51</td>
<td>COMPSCI 112</td>
<td>STATS 67</td>
</tr>
<tr>
<td></td>
<td>PHYSICS 3A</td>
<td>GE III/VII</td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>I&amp;C SCI 162, 163, or 166³</td>
<td>COMPSCI 171</td>
<td>CGS Elective</td>
</tr>
<tr>
<td></td>
<td>I&amp;C SCI 162A, IN4MATX 113, IN4MATX 121, or IN4MATX 131³</td>
<td>UD Writing</td>
<td>CGS Elective</td>
</tr>
<tr>
<td></td>
<td>FLM&amp;MDA 85A²</td>
<td>CGS Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CGS Elective</td>
<td>GE IV</td>
<td>GE IV/VIII</td>
</tr>
<tr>
<td>Senior</td>
<td>I&amp;C SCI 162, 163, or 166³</td>
<td>CGS Elective</td>
<td>GE III</td>
</tr>
<tr>
<td></td>
<td>CGS Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>GE III</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Fulfills GE III.
² Fulfills GE IV.
³ Select one of these.
Undergraduate Major in Information and Computer Science

The Information and Computer Science major is intended for highly motivated students who are currently enrolled at UCI, who find that their academic and career interests are not well served by any of the existing ICS majors, and would be better served by a uniquely designed course of study.

Application Process

New students are not admitted directly to the Information and Computer Science major. Continuing students can apply to change their major to Information and Computer Science no earlier than the fall quarter of their sophomore year. Students must submit a proposal for a four-year plan of study, along with rationale explaining why the proposed plan is a well-motivated and coherent set of courses that does not fit into any of the existing ICS majors. Students submitting proposals are strongly encouraged to follow the lower-division requirements for one of the ICS majors (or provide a rationale for why this is not appropriate) and should include at least 48 units of upper-division ICS, Computer Science, Informatics, or Statistics courses. Proposals must be approved by the ICS Associate Dean for Student Affairs. See the ICS Student Affairs Office for more details. Complete information about changing majors to ICS is available at http://www.changeofmajor.uci.edu.

Admissions

New students are not admitted directly to the Information and Computer Science major.

Transfer Applicants:

Students are strongly encouraged to follow the transfer preparation guidelines for any of the other Bren ICS majors.

Requirements for the B.S. Degree in Information and Computer Science

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree).

Major Requirements: See the ICS Student Affairs Office.

Minor in Information and Computer Science

Students outside the School may also pursue a minor in Information and Computer Science. The minor provides a focused study of Information and Computer Science to supplement a student’s major program of study and prepares students for a profession, career, or academic pursuit in which computer science is an integral part but is not the primary focus. The ICS minor contributes to students’ competence in computing technology and proficiency in programming as well as exposing them to the fundamentals of computer science. The minor allows students sufficient flexibility to pursue courses that complement their major field or address specific interests.

Requirements for the Minor

Select one of the following groups:

| I&C SCI 21 - 22 - 46 | Introduction to Computer Science I and Introduction to Computer Science II and Data Structure Implementation and Analysis |
| I&C SCI 31 - 32 - 33 - 45C - 46 | Introduction to Programming and Programming with Software Libraries and Intermediate Programming and Programming in C/C++ as a Second Language and Data Structure Implementation and Analysis |

Complete:

| I&C SCI 6D | Discrete Mathematics for Computer Science |

Complete one of:

| I&C SCI 51 | Introductory Computer Organization |
| I&C SCI 52 | Introduction to Software Engineering |
| or I&C SCI 52 | Introduction to Software Engineering |
| or IN4MATX 43 | Introduction to Software Engineering |

Select two upper-division from the following:¹

| CS 111-144 |
| CS 151-177 |
| IN4MATX 101-102 |
| IN4MATX 111-119 |
| IN4MATX 123 | Software Architecture |
| IN4MATX 125 | Computer Game Development |
| IN4MATX 131 | Human Computer Interaction |
| IN4MATX 132-134 |
| IN4MATX 141 | Information Retrieval |
| IN4MATX 148 | Project in Ubiquitous Computing |
| IN4MATX 153 | Computer Supported Cooperative Work |
| IN4MATX 161-163 |
| IN4MATX 171 | Introduction to Medical Informatics |

¹ COMPSCI 190–199 and IN4MATX 190–199 may not be applied to the minor.

Major and minor restrictions: Click on the "Major/Minor Restrictions" tab at the top of this page.

Undergraduate Major in Software Engineering

The Software Engineering major gives students a strong foundation in software engineering as well as a solid basis in computer science. Students who complete the major will be able to be productive members of software engineering teams in a variety of application domains including, but not restricted to, Web and mobile applications. The acquired technical knowledge and appreciation for life-long learning, combined with the ability to place software in the social context in which it is developed, empowers...
students to create novel applications that have the potential to bring social change.

**Admissions**

Freshman Applicants: See the Undergraduate Admissions (catalogue.uci.edu/previouseditions/2013-14/preadmissionmatters/undergraduateadmissions/#freshman) section.

**Transfer Applicants:**

Junior-level applicants who satisfactorily complete course requirements will be given preference for admission. Applicants must satisfy the following requirements:

1. Completion of one year of college-level mathematics (calculus or discrete math).
2. Completion of one year of transferable Computer Science courses*; at least one of these should involve concepts such as those found in Java, Python, Scheme, C++, or other object-oriented or high-level programming language.

*NOTE: Additional Computer Science courses beyond the two required are strongly recommended, particularly those that align with the major(s) of interest. Java and C++ are used in the curriculum; therefore, transfer students should plan to learn these languages by studying on their own or by completing related programming courses prior to their first quarter at UCI.

Additional courses beyond those required for admission must be taken to fulfill the lower-division degree requirements, as many are prerequisites for upper-division courses. For some transfer students, this may mean that it will take longer than two years to complete their degree.

**Requirements for the B.S. Degree in Software Engineering**

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree). 

**Major Requirements**

**Lower-division**

A. Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 21-22</td>
<td>Introduction to Computer Science I and Introduction to Computer Science II</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>IN4MATX 41-42</td>
<td>Informatics Core Course I and Informatics Core Course II</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>I&amp;C SCI 31-32:33</td>
<td>Introduction to Programming and Programming with Software Libraries and Intermediate Programming</td>
</tr>
</tbody>
</table>

B. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 45C</td>
<td>Programming in C/C++ as a Second Language</td>
</tr>
</tbody>
</table>

C. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 45J</td>
<td>Programming in Java as a Second Language</td>
</tr>
</tbody>
</table>

D. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 46</td>
<td>Data Structure Implementation and Analysis</td>
</tr>
</tbody>
</table>

E. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN4MATX 43 or I&amp;C SCI 52</td>
<td>Introduction to Software Engineering</td>
</tr>
</tbody>
</table>

F. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 51</td>
<td>Introductory Computer Organization</td>
</tr>
</tbody>
</table>

G. Complete:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2A-2B</td>
<td>Single-Variable Calculus and Single-Variable Calculus</td>
</tr>
<tr>
<td>I&amp;C SCI 6B</td>
<td>Boolean Algebra and Logic</td>
</tr>
<tr>
<td>I&amp;C SCI 6D</td>
<td>Discrete Mathematics for Computer Science</td>
</tr>
<tr>
<td>I&amp;C SCI 6N</td>
<td>Computational Linear Algebra</td>
</tr>
<tr>
<td>STATS 67</td>
<td>Introduction to Probability and Statistics for Computer Science</td>
</tr>
</tbody>
</table>

**Upper-division**

A. Core Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPSCI 122A</td>
<td>Introduction to Data Management</td>
</tr>
<tr>
<td>COMPSCI 143A</td>
<td>Principles of Operating Systems</td>
</tr>
<tr>
<td>COMPSCI 132</td>
<td>Computer Networks</td>
</tr>
<tr>
<td>COMPSCI 161</td>
<td>Design and Analysis of Algorithms</td>
</tr>
<tr>
<td>IN4MATX 101/COMPSCI 141</td>
<td>Concepts in Programming Languages I</td>
</tr>
<tr>
<td>IN4MATX 113</td>
<td>Requirements Analysis and Engineering</td>
</tr>
<tr>
<td>IN4MATX 115</td>
<td>Software Testing, Analysis, and Quality Assurance</td>
</tr>
<tr>
<td>IN4MATX 131</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>IN4MATX 121</td>
<td>Software Design I</td>
</tr>
<tr>
<td>IN4MATX 122</td>
<td>Software Design II</td>
</tr>
<tr>
<td>IN4MATX 123</td>
<td>Software Architecture</td>
</tr>
<tr>
<td>IN4MATX 151</td>
<td>Project Management</td>
</tr>
<tr>
<td>IN4MATX 191A</td>
<td>Senior Design Project</td>
</tr>
<tr>
<td>IN4MATX 191B</td>
<td>Senior Design Project</td>
</tr>
<tr>
<td>IN4MATX 191C</td>
<td>Senior Design Project</td>
</tr>
<tr>
<td>I&amp;C SCI 139W</td>
<td>Critical Writing on Information Technology</td>
</tr>
</tbody>
</table>

B. Select four of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN4MATX 102</td>
<td>Concepts of Programming Language II</td>
</tr>
<tr>
<td>IN4MATX 124</td>
<td>Internet Applications Engineering</td>
</tr>
<tr>
<td>IN4MATX 125/COMPSCI 113</td>
<td>Computer Game Development</td>
</tr>
<tr>
<td>IN4MATX 133</td>
<td>User Interaction Software</td>
</tr>
<tr>
<td>IN4MATX 134</td>
<td>Project in User Interaction Software</td>
</tr>
<tr>
<td>IN4MATX 141/COMPSCI 121</td>
<td>Information Retrieval</td>
</tr>
<tr>
<td>IN4MATX 143</td>
<td>Information Visualization</td>
</tr>
<tr>
<td>IN4MATX 148</td>
<td>Project in Ubiquitous Computing</td>
</tr>
<tr>
<td>IN4MATX 161</td>
<td>Social Analysis of Computerization</td>
</tr>
<tr>
<td>COMPSCI 133</td>
<td>Advanced Computer Networks</td>
</tr>
<tr>
<td>COMPSCI 134</td>
<td>Computer and Network Security</td>
</tr>
<tr>
<td>COMPSCI 142A</td>
<td>Compilers and Interpreters</td>
</tr>
<tr>
<td>COMPSCI 142B</td>
<td>Language Processor Construction</td>
</tr>
</tbody>
</table>
Career Paths. A wide variety of careers and graduate programs are open to Software Engineering graduates. The Web and mobile applications industry is a multi-billion dollar industry, and job growth projections are the strongest for people with strong technical backgrounds. Many other application domains, including interactive entertainment, medical information systems, and training and education software have demand for similar skill sets and knowledge. Graduate school in either computer science or software engineering or a related IT field is also a possible career path.

Sample Program of Study — Software Engineering

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 31</td>
<td>I&amp;C SCI 32</td>
<td>I&amp;C SCI 33</td>
</tr>
<tr>
<td>MATH 2A</td>
<td>MATH 2B</td>
<td>IN4MATX 43</td>
</tr>
<tr>
<td>WRITING 39A</td>
<td>WRITING 39B</td>
<td>I&amp;C SCI 6B</td>
</tr>
<tr>
<td>GE III</td>
<td>GE III</td>
<td>WRITING 39C</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Sophomore</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C SCI 51</td>
<td>I&amp;C SCI 46</td>
<td>I&amp;C SCI 45J</td>
</tr>
<tr>
<td>I&amp;C SCI 45C</td>
<td>IN4MATX 113</td>
<td>COMPSCI 143A</td>
</tr>
<tr>
<td>I&amp;C SCI 6D</td>
<td>I&amp;C SCI 6N</td>
<td>COMPSCI 122A</td>
</tr>
<tr>
<td>GE III/VII</td>
<td>IN4MATX 131</td>
<td>STATS 67</td>
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</table>

<table>
<thead>
<tr>
<th>Junior</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN4MATX 121</td>
<td>IN4MATX 122</td>
<td>IN4MATX 123</td>
</tr>
<tr>
<td>IN4MATX 115</td>
<td>IN4MATX 151</td>
<td>IN4MATX 191A</td>
</tr>
<tr>
<td>GE IV</td>
<td>IN4MATX 101</td>
<td>COMPSCI 132</td>
</tr>
<tr>
<td>GE III</td>
<td>GE IV/VIII</td>
<td>GE IV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPSCI 161</td>
<td>I&amp;C SCI 139W</td>
<td>SE Elective</td>
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<tr>
<td>IN4MATX 191B</td>
<td>IN4MATX 191C</td>
<td>SE Elective</td>
</tr>
<tr>
<td>SE Elective</td>
<td></td>
<td>GE VI</td>
</tr>
</tbody>
</table>

Major and Minor Restrictions

- Students majoring in Business Information Management may not double major in Business Administration nor minor in Management, Informatics, or Information and Computer Science.
- The major in Computer Science (CS) cannot be combined with the major in Computer Science and Engineering (CSE).
- The major in Computer Science and Engineering (CSE) cannot be combined with the major in Computer Engineering (offered by The Henry Samuei School of Engineering).
- The major in Information and Computer Science (ICS) cannot be combined with the majors in Computer Game Science, Computer Science (CS), Computer Science and Engineering (CSE), Informatics, or Software Engineering.
- Courses used to complete the minor in Digital Information Systems may not also count toward the requirements for the Information and Computer Science minor or the Informatics minor.
- Informatics majors in the Organizations and Information Technology specialization may not also pursue the Management minor.
- Any major in Computer Science, Computer Game Science, Informatics, Information and Computer Science, or Software Engineering may take any other minor in the Bren School of Information and Computer Sciences, provided that they take a minimum of five courses toward the minor that do not count toward any other major or minor.

Students who have completed both I&C SCI 21 and I&C SCI 22 with grades of C or better and who wish to change majors to Informatics may use I&C SCI 21 and I&C SCI 22 in satisfaction of the requirements of IN4MATX 41 and IN4MATX 42.

Students who have completed both IN4MATX 41 and IN4MATX 42 with grades of C or better and who wish to change majors to Computer Game Science, Computer Science, or Information and Computer Science may use IN4MATX 41 and IN4MATX 42 in satisfaction of the requirement of I&C SCI 21 and I&C SCI 22.

Students enrolled in other degree programs who are interested in the field of computer science may pursue the Bren School introductory course sequences (I&C SCI 31/CSE 41, I&C SCI 32/CSE 42, and I&C SCI 33/CSE 43) followed by other courses for which they have met the prerequisites as far as their interests require and their programs permit. The introductory courses, along with other lower-division ICS courses, may be used to fulfill General Education requirements. Nonmajors may also take other Bren ICS courses for which they have met the prerequisites.

The ICS Student Affairs Office is staffed by professional academic counselors and peer advisors. These individuals are available to assist students with program planning, questions on University and School policies and procedures, progress toward graduation, and other issues that arise in the course of a student’s education. Faculty also are available for advising, generally for suggestions of additional course work in the student’s academic, research, and career interest areas and on preparation for graduate school.

Graduate Programs in Information and Computer Science


ICS Ph.D. students must complete a concentration in Informatics (INF).

ICS M.S. students must complete one of the following concentrations: Embedded Systems or Informatics (INF).

For additional information about the following graduate programs and requirements, click on these links: Computer Science (catalogue.ucl.edu/previouseditions/2013-14/ donaldbrenschoolofinformationandcomputersciences/ departmentofcomputerscience/#graduatetext).
Admission
Applicants will be evaluated on the basis of their prior academic record. Applicants for the M.S. degree are expected to have a bachelor’s degree in computer science or a related field. Those who do not have an undergraduate degree in computer science may take the Computer Science Subject GRE test to demonstrate sufficient background in the field. Scores are reviewed on a case-by-case basis. Ph.D. applicants will additionally be evaluated in their potential for creative research and teaching in Information and Computer Science.

Applicants are expected to have (1) skills in computer programming at least equivalent to those obtained in college-level courses in programming and language development; (2) skills in mathematics equivalent to those obtained in complete college-level courses in logic and set theory, analysis, linear algebra and modern algebra, or probability and statistics; (3) data structures, analysis of algorithms, automata theory, or formal languages; and (4) computer architectures.

All applicants are evaluated on the materials submitted: letters of recommendation, official GRE test scores, official college transcripts, and personal statement. For more information, contact the ICS graduate counselor at (949) 824-5156 or send e-mail to gcounsel@ics.uci.edu.

Financial Assistance
Financial assistance is available to Ph.D. students in the form of fellowships, teaching assistantships, and research assistantships. Although assistance varies, it is the School’s goal to support all entering Ph.D. students, subject to availability of funds. International students who are not citizens of countries where English is either the primary or dominant language, as approved by Graduate Council, and who apply for teaching assistantships must have one of the approved English language proficiency examinations. More information is available in the Graduate Division (catalogue.uci.edu/previouseditions/2013-14/graduatedivision/#financialassistancecontext) section of the Catalogue.

Students with a Previously Earned Master’s Degree
Credit for one or all required courses may be given at the time of admission to those students who have completed a master’s degree in computer science or a closely related field. Course equivalency will be determined by the Bren School Associate Dean for Student Affairs following a written recommendation from a sponsoring research advisor. Research advisors can require that a student take additional courses when this is appropriate.

An additional M.S. degree will not be awarded if the student currently holds an M.S. degree in computer science or a related field from another university.

Course Substitutions
A student who has taken relevant graduate courses at UCI or another university may petition to have a specific course certified as equivalent to one which satisfies Bren School of ICS requirements. The petition should describe the course and should be approved by either the student’s advisor or the instructor teaching the class, and by the Associate Dean for Student Affairs. Only two courses can be substituted.

Master of Science Program

For additional information about the following graduate programs and requirements, click on these links: Computer Science (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departmentofcomputer#graduatetext); Statistics (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#graduatetext); Networked Systems (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/networkedsystems).

M.S. students may select one of two options, the thesis plan or the comprehensive examination plan, as described below. The normative time for completion of the M.S. degree is two years. All study must be completed within four calendar years from the date of admission.

Plan I: Thesis Plan. The thesis option is available for graduate students who may wish to continue on to a Ph.D. program or those who wish to concentrate on a specific problem. To qualify for this option, students must be in good academic standing with their Department. The student must enroll in at least two quarters of Thesis Supervision (CS 298 or IN4MATX 298) that will substitute for two required courses as specified under the concentration area or specialization of choice. All required courses must be completed with a grade of B or better, and the student must write a research or thesis project. A committee of three faculty members (voting members of the Academic Senate) will guide the student and give final approval of the thesis. The committee will consist of an advisor (faculty member from the student’s department) who is willing to supervise the thesis project, and two other faculty members (one of which must be from the student’s department) who are willing to serve on the committee as readers of the thesis. An oral presentation of the thesis to the committee will be required. Seminar courses that have an “S” suffix (e.g., 209S) do not count toward degree requirements.

Plan II: Comprehensive Examination Plan. The student completes the required units as specified under the concentration area. Each course must be completed with a grade of B or better. Seminar courses that have an “S” suffix (e.g., 209S) do not count toward degree requirements. The student must take a comprehensive examination given by ICS faculty. The examination covers the core requirements.

ICS Concentration in Embedded Systems—M.S.
The goal of this program is to prepare students for challenges in developing future embedded systems. These future systems will further integrate communications, multimedia, and advanced processors with complex embedded and real-time software for automotive, medical, telecommunications, and many other application domains. Furthermore, embedded systems are becoming parallel, deploying multiprocessor
systems-on-a-chip and parallel application software. An in-depth knowledge of the underlying scientific and engineering principles is required to understand these advances and to contribute productively to development of such systems. This program helps students master embedded system fundamentals, advanced computer architecture and compilers, networking, security, embedded, parallel and distributed software, and computer graphics in a sequence of courses and labs. Students also complete a large embedded systems project and may choose to write a Master’s thesis.

**Required Courses**
The following courses must be completed with a grade of B or better.

Select six of the following:

<table>
<thead>
<tr>
<th>List A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPSCI 244</td>
<td>Introduction to Embedded and Ubiquitous Systems</td>
</tr>
<tr>
<td>COMPSCI 247</td>
<td>Design Automation and Prototyping of Embedded Systems</td>
</tr>
<tr>
<td>COMPSCI 250A</td>
<td>Computer Systems Architecture</td>
</tr>
<tr>
<td>COMPSCI 232</td>
<td>Computer and Communication Networks</td>
</tr>
<tr>
<td>COMPSCI 203</td>
<td>Network and Distributed Systems Security</td>
</tr>
<tr>
<td>COMPSCI 242</td>
<td>Parallel Computing</td>
</tr>
<tr>
<td>COMPSCI 250B</td>
<td>Modern Microprocessors</td>
</tr>
<tr>
<td>COMPSCI 230</td>
<td>Distributed Computer Systems</td>
</tr>
<tr>
<td>COMPSCI 243</td>
<td>High-Performance Architectures and Their Compilers</td>
</tr>
</tbody>
</table>

Select six additional courses in one of the following two ways:

1. For students pursuing the M.S. thesis option, two four-unit courses in Thesis Supervision (CS 298) plus four graduate courses taken from List A or the following List B
2. For all other students, six graduate courses taken from List A or the following List B

<table>
<thead>
<tr>
<th>List B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPSCI 241</td>
<td>Advanced Compiler Construction</td>
</tr>
<tr>
<td>COMPSCI 245</td>
<td>Software for Embedded Systems</td>
</tr>
<tr>
<td>COMPSCI 246</td>
<td>Valification and Testing of Embedded Systems</td>
</tr>
<tr>
<td>COMPSCI 252</td>
<td>Introduction to Computer Design</td>
</tr>
<tr>
<td>EECS 211</td>
<td>Advanced System Software</td>
</tr>
<tr>
<td>COMPSCI 211A</td>
<td>Visual Computing</td>
</tr>
<tr>
<td>COMPSCI 248A/IN4MATX 241</td>
<td>Introduction to Ubiquitous Computing</td>
</tr>
<tr>
<td>IN4MATX 211</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>IN4MATX 235</td>
<td>Advanced User Interface Architecture</td>
</tr>
<tr>
<td>COMPSCI 236</td>
<td>Wireless and Mobile Networking</td>
</tr>
<tr>
<td>COMPSCI 267</td>
<td>Data Compression</td>
</tr>
<tr>
<td>COMPSCI 265</td>
<td>Graph Algorithms</td>
</tr>
<tr>
<td>EECS 223</td>
<td>Real-Time Computer Systems</td>
</tr>
</tbody>
</table>

M.S. Students who do not have an undergraduate degree in Computer Science or equivalent must also take COMPSCI 260.

**Comprehensive Examination or Thesis**
Each student must either (1) pass a comprehensive examination administered by the Embedded Systems faculty; or (2) submit a thesis for approval by a three-person committee consisting of an advisor (who is an ICS Embedded Systems full-time faculty member) and two other full-time faculty members (one of which must be from ICS).

**ICS Concentration in Informatics—M.S.**
See course requirements under Doctor of Philosophy program, on this page.

**Doctor of Philosophy Program**

Students pursuing the Ph.D. in Information and Computer Science must complete a concentration in Informatics (INF).

For additional information about the following graduate programs and requirements, click on these links: Computer Science (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departments/computerengineering/graduatetext) ; Statistics (catalogue.uci.edu/previouseditions/2013-14/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/graduatetext) ; Networked Systems (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/networkedsystems).

The Ph.D. program is research oriented and encourages students to work together with faculty to solve advanced problems in information and computer science. The program is designed for full-time study, and the normative time for completion of the Ph.D. is five years (four years for students who entered with a master’s degree). The maximum time permitted is seven years. Students enrolled in the Ph.D. program must maintain satisfactory academic progress.

**Teaching Requirements for the Ph.D. Program**
All ICS doctoral students are required to participate in a minimum of two quarters of teaching activities before graduating. College-level teaching activities in UCI Summer Sessions or UCI Extension, or service at other U.S. universities may be accepted in fulfillment of this requirement.

**Timeline for the Ph.D. Program**
All course requirements must be satisfied prior to the student’s application for advancement to candidacy. The normative time for advancement to candidacy is four years (three years for students who entered with a master’s degree). Information on the selection of committees, advancement to candidacy, development of a doctoral dissertation, and final examination on the dissertation is available from the ICS Student Affairs Office.

**ICS Concentration in Informatics (INF)—M.S. and Ph.D.**
Informatics is the interdisciplinary study of the design, application, use, and impact of information technology. It goes beyond technical design to focus on the relationship between information system design and use in real-world settings. These investigations lead to new forms of system architecture, new approaches to system design and development,
new means of information system implementation and deployment, and new models of interaction between technology and social, cultural, and organizational settings.

In the Donald Bren School of Information and Computer Sciences, Informatics is concerned with software architecture, software development, design and analysis, programming languages, ubiquitous computing, information retrieval and management, human-computer interaction, computer-supported cooperative work, and other topics that lie at the relationship between information technology design and use in social and organizational settings. Effective design requires an ability to analyze things from many different perspectives, including computer science, information science, organizational science, social science, and cognitive science. Relevant courses in those disciplines are therefore an integral part of the program and give this concentration a unique interdisciplinary flavor—which is imperative as the computing and information technology fields play such a pervasive role in our daily lives.

Students must complete the Survey courses, Informatics Core courses, Informatics Breadth courses, and a focus track in General Informatics, Interactive and Collaborative Technology, or Ubiquitous Computing. All courses must be passed with a grade of B or better.

Survey of Research and Research Methods: IN4MATX 201 Research Methodology for Informatics and two quarters of IN4MATX 299S Seminar in Software . Students in the M.S. program may substitute for IN4MATX 201 one additional four-unit Informatics course numbered 200–299.

Informatics Core Courses: three courses chosen from IN4MATX 211 Software Engineering, Human-Computer Interaction (IN4MATX 231 User Interface Design and Evaluation), IN4MATX 232 Research in Human-Centered Computing, IN4MATX 241 Introduction to Ubiquitous Computing, IN4MATX 261 Social Analysis of Computing.

Informatics Breadth: two four-unit graduate courses in ICS, CS, or Statistics, outside of Informatics.

Students must choose a track and complete the required courses:

General Informatics Track (GEN)
Electives: six four-unit graduate courses approved by the student’s advisor and the Department Chair, excluding 290s, 298s, and 299s.

Interactive and Collaborative Technology Track (ICT)
ICT electives (group 1): two courses chosen from IN4MATX 263 Computerization, Work, and Organizations, IN4MATX 265 Theories of Computerization and Information Systems, IN4MATX 203 Qualitative Research Methods in Information Systems, IN4MATX 205 Quantitative Research Methods in Information Systems.

ICT electives (group 2): two courses chosen from IN4MATX 233 Knowledge-Based User Interfaces, IN4MATX 235 Advanced User Interface Architecture, IN4MATX 251 Computer-Supported Cooperative Work.

ICT Breadth: two four-unit graduate courses approved by the student's advisor, excluding 290s, 298s, and 299s. Students are encouraged, but not required, to take them outside of Informatics.

Ubiquitous Computing Track (UBICOMP)
Additional required courses: IN4MATX 242 Ubiquitous Computing and Interaction and IN4MATX 244 Introduction to Embedded and Ubiquitous Systems.

UBICOMP Breadth: four four-unit graduate courses approved by the student’s advisor excluding 290s, 298s, and 299s. Students are encouraged, but not required, to take them outside of Informatics.

Research Project for the Ph.D.
Each student must find an Informatics faculty advisor and successfully complete a research project with that faculty member by the end of the second year. The research project should be done over at least two quarters of independent study or thesis supervision (IN4MATX 299 or IN4MATX 298) with that faculty.

Written Assessment for the Ph.D.
Each student must pass a written assessment. Students in the ICT track must pass a written examination (also known as phase II exam) regularly administered by the Department. This examination is based on predetermined reading lists maintained by the ICT faculty. Students in the UBICOMP and GEN tracks must describe the research project in a publication-quality report, which must be approved by three UBICOMP and Informatics faculty, respectively.

Candidacy Examination for the Ph.D.
Each student must pass the oral advancement to candidacy examination, which assesses the student’s ability to conduct, present, and orally defend research work at the doctoral level. The candidacy committee will consist of five faculty members, the majority of whom must be members of the student’s program, and the examination is conducted in accordance with UCI Senate regulations. The student must complete the course requirements, complete the research project, and pass the written assessment prior to advancing to candidacy. The oral candidacy examination consists of a research presentation by the student, followed by questions from the candidacy committee.

Students in the UBICOMP and GEN tracks, additionally to questions about the presented research, will also be asked questions about a predetermined list of readings. In the case of UBICOMP, that list is maintained by the UBICOMP faculty; in the case of GEN, that list is to be determined by the student’s committee.

Doctoral Dissertation Topic Defense
The student must present a substantial written document representing the student’s dissertation plan. This document must include the proposed dissertation abstract, a dissertation outline, a comprehensive survey of related work, and a detailed plan for completing the work. The dissertation plan is presented by the student to the dissertation committee, which must unanimously approve the student’s proposal. The dissertation defense committee is formed in accordance with UCI Senate regulations.

Doctoral Dissertation and Final Examination
The student is required to complete a doctoral dissertation in accordance with Academic Senate regulations. In addition, the student must pass an oral thesis defense which consists of a public presentation of the student’s research followed by an oral examination by the student’s doctoral committee. The thesis must be approved unanimously by the committee.

Faculty
Shannon Alfaro, M.S. University of California, Irvine, Lecturer in Computer Science
Pierre Baldi, Ph.D. California Institute of Technology, Director of the Institute for Genomics and Bioinformatics and UCI Chancellor's Professor of Computer Science, Biomedical Engineering, and Biological Chemistry

Lubomir Bic, Ph.D. University of California, Irvine, Professor of Computer Science, Electrical Engineering and Computer Science, and Biomedical Engineering

Geoffrey Bowker, Ph.D. University of Melbourne, Professor of Informatics

Elahae Bozorgzadeh, Ph.D. University of California, Los Angeles, Associate Professor of Computer Science

Michael Carey, Ph.D. University of California, Berkeley, Department Vice Chair and Donald Bren Professor of Computer Science

Yunan Chen, Ph.D. Drexel University, Assistant Professor of Informatics

Rina Dechter, Ph.D. University of California, Los Angeles, Professor of Computer Science

Michael Dillencourt, Ph.D. University of Maryland, Professor of Computer Science

J. Paul Dourish, Ph.D. University College, London, Professor of Informatics and of Computer Science

Nikil Dutt, Ph.D. University of Illinois, UCI Chancellor's Professor of Computer Science and of Electrical Engineering and Computer Science

Magda El Zarki, Ph.D. Columbia University, Professor of Computer Science, Informatics, and Electrical Engineering and Computer Science

David Eppstein, Ph.D. Columbia University, Professor of Computer Science

Julian Feldman, Ph.D. Carnegie Institute of Technology, Professor Emeritus of Computer Science

Charless Fowlkes, Ph.D. University of California, Berkeley, Assistant Professor of Computer Science

Michael Franz, D.Sc. Techn. Swiss Federal Institute of Technology (ETH), Professor of Computer Science

Daniel Frost, Ph.D. University of California, Irvine, Senior Lecturer with Security of Employment, Computer Science and Informatics

David G. Kay, J.D. Loyola Law School, Los Angeles; M.S. University of California, Los Angeles, Department Vice Chair of Informatics and Senior Lecturer with Security of Employment, Informatics and Computer Science

Dennis F. Kibler, Ph.D. University of California, Irvine, and Ph.D. University of Rochester, Professor Emeritus of Computer Science

Cory Knobel, Ph.D. University of Michigan, Ann Arbor, Assistant Adjunct Professor of Informatics

Alfred Kobsa, Ph.D. University of Vienna, Professor of Informatics and of Computer Science

Ian G. Harris, Ph.D. University of California, San Diego, Associate Professor of Computer Science

Gillian Hayes, Ph.D. Georgia Institute of Technology, Assistant Professor of Informatics

Wayne Hayes, Ph.D. University of Toronto, Associate Professor of Computer Science

Daniel Hirschberg, Ph.D. Princeton University, Professor of Computer Science and of Electrical Engineering and Computer Science

Alexander Inler, Ph.D. Massachusetts Institute of Technology, Assistant Professor of Computer Science

Sandy Irani, Ph.D. University of California, Berkeley, Department Vice Chair and Professor of Computer Science

Mizuko “Mimi” Ito, Ph.D. Stanford University, Professor in Residence of Anthropology and Informatics, and John D. and Catherine T. MacArthur Foundation Chair in Digital Media and Learning

Ramesh C. Jain, Ph.D. Indian Institute of Technology, Donald Bren Professor of Information and Computer Sciences

Stanislaw Jarecki, Ph.D. Massachusetts Institute of Technology, Associate Professor of Computer Science

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David L. Gillen, Ph.D. University of Washington, Associate Professor of Statistics

Daniel L. Gillen, Ph.D. University of Washington, Associate Professor of Statistics

Daniel T. Goodrich, Ph.D. Purdue University, Department Chair and UCI Chancellor's Professor of Computer Science

Richard H. Granger, Ph.D. Yale University, Professor Emeritus of Computer Science

Judith Gregory, Ph.D. University of California, San Diego, Associate Adjunct Professor of Informatics

Stacey Hancock, Ph.D. Colorado State University, Lecturer with Potential Security of Employment, Statistics
Courses

I&C SCI 3. Internet Technologies and their Social Impact. 4 Units.
Examines current Internet technologies and social implications at the individual, group, and societal level. Blogs, wikis, sharing of video, photos, and music, e-commerce, social networking, gaming, and virtual environments. Issues include privacy, trust, identity, reputation, governance, copyright, and malicious behavior.

I&C SCI 4. Human Factors for the Web. 4 Units.

Restriction: May not be taken for credit after IN4MATX 131.

I&C SCI 5. Environmental Issues in Information Technology. 4 Units.
Explores the relationship between recent developments in information technology and current global environmental issues. Potential topics include ecoinformatics, e-waste, technological life cycle assessment, and online community building. Activities involve reading, writing, discussion, and a final project.
I&C SCI 6B. Boolean Algebra and Logic. 4 Units.
Relations and their properties; Boolean algebras, formal languages; finite automata.
Prerequisite: High school mathematics through trigonometry.
(Vb)

I&C SCI 6D. Discrete Mathematics for Computer Science. 4 Units.
Covers essential tools from discrete mathematics used in computer science with an emphasis on the process of abstracting computational problems and analyzing them mathematically. Topics include: mathematical induction, combinatorics, and recurrence relations.
Prerequisite: High school mathematics through trigonometry.
(Vb)

I&C SCI 6N. Computational Linear Algebra. 4 Units.
Matrices and linear transformations, systems of linear equations, determinants, linear vector spaces, eigenvalues and eigenvectors, orthogonal matrices, diagonalization, and least squares. Topics will be taught primarily from an algorithmic perspective, including computational solutions, applications, and numerical error analysis.
Overlaps with MATH 6G, MATH 3A.
(II, Vb)

I&C SCI 7. Introducing Modern Computational Tools. 4 Units.
A unified look at a spectrum of modern tools for building, solving, and analyzing simple computational models (deterministic and random) in diverse subject areas. Tools include those for numeric/symbolic computation, and those for acquiring, organizing, translating, processing, and displaying information.
(Va)

I&C SCI 8. Practical Computer Security. 4 Units.
Principles of practical computer security to enable students to defend themselves against malicious threats. Firewalls, anti-virus, secure setup of a wireless access point. Cryptography basics and its application. Embedded devices and related security issues.
(II)

I&C SCI 10. How Computers Work. 4 Units.
Introduction to digital computer and communication systems. Capabilities and limitations of information technology. Representing information in digital form. Overview of computer organization, Internet, operating systems, software. Human-computer interaction and social impact.
Restriction: May not be taken for credit after I&C SCI 51, I&C SCI 52, I&C SCI 105, or IN4MATX 43.
(II)

I&C SCI 11. The Internet and Public Policy. 4 Units.
How the Internet works. Current public policy issues concerning the Internet. Introductory economics. Communications law. Interactions between information technology, economics, and law. Case studies about Internet and communications policy.
Same as ECON 11.
(II or III)

I&C SCI 21. Introduction to Computer Science I. 6 Units.
Introduces fundamental concepts related to computer software design and construction. Develops initial design and programming skills using a high-level language. Fundamental concepts of control structures, data structures, and object-oriented programming.
Same as CSE 21.
Overlaps with I&C SCI H21, I&C SCI 31, EECS 10, EECS 12, ENGRMAE 10.
Restriction: CSE 21 or I&C SCI 21 may not be taken for credit if taken after IN4MATX 42.
(II, Vb)

I&C SCI H21. Honors Introduction to Computer Science I. 6 Units.
Introduces fundamental concepts of computer software design and construction. Develops initial design and programming skills using a high-level language. Fundamental concepts of control structures, data structures, functional and object-oriented programming. Introduces topics in computer organization and social impact of technology.
Overlaps with I&C SCI 21, I&C SCI 31, CSE 21, EECS 10, EECS 12, ENGR 10.
Restriction: Information and Computer Science, Computer Science Engineering, and Computer Science majors only. Campuswide Honors Program students only. May not be taken for credit after IN4MATX 42.
(II, Vb)

I&C SCI 22. Introduction to Computer Science II. 6 Units.
Abstract behavior of classic data structures (stacks, queues, sorted and unsorted maps), alternative implementations, analysis of time, and space efficiency.
Prerequisite: CSE 21 or I&C SCI 21 or I&C SCI H21. CSE 21 with a grade of C or better. I&C SCI 21 with a grade of C or better. I&C SCI H21 with a grade of C or better.
Same as CSE 22.
Overlaps with I&C SCI H22, CSE 22, CSE 42, I&C SCI 32, CSE 43.
(II, Vb)

I&C SCI H22. Honors Introduction to Computer Science II. 6 Units.
Abstract behavior of classic data structures (stacks, queues, sorted and unsorted maps), alternative implementations. Recursion. Mathematical analysis of time and space efficiency, program analysis and correctness, system design techniques, programming paradigms.
Prerequisite: I&C SCI H21 or I&C SCI 21 or CSE 21. I&C SCI H21 with a grade of B- or better. I&C SCI 21 with a grade of A or better. CSE 21 with a grade of A or better.
Overlaps with IN4MATX 42, CSE 22, CSE 42, I&C SCI 22, I&C SCI 33, CSE 43.
(II, Vb)
I&C SCI H23. Honors Introduction to Computer Science III. 4 Units.
Builds on ICS H22 with respect to mathematical tools and analysis.
Focuses on fundamental algorithms in computer science, basic data structures, complexity analysis, and design techniques.
Prerequisite: I&C SCI H22 or I&C SCI 22 or IN4MATX 42. I&C SCI H22 with a grade of B- or better. I&C SCI 22 with a grade of A or better. IN4MATX 42 with a grade of A or better.
Overlaps with I&C SCI 46, CSE 46.
(Vb)

I&C SCI 31. Introduction to Programming. 4 Units.
Introduction to fundamental concepts and techniques for writing software in a high-level programming language. Covers the syntax and semantics of data types, expressions, exceptions, control structures, input/output, methods, classes, and object-oriented programming.
Same as CSE 41.
Overlaps with I&C SCI 21, CSE 21, I&C SCI H21, EECS 10, EECS 12.
(II, Vb)

I&C SCI 32. Programming with Software Libraries. 4 Units.
Construction of programs for problems and computing environments more varied than in CSE41. Using library modules for applications such as graphics, sound, GUI, database, Web, and network programming. Language features beyond those in CSE41 are introduced as needed.
Prerequisite: I&C SCI 31 or CSE 41. I&C SCI 31 with a grade of C or better. CSE 41 with a grade of C or better.
Same as CSE 42.
Overlaps with I&C SCI 22, CSE 22, I&C SCI H22, IN4MATX 42.
(II and (VA or VB) ).

I&C SCI 33. Intermediate Programming. 4 Units.
Intermediate-level language features and programming concepts for larger, more complex, higher-quality software. Functional programming, name spaces, modules, class protocols, inheritance, iterators, generators, operator overloading, reflection. Analysis of time and space efficiency.
Prerequisite: I&C SCI 32 or CSE 42. I&C SCI 32 with a grade of C or better. CSE 42 with a grade of C or better.
Same as CSE 43.
Overlaps with I&C SCI 33, I&C SCI 22, CSE 22, I&C SCI H22, IN4MATX 42.
(II, Vb)

I&C SCI 45C. Programming in C/C++ as a Second Language. 4 Units.
Prerequisite: I&C SCI 22 or CSE 22 or IN4MATX 42 or I&C SCI 33 or CSE 43. I&C SCI 22 with a grade of C or better. CSE 22 with a grade of C or better. IN4MATX 42 with a grade of C or better. I&C SCI 33 with a grade of C or better. CSE 43 with a grade of C or better.
Same as CSE 45C.

I&C SCI 45J. Programming in Java as a Second Language. 4 Units.
An introduction to the lexical, syntactic, semantic, and pragmatic characteristics of the Java language for experienced programmers. Emphasis on object-oriented programming, using standard libraries, and programming with automatic garbage collection.
Prerequisite: I&C SCI 33 or CSE 43. I&C SCI 33 with a grade of C or better. CSE 43 with a grade of C or better.
Overlaps with I&C SCI 22, CSE 22, I&C SCI 23, CSE 23, IN4MATX 45.
Restriction: I&C SCI 45J may not be taken for credit after I&C SCI 22, CSE 22, I&C SCI 23, CSE 23, or IN4MATX 45.

I&C SCI 46. Data Structure Implementation and Analysis. 4 Units.
Focuses on implementation and mathematical analysis of fundamental data structures and algorithms. Covers storage allocation and memory management techniques.
Prerequisite: CSE 45C or I&C SCI 45C or I&C SCI 65. CSE 45C with a grade of C or better. I&C SCI 45C with a grade of C or better. I&C SCI 65 with a grade of C or better.
Same as CSE 46.
Overlaps with I&C SCI H23.
(Vb)

I&C SCI 51. Introductory Computer Organization. 6 Units.
Multilevel view of system hardware and software. Operation and interconnection of hardware elements. Instruction sets and addressing modes. Virtual memory and operating systems. Laboratory work using low-level programming languages. Course may be offered online.
Prerequisite: (I&C SCI 21 or CSE 21 or I&C SCI 31 or CSE 41 or I&C SCI 23, CSE 23, or IN4MATX 45) and I&C SCI 45B or CSE 45B or IN4MATX 45.

I&C SCI 52. Introduction to Software Engineering. 6 Units.
Introduction to concepts, methods, and current practice of software engineering. Study of large-scale software production; software life cycle models as an organizing structure; principles and techniques appropriate for each stage of production. Laboratory work involves a project illustrating these elements.
Prerequisite: I&C SCI 23. I&C SCI 23 with a grade of C or better.
Overlaps with I&C SCI 105, IN4MATX 43.

I&C SCI 53. Principles in System Design. 4 Units.
Principles and practice of engineering of computer software and hardware systems. Topics include techniques for controlling complexity; strong modularity using client-server design, virtual memory, and threads; networks; coordination of parallel activities; security and encryption; and performance optimizations.
Corequisite: I&C SCI 53L.
Prerequisite: I&C SCI 51.

I&C SCI 53L. Principles in System Design Library. 2 Units.
Required laboratory section and co-requisite for I&C SCI 53.
Corequisite: I&C SCI 53.
Prerequisite: I&C SCI 51.
I&C SCI 60. Computer Games and Society. 4 Units.
The study and critical analysis of computer games as art objects, cultural artifacts, gateways to virtual worlds, educational aids, and tools for persuasion and social change. Emphasis on understanding games in their historical and cultural context.

Overlaps with UNI STU 12A, UNI STU 12B, UNI STU 12C.

(Ill)

I&C SCI 61. Game Systems and Design. 4 Units.
Principles and usage of game design elements. Introduction to technologies that support modern computer games. Students design, implement, and critique several small games.

(Ill)

I&C SCI 62. Game Technologies and Interactive Media. 4 Units.
Technologies for interactive media and game design. Web-based software systems, virtual world platforms, and game engines. Emphasis on conceptual and architectural aspects of these technologies.

Prerequisite: I&C SCI 21 or CSE 21 or I&C SCI 31 or CSE 41 or IN4MATX 42. IN4MATX 42 with a grade of C or better.

I&C SCI 77A. Topics in Mathematics and Computation in the Digital Age. 4 Units.
Signals in Matlab: blurring, filtering; elements of linear algebra, statistics, optimization; blind matrix inversion; de-correlation method, stochastic gradient descent method, applications to sounds and images.

Corequisite: MATH 2J or MATH 6G
Prerequisite: MATH 2A and MATH 2B and (I&C SCI 21 or CSE 21 or IN4MATX 41)

Same as MATH 77A.
Restriction: Prerequisite required and Lower division only

(Ill, Va)

I&C SCI 77B. Topics in Mathematics and Computation in the Digital Age. 4 Units.
Basic concepts of collaborative filtering; Clustering; Matrix factorization & Principal Components Analysis; Regression; Classification: naive Bayes classifier, decision trees, Perceptron (neural networks).

Corequisite: MATH 2J or MATH 6G
Prerequisite: MATH 2A and MATH 2B and (I&C SCI 21 or CSE 21 or IN4MATX 41)

Same as MATH 77B.
Restriction: Prerequisite required and Lower division only

(Ill, Va)

I&C SCI 77C. Topics in Mathematics and Computation in the Digital Age. 4 Units.
Image de-noising, de-blurring, low pass filtering; image segmentation and classification; Sparse representation; visualization.

Corequisite: MATH 2J or MATH 6G
Prerequisite: MATH 2A and MATH 2B and (I&C SCI 21 or CSE 21 or IN4MATX 41)

Same as MATH 77C.
Restriction: Prerequisite required and Lower division only

(Ill, Va)

I&C SCI 77D. Topics in Mathematics and Computation in the Digital Age. 4 Units.
Combinatorial Game Theory - game classification, tree graphs, strategy analysis, Sprague Grundy functions, Bouton’s Theorem; Zero-Sum and General-Sum Game Theory - pay off matrices, Minimax Theorem, Nach equilibrium; Machine learning - Search algorithms.

Corequisite: MATH 2J or MATH 6G
Prerequisite: MATH 2A and MATH 2B and (I&C SCI 21 or CSE 21 or IN4MATX 41)

Same as MATH 77D.
Restriction: Prerequisite required and Lower division only

(Ill, Va)

I&C SCI 80. Special Topics in Information and Computer Science. 2-4 Units.
Studies in selected areas of information and computer sciences. Topics addressed vary each quarter.

Prerequisite: Prerequisites vary.

Repeatability: Unlimited as topics vary.

I&C SCI 90. New Students Seminar. 1 Unit.
Introduces students to the Donald Bren School of Information and Computer Sciences. Focuses on advising students making the transition to UCI, community building, and mostly surveying the technical areas within departments in ICS, via talks by faculty on their research.

Grading Option: Pass/no pass only.

I&C SCI 105. Digital Information Systems. 4 Units.
Design and analysis of digital information systems. Covers underlying database and network technology, and software engineering principles used to build these systems. Evaluating digital information systems, and recognizing common flaws and vulnerabilities.

Prerequisite: I&C SCI 10 or I&C SCI 21 or CSE 21 or I&C SCI H21 or IN4MATX 41. I&C SCI 10 with a grade of C or better. I&C SCI 21 with a grade of C or better. CSE 21 with a grade of C or better. I&C SCI H21 with a grade of C or better. IN4MATX 41 with a grade of C or better.

Overlaps with I&C SCI 52, IN4MATX 43.
I&C SCI 139W. Critical Writing on Information Technology. 4 Units.
Study and practice of critical writing and oral communication as it applies to information technology. Each student writes assignments of varying lengths, totaling at least 4,000 words.
Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.
Restriction: Upper-division students only.

I&C SCI 160. Graphics Processors and Game Platforms. 4 Units.
Principles of computer architecture emphasizing hardware used with general purpose processor to support high-performance computer games and graphics engines.
Prerequisite: I&C SCI 51.
Overlaps with COMPSCI 152.

I&C SCI 161. Game Engine Lab. 4 Units.
The use of an open source game or graphics engine in the design and implementation of a computer game. Principles of game engine design. Students work on teams to design, implement, and evaluate new computer games based on an engine.
Prerequisite: I&C SCI 45C or I&C SCI 65.

I&C SCI 162. Modeling and World Building. 4 Units.
Use of 3D modeling software and related tools to design and create animated, textured models and expansive virtual worlds incorporating objects, scenes, and venues for activity within game worlds and online environments.
Prerequisite: COMPSCI 112.

I&C SCI 163. Mobile and Ubiquitous Games. 4 Units.
Design and technology of mobile games, including mixed reality gaming, urban games, and locative media. Case studies of significant systems. Uses and limitations of location-based technologies. Infrastructures and their relationships to gameplay and design.
Prerequisite: I&C SCI 61 and (I&C SCI 10 or I&C SCI 21 or I&C SCI 31 or IN4MATX 41).

I&C SCI 166. Game Design. 4 Units.
Game design takes into consideration psychology, narrative, platform features and limitations, marketing, computer science capabilities, human-computer interface principles, industry trends, aesthetic judgment, and other factors. Students focus on video game design through lectures, readings, presentations, implementation, and play testing.
Prerequisite: I&C SCI 61 and (IN4MATX 43 or I&C SCI 52).

I&C SCI 167. Multiplayer Game Project. 4 Units.
Designing and implementing a multuser, networked, and persistent virtual environment or game. Emphasis on cultural aspects, community building, user interface issues and design, security, privacy, and economics.
Prerequisite: (I&C SCI 52 or IN4MATX 43) and I&C SCI 167. IN4MATX 43 with a grade of C or better.

I&C SCI 169A. Capstone Game Project I. 4 Units.
Students work in teams to design and implement a new computer game or virtual world. Emphasis on sound, art, and level design, building a community, cut scenes, production values, full utilization of hardware and software platform, and current industry trends.
Prerequisite: I&C SCI 168.
Grading Option: In progress only.

I&C SCI 169B. Capstone Game Project II. 4 Units.
Students work in teams to design and implement a new computer game or virtual world. Emphasis on sound, art, and level design, building a community, cut scenes, production values, full utilization of hardware and software platform, and current industry trends.
Prerequisite: I&C SCI 169A.

I&C SCI 192. Industrial or Public Sector Field Study. 2 Units.
Students participate in an off-campus, supervised internship for a minimum of 60 hours. Students apply classroom knowledge through internship projects in the private sector or nonprofit agencies.
Grading Option: Pass/no pass only.
Repeatability: May be taken for credit 2 times.

I&C SCI 193. Tutoring in ICS. 2 Units.
Principles and practice of providing technical assistance to novice learners in information and computer sciences.
Repeatability: May be taken for credit for 18 units.
Restriction: ICS Peer Tutoring Program students only.

I&C SCI H197. Honors Seminar. 2 Units.
An overview of computer science and selected recent trends in research. Students attend talks on current faculty research, with opportunities for discussion.
Grading Option: Pass/no pass only.
Restriction: Bren School of ICS Honors Program or Campuswide Honors Program students only.

I&C SCI 398A. Teaching Assistant Training Seminar. 2 Units.
Theories, methods, and resources for teaching computer science at the university level, particularly by teaching assistants. Classroom presentations, working with individuals, grading, motivating students. Participants will give and critique presentations and may be videotaped while teaching.
Grading Option: Satisfactory/unsatisfactory only.
I&C SCI 398B. Advanced Teaching Assistant Seminar. 4 Units.
Teaching computer science at the university level, emphasizing issues in teaching an entire course. Course organization, designing examinations and projects, grading, motivating students. Participants will begin to assemble teaching portfolios.

Prerequisite: EDUC 398A.

Grading Option: Satisfactory/unsatisfactory only.

I&C SCI 399. University Teaching. 4 Units.
Involves on-the-job experience for Teaching Assistants.

Repeatability: May be repeated for credit unlimited times.

Restriction: Teaching assistants only.