

Donald Bren School of Information and Computer Sciences

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Overview

The Donald Bren School of Information and Computer Sciences (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.

ICS 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 ICS 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. ICS 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.

ICS faculty actively lead and participate in a variety of research laboratories, institutes and centers, including the Institute for Genomics and Bioinformatics; Institute for Software Research; Institute for Virtual Environments and Computer Games; California Institute for Telecommunications and Information Technology (Calit2); Data Science Initiative; Center for Machine Learning and Intelligent Systems; Center for Digital Transformation; Center for Emergency Response Technologies; Center for Algorithms and Theory of Computation; Center for Research in Sustainability, Collapse-Preparedness & Information Technology; Secure Computing and Networking Center; Center for Ethnography; Social & Technological Action Research Group; Secure Systems and Software Laboratory; Software Engineering and Analysis Lab; Computational Vision Lab; Transformative Play Lab; Laboratory for Ubiquitous Computing and Interaction; and Institute for Future Health.

Faculty and student-driven research in ICS 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 The Aerospace Corporation, Boeing, Disney, Experian, Google, IBM, Intel, Microsoft, Samsung, Facebook, and Yahoo!

Faculty and alumni 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 more than 60 percent of public Internet websites; 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.

ICS is committed to increasing diversity in the computing and information technology fields. The Office of Access and Inclusion (<http://tech.uci.edu/access>) was created in 2014 as a joint initiative between ICS and UCI's Samueli School of Engineering to support the recruitment, retention, and graduation of undergraduate and graduate students from populations underrepresented in engineering and computer science. The School is also an active partner of the National Center for Women & Information Technology (NCWIT), whose overarching goal is parity in the professional information

technology workforce, and a committed BRAID (Building, Recruiting And Inclusion for Diversity) Institution, working to increase the percentage of women and students of color majoring in computer science.

Degrees

Business Information Management ¹	B.S.
Computer Game Science	B.S.
Computer Science	B.S., M.C.S., M.S., Ph.D.
Computer Science and Engineering ²	B.S.
Data Science	B.S.
Human Computer Interaction and Design	M.H.C.I.D.
Informatics	B.S., Ph.D.
Information and Computer Science	B.S., M.S., Ph.D. ³
Networked Systems ²	M.S., Ph.D.
Software Engineering	B.S., M.S., Ph.D.
Statistics	M.S., Ph.D.

¹ Offered jointly with The Paul Merage School of Business. See the Interdisciplinary Studies (<http://catalogue.uci.edu/interdisciplinarystudies>) section of the *Catalogue* for information.

² Offered jointly with The Henry Samueli School of Engineering. See the Interdisciplinary Studies (<http://catalogue.uci.edu/interdisciplinarystudies>) section of the *Catalogue* for information.

³ Admission to the Ph.D. program is no longer available.

Honors

Honors at graduation, e.g., *cum laude*, *magna cum laude*, *summa cum laude*, are awarded to approximately the top 16 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 visit at Honors Recognition (<http://catalogue.uci.edu/informationforadmittedstudents/academicadvisingandhonors/#honorsopportunities>).

Careers

Graduates of the Donald Bren School of Information and Computer Sciences go on to pursue a variety of careers in both industry and academia in the areas of cutting-edge technology, science and business. With the goal of solving real-world problems with a global impact, ICS graduates find limitless opportunities as leaders in virtually every domain—from aerospace, automotive, biomedical, business information management, consumer products, cybersecurity, data science, engineering, entertainment, environmental, finance, gaming, national defense, pharmacology, and software engineering. ICS graduates often find jobs as members of research and development teams—building advanced technologies; designing software and hardware systems; analyzing and securing data; and specifying, designing, and maintaining computing infrastructures for a variety of institutions—while others venture off to form successful start-up companies or work as independent consultants. It is also common for ICS graduates to spend a few years in their related industry before moving into management or advanced technical positions, while others find that the undergraduate educational experience in ICS is the perfect stepping-stone for pursuing graduate studies in various computer science, informatics and statistics degrees, or venturing off into other academic areas such as medicine, law, engineering, or management.

Undergraduate Programs

A Donald 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 programs are 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 quickly gain 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 Bren School offers eight majors:

B.S. in Business Information Management (<http://catalogue.uci.edu/interdisciplinarystudies/businessinformationmanagement>) (offered jointly with The Paul Merage School of Business)

B.S. in Computer Game Science (p. 4)

B.S. in Computer Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofcomputerscience/#majorstext>)

B.S. in Computer Science and Engineering (<http://catalogue.uci.edu/interdisciplinarystudies/computerscienceandengineering>) (offered jointly with The Henry Samueli School of Engineering)

B.S. in Data Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#majortext>)

B.S. in Informatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#majortext>)

B.S. in Information and Computer Science (p. 8)

B.S. in Software Engineering (p. 9)

The Bren School offers the following minors:

Bioinformatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofcomputerscience/#minortext>)

Digital Information Systems (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#minortext>)

Health Informatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#minortext>)

Informatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#minortext>)

Information and Computer Science (p. 12)

Statistics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#minortext>)

Visit the ICS Student Affairs Office website for Majors and Minors restrictions (http://www.ics.uci.edu/ugrad/degrees/MajorMinor_Restrictions_Chart.pdf) and Double Major Restrictions (http://www.ics.uci.edu/ugrad/degrees/DbI_Major_Restrictions_Chart.pdf).

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 (<http://catalogue.uci.edu/interdisciplinarystudies/businessinformationmanagement>)

Computer Game Science (p. 4)

Computer Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofcomputerscience>)

Computer Science and Engineering (<http://catalogue.uci.edu/interdisciplinarystudies/computerscienceandengineering>)

Data Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#majortext>)

Informatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics>)

Software Engineering (p. 9)

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. Python, 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. **Please note:** For Fall 2019 applicants, a minimum grade of B will be expected for each major's required courses for admission.

It is recommended that students meet the articulation agreement on Assist.org (<http://www.assist.org/web-assist/welcome.html>) between their community colleges and this major at UC Irvine. This will allow them to make efficient progress toward the major.

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 the UCI Change of Major Criteria website (<http://www.changeofmajor.uci.edu>).

Major and Minor Restrictions

ICS majors (including shared majors, BIM and CSE) pursuing minors within the Donald Bren School of ICS may not count more than five courses toward both the major and minor. Some ICS majors and minors outside of the School are not permitted due to significant overlap. Visit the ICS Student Affairs Office website for Majors and Minors restrictions. (http://www.ics.uci.edu/ugrad/degrees/MajorMinor_Restrictions_Chart.pdf) All students should check the Double Major Restrictions Chart (http://www.ics.uci.edu/ugrad/degrees/DbI_Major_Restr_Chart.pdf) and view our information page (http://www.ics.uci.edu/ugrad/degrees/Double_Majors.php) on double majoring to see what degree programs are eligible for double majoring.

Special Programs and Courses

The ICS Honors Program

The 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://honors.ics.uci.edu/>, or contact the Student Affairs Office at 949 824-5156.

Other Opportunities

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 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 ICS 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 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 ICS Student Affairs Office.

Undergraduate Major in Business Information Management (BIM)

This program is administered jointly by ICS and The Paul Merage School of Business. For information, see the Interdisciplinary Studies (<http://catalogue.uci.edu/interdisciplinarystudies/businessinformationmanagement>) section of the *Catalogue*.

Requirements for the B.S. in Business Information Management

All students must meet the University Requirements (<http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree>).

Major Requirements: See the **Interdisciplinary Studies** (<http://catalogue.uci.edu/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 (<http://catalogue.uci.edu/informationforprospectivestudents/undergraduateadmissions/#freshman>).

Transfer Applicants:

Junior-level applicants who satisfactorily complete course requirements will be given preference for admission. **Please note:** For Fall 2019 applicants, a minimum grade of B will be required for each major's required courses below. 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. One year of computer programming courses in an object-oriented or higher-level programming language. For example, Python, Java, C++, data structures, assembly language and machine organization. Object-oriented or higher-level programming language courses that do not directly articulate to I&C SCI 31 and I&C SCI 33 can be used to satisfy the admissions requirements. Introduction to computer science courses do not meet this requirement.

NOTES:

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.

Additional computer science courses beyond the two required are strongly recommended, particularly those that align with the major of interest. Our first year of object-oriented programming is taught in Python. C++ and Java is used extensively in the curriculum; therefore, transfer students should plan to learn it by studying on their own or by completing related programming courses prior to their first quarter at UCI.

Courses in Visual Basic, C, and C# are not approved preparation for this major.

Requirements for the B.S. in Computer Game Science

All students must meet the University Requirements (<http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree>).

Major Requirements

Lower-division

A. Select one of the following series:

I&C SCI 31- 32- 33

Introduction to Programming
and Programming with Software Libraries
and Intermediate Programming

or

I&C SCI 32A- 33

Python Programming and Libraries (Accelerated)
and Intermediate Programming

B. Complete:

I&C SCI 45C

Programming in C/C++ as a Second Language

I&C SCI 46

Data Structure Implementation and Analysis

I&C SCI 51

Introductory Computer Organization

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

IN4MATX 43

Introduction to Software Engineering

MATH 2A

Single-Variable Calculus

MATH 2B

Single-Variable Calculus

I&C SCI 6N

Computational Linear Algebra

or MATH 3A

Introduction to Linear Algebra

I&C SCI 6B

Boolean Logic and Discrete Structures

I&C SCI 6D

Discrete Mathematics for Computer Science

STATS 67

Introduction to Probability and Statistics for Computer Science

PHYSICS 3A

Basic Physics I

FLM&MDA 85A

Introduction to Film and Visual Analysis

or FLM&MDA 85C

New Media and Digital Technologies

Upper-division

A. Computer Game Science Core Requirements

COMPSCI 171

Introduction to Artificial Intelligence

I&C SCI 161

Game Engine Lab

I&C SCI 162

Modeling and World Building

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:

COMPSCI 112

Computer Graphics

I&C SCI 163

Mobile and Ubiquitous Games

I&C SCI 166

Game Design

B. Select two of the following:

COMPSCI 122A

Introduction to Data Management

COMPSCI 132

Computer Networks

COMPSCI 143A

Principles of Operating Systems

COMPSCI 152

Computer Systems Architecture

IN4MATX 113

Requirements Analysis and Engineering

IN4MATX 121

Software Design: Applications

IN4MATX 131

Human Computer Interaction

C. CGS Elective Courses:

Five additional courses:

1. Two courses from A-C.

2. Three courses 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

Artificial Intelligence

COMPSCI 171

Introduction to Artificial Intelligence

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 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 145	Embedded Software
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 146	Programming in Multitasking Operating Systems

Programming Languages and Compilers

IN4MATX 101	Concepts in Programming Languages I (same as COMPSCI 141)
IN4MATX 102	Concepts of Programming Language II
COMPSCI 142A	Compilers and Interpreters
COMPSCI 142B	Language Processor Construction

Social and Organizational Computing

IN4MATX 151	Project Management
IN4MATX 153	Computer Supported Cooperative Work
IN4MATX 161	Social Analysis of Computing
IN4MATX 162W	Organizational Information Systems
IN4MATX 163	Project in the Social and Organizational Impacts of Computing
IN4MATX 171	Introduction to Medical Informatics

Software Engineering

IN4MATX 113	Requirements Analysis and Engineering
IN4MATX 115	Software Testing, Analysis, and Quality Assurance
IN4MATX 117	Project in Software System Design
IN4MATX 121	Software Design: Applications
IN4MATX 122	Software Design: Structure and Implementation
IN4MATX 124	Internet Applications Engineering (same as COMPSCI 137)

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

I&C SCI 162	Modeling and World Building
I&C SCI 163	Mobile and Ubiquitous Games
I&C SCI 166	Game Design

Business Management

MGMT 101	Management Science
MGMT 102	Managing Organizational Behavior
MGMT 105	Introduction to Marketing
MGMT 154	Global Marketing
MGMT 155	Brand Management

Cognitive Science

PSYCH 130A	Perception and Sensory Processes
PSYCH 131A	Vision
PSYCH 131B	Hearing
PSYCH 135M	The Mind/Body Problem
PSYCH 140C	Cognitive Science

Mathematics

MATH 112A- 112B- 112C	Introduction to Partial Differential Equations and Applications and Introduction to Partial Differential Equations and Applications and Introduction to Partial Differential Equations and Applications
MATH 115	Mathematical Modeling
MATH 121A- 121B	Linear Algebra and Linear Algebra
Film and Media Studies	
FLM&MDA 113	Narrative/Image
FLM&MDA 114	Film, Media, and the Arts
FLM&MDA 117A	Introduction to Screenwriting
FLM&MDA 144	Studies in New Media

With prior approval of the ICS Associate Dean for Student Affairs, a student may design a new track, or an Independent Study, Honors Research, or Special Topics course may be substituted for a course in a track. Computer Game Science (CGS) elective courses may not be counted as part of the Management minor. NOTE: All proposed courses must be upper-division and at least 4 units in value.

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

Sample Program of Study — Computer Game Science

Freshman		
Fall	Winter	Spring
I&C SCI 31	I&C SCI 32	I&C SCI 33
I&C SCI 60 ¹	I&C SCI 61	I&C SCI 62
MATH 2A	MATH 2B	I&C SCI 6B
	WRITING 39B	WRITING 39C
Sophomore		
Fall	Winter	Spring
I&C SCI 45C	I&C SCI 46	IN4MATX 43
I&C SCI 51	I&C SCI 161	I&C SCI 162
I&C SCI 6D	I&C SCI 6N	STATS 67
		General Education III/VII
Junior		
Fall	Winter	Spring
COMPSCI 112, IC SCI 163, or IC SCI 166	I&C SCI 167	COMPSCI 112, IC SCI 163, or IC SCI 166
COMPSCI 171	COMPSCI 122A, IN4MATX 113, IN4MATX 121, or IN4MATX 131 ³	I&C SCI 168
FLM&MDA 85A or 85C ²	U-D Writing	Computer Game Science Elective
PHYSICS 3A		
Senior		
Fall	Winter	Spring
I&C SCI 169A	I&C SCI 169B	Computer Game Science Elective
General Education III	Computer Game Science Elective	General Education VI
General Education IV	General Education IV	General Education VIII

¹ Fulfills GE III. Note, you must satisfy the UC Entry Level Writing requirement to enroll in I&C SCI 60.

² Fulfills GE IV.

³ Select two of these.

NOTES:

1. Students are advised that this sample program lists the minimum requirements; it is possible that students may have to take additional courses to prepare for required courses.

2. The lower-division writing requirement must be completed by the end of the seventh quarter at UCI.

3. This is only a sample plan. Course offerings may be moved due to unforeseen circumstances. It is strongly recommended that students meet with an academic advisor to create an academic plan tailored to meet their specific areas of interest.

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 the UCI Change of Major Criteria website (<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. in Information and Computer Science

All students must meet the University Requirements (<http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree>).

Major Requirements: See the ICS Student Affairs Office.

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 section (<http://catalogue.uci.edu/informationforprospectivestudents/undergraduateadmissions/#freshman>).

Transfer Applicants:

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

Have a cumulative GPA of 3.0 and a grade of B or higher in the required courses below:

1. Completion of one year of approved college-level math, preferably courses in calculus equivalent to UCI's MATH 2A-MATH 2B; if not available, one year of coursework equivalent to other major-related math courses is acceptable.
2. One year of computer programming courses in an object-oriented or higher-level programming language. For example, Python, Java, C++, data structures, assembly language and machine organization. Object-oriented or higher-level programming language courses that do not directly articulate to I&C SCI 31-33 can be used to satisfy the admissions requirements. Introduction to computer science courses do not meet this requirement.

Additional Approved Courses:

- One course in advanced data structures
- One course in machine organization and assembly language (both topics must be covered)
- One course in software engineering
- One course in discrete mathematics
- One course in Boolean algebra
- One course in linear algebra

NOTES:

Additional computer science courses beyond the two required are strongly recommended, particularly those that align with the major of interest. Our first year of object-oriented programming is taught in Python. C++ and Java is used extensively in the curriculum; therefore, transfer students should plan to learn it by studying on their own or by completing related programming courses prior to their first quarter at UCI.

Courses in Visual Basic, C, and C# are not approved preparation for this major.

Requirements for the B.S. in Software Engineering

All students must meet the University Requirements (<http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree>).

Major Requirements

Lower-division

A. Select one of the following series:

I&C SCI 31- 32- 33

Introduction to Programming
and Programming with Software Libraries
and Intermediate Programming

or

I&C SCI 32A- 33

Python Programming and Libraries (Accelerated)
and Intermediate Programming

B. Complete:

I&C SCI 45C

Programming in C/C++ as a Second Language

I&C SCI 45J

Programming in Java as a Second Language

I&C SCI 46

Data Structure Implementation and Analysis

I&C SCI 51

Introductory Computer Organization

IN4MATX 43

Introduction to Software Engineering

MATH 2A- 2B

Single-Variable Calculus
and Single-Variable Calculus

I&C SCI 6B

Boolean Logic and Discrete Structures

I&C SCI 6D

Discrete Mathematics for Computer Science

I&C SCI 6N

Computational Linear Algebra

or MATH 3A

Introduction to Linear Algebra

STATS 67

Introduction to Probability and Statistics for Computer Science

Upper-division

A. Core Requirements

COMPSCI 122A

Introduction to Data Management

COMPSCI 143A

Principles of Operating Systems

COMPSCI 132

Computer Networks

COMPSCI 161

Design and Analysis of Algorithms

IN4MATX 101/COMPSCI 141

Concepts in Programming Languages I

IN4MATX 113

Requirements Analysis and Engineering

IN4MATX 115

Software Testing, Analysis, and Quality Assurance

IN4MATX 131

Human Computer Interaction

IN4MATX 121

Software Design: Applications

IN4MATX 122

Software Design: Structure and Implementation

IN4MATX 123

Software Architecture

or IN4MATX 124

Internet Applications Engineering

IN4MATX 151

Project Management

IN4MATX 191A

Senior Design Project

IN4MATX 191B

Senior Design Project

I&C SCI 139W

Critical Writing on Information Technology

B. Select four of the following:

IN4MATX 102

Concepts of Programming Language II

IN4MATX 125/COMPSCI 113

Computer Game Development

IN4MATX 132

Project in Human-Computer Interaction Requirements and Evaluation

IN4MATX 133

User Interaction Software

IN4MATX 134

Project in User Interaction Software

IN4MATX 141/COMPSCI 121

Information Retrieval

IN4MATX 143

Information Visualization

IN4MATX 148

Project in Ubiquitous Computing

IN4MATX 161

Social Analysis of Computing

COMPSCI 133	Advanced Computer Networks
COMPSCI 134	Computer and Network Security
COMPSCI 142A	Compilers and Interpreters
COMPSCI 142B	Language Processor Construction
COMPSCI 145- 145L	Embedded Software and Embedded Software Laboratory
COMPSCI 146	Programming in Multitasking Operating Systems
COMPSCI 165	Project In Algorithms And Data Structures
I&C SCI 160	Graphics Processors and Game Platforms
I&C SCI 167	Multiplayer Game Systems
I&C SCI 168	Multiplayer Game Project
Software Engineering elective courses may not be counted as part of the Management minor.	

Sample Program of Study — Software Engineering

Freshman		
Fall	Winter	Spring
I&C SCI 31	I&C SCI 32	I&C SCI 33
MATH 2A	MATH 2B	IN4MATX 43
WRITING 39A	WRITING 39B	I&C SCI 6B
	General Education III	WRITING 39C
Sophomore		
Fall	Winter	Spring
I&C SCI 45C	I&C SCI 46	COMPSCI 122A
I&C SCI 51	IN4MATX 113	COMPSCI 143A
I&C SCI 6D	I&C SCI 6N	STATS 67
General Education III/VII	IN4MATX 131	General Education III
Junior		
Fall	Winter	Spring
I&C SCI 45J	IN4MATX 122	IN4MATX 124
IN4MATX 115	IN4MATX 151	COMPSCI 132
IN4MATX 121	COMPSCI 161	General Education IV
General Education IV	General Education IV/VIII	
Senior		
Fall	Winter	Spring
IN4MATX 101	IN4MATX 191B	Software Engineering Elective
IN4MATX 191A	I&C SCI 139W	Software Engineering Elective
Software Engineering Elective	Software Engineering Elective	General Education VI
General Educaiton III		

NOTES:

1. Students are advised that this sample program lists the minimum requirements; it is possible that students may have to take additional courses to prepare for required courses.
2. The lower-division writing requirement must be completed by the end of the seventh quarter at UCI.
3. This is only a sample plan. Course offerings may be moved due to unforeseen circumstances. It is strongly recommended that students meet with an academic advisor to create an academic plan tailored to meet their specific areas of interest.

Important Notes:

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.**

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 in Information and Computer Science

A. Complete:

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

I&C SCI 6D

Discrete Mathematics for Computer Science

B. Select one of the following:

I&C SCI 51

Introductory Computer Organization

or IN4MATX 43

Introduction to Software Engineering

C. Select two upper-division from the following:¹

COMPSCI 111-144

COMPSCI 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.

NOTES:

1. Visit the ICS Student Affairs Office website for Majors and Minors restrictions (http://www.ics.uci.edu/ugrad/degrees/MajorMinor_Restrictions_Chart.pdf).
2. A maximum of two courses may be taken for the Pass/Not Pass grade option toward any minor
3. There are no applications for an ICS minor. Students must have a peer advisor or academic counselor of their major add the minor to their Degree Audit once they begin pursuing the minor.
4. To ensure you are certified for the minor at graduation, the minor must be on your Degree Audit and Application for Graduation. Your Student Affairs Office can add the minor to your Degree Audit and will certify your minor at time of graduation, so it is important to keep them updated on your academic progress.

Graduate Programs in Information and Computer Sciences

The Donald Bren School of ICS offers M.S. and Ph.D. degrees in Computational Science, Computer Science, Informatics, Information and Computer Science, Networked Systems, Software Engineering, and Statistics.

ICS M.S. students must complete the concentration in Embedded Systems (p. 14).

For additional information about the following graduate programs and requirements, click on these links: Computer Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofcomputerscience/#graduatetext>); Informatics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#graduatetext>); Statistics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#graduatetext>); Software Engineering (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#graduatetext>); Networked Systems (<http://catalogue.uci.edu/interdisciplinarystudies/networkedsystems>), which is supervised by an interdepartmental faculty group from the Department of Computer Science in the

Bren School and the Department of Electrical Engineering and Computer Science in The Henry Samueli School of Engineering. Information is available on the Interdisciplinary Studies section (<http://catalogue.uci.edu/interdisciplinarystudies>) of the *Catalogue*.

Admission

Applicants will be evaluated on the basis of their prior academic record. Applicants for the M.S. 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 Sciences.

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 email 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 take one of the approved English proficiency examinations. More information is available in the Graduate Division (<http://catalogue.uci.edu/graduatedivision/#financialassistancetext>) 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. will not be awarded if the student currently holds an M.S. 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

ICS offers M.S. degrees in Computer Science, Information and Computer Science, Networked Systems, Software Engineering, and Statistics.

Students pursuing the M.S. in Information and Computer Science must complete a concentration in Embedded Systems.

For additional information about the following graduate programs and requirements, click on these links: Computer Science (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofcomputerscience/#graduatetext>); Software Engineering (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofinformatics/#graduatetext>); Statistics (<http://catalogue.uci.edu/donaldbrenschoolofinformationandcomputersciences/departmentofstatistics/#graduatetext>); Networked Systems (<http://catalogue.uci.edu/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. 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 (COMPSCI 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:

List A	
COMPSCI 244	Introduction to Embedded and Ubiquitous Systems
COMPSCI 250A	Computer Systems Architecture
COMPSCI 232	Computer and Communication Networks
COMPSCI 203	Network and Distributed Systems Security
COMPSCI 242	Parallel Computing
COMPSCI 250B	Modern Microprocessors
COMPSCI 230	Distributed Computer Systems
COMPSCI 243	High-Performance Architectures and Their Compilers

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 (COMPSCI 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

List B	
COMPSCI 241	Advanced Compiler Construction
COMPSCI 245	Software for Embedded Systems
COMPSCI 252	Introduction to Computer Design
EECS 211	Advanced System Software
COMPSCI 211A	Visual Computing
COMPSCI 248A/IN4MATX 241	Introduction to Ubiquitous Computing
IN4MATX 211	Software Engineering
IN4MATX 235	Advanced User Interface Architecture
COMPSCI 236	Wireless and Mobile Networking
COMPSCI 265	Graph Algorithms
EECS 223	Real-Time Computer Systems

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).

Faculty

Jonathan Alexander, Ph.D. Louisiana State University, *Campus Writing Coordinator and Professor of English; Culture and Theory; Education; Gender and Sexuality Studies; Informatics* (writing studies, sexuality studies, queer theory, new media studies)

Shannon L. Alfaro, M.S. University of California, Irvine, *Lecturer of Computer Science*

Animashree Anandkumar, Ph.D. Cornell University, *Assistant Professor of Computer Science* (statistical inference and learning of graphical models, scalable network algorithms)

Nader Bagherzadeh, Ph.D. University of Texas at Austin, *Professor of Electrical Engineering and Computer Science; Computer Science* (parallel processing, computer architecture, computer graphics, VLSI design)

Brigitte Baldi, Ph.D. Massachusetts Institute of Technology, *Lecturer of Statistics*

Pierre F. Baldi, Ph.D. California Institute of Technology, *UCI Chancellor's Professor of Computer Science; Biological Chemistry; Biomedical Engineering; Developmental and Cell Biology; Mathematics* (bioinformatics, computational biology)

Scott Bartell, Ph.D. University of California, Davis, *Associate Professor of Program in Public Health; Environmental Health Sciences; Social Ecology; Statistics*

Lubomir Bic, Ph.D. University of California, Irvine, *Professor of Computer Science; Electrical Engineering and Computer Science* (parallel and distributed computing, mobile agents)

Rebecca W. Black, Ph.D. University of Wisconsin-Madison, *Associate Professor of Informatics*

Geoffrey C. Bowker, Ph.D. University of Melbourne, *Chancellor's Professor of Informatics; Visual Studies* (values in design, social studies of databases, science and technology studies)

Elaheh Bozorgzadeh, Ph.D. University of California, Los Angeles, *Associate Professor of Computer Science; Electrical Engineering and Computer Science* (design automation and synthesis for embedded systems, VLSI CAD, reconfigurable computing)

Carter Butts, Ph.D. Carnegie Mellon University, *Professor of Sociology; Electrical Engineering and Computer Science; Statistics* (mathematical sociology, social networks, quantitative methodology, human judgment and decision making, economic sociology)

Michael Carey, Ph.D. University of California, Berkeley, *Donald Bren Professor of Information & Computer Sciences and Professor of Computer Science*

Yunan Chen, Ph.D. Drexel University, *Associate Professor of Informatics; Program in Public Health* (medical informatics, human computer interaction)

Pai H. Chou, Ph.D. University of Washington, *Professor Emeritus of Electrical Engineering and Computer Science; Computer Science* (embedded systems, wireless sensor systems, medical devices, real-time systems, hardware/software co-synthesis)

John L. Crawford, Media Artist and Software Designer, *Graduate Advisor and Associate Dean for Research Creation and Associate Professor of Dance; Informatics* (dance film, interactive media, telematic performance, motion capture, digital arts)

Roderic N. Crooks, Ph.D. University of California, Los Angeles, *Assistant Professor of Informatics* (science and technology studies, education technology, critical data studies, data visualization, community archives)

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

Brian C. Densky, Ph.D. Massachusetts Institute of Technology, *Associate Professor of Electrical Engineering and Computer Science; Computer Science* (compiler programming, language software engineering, fault tolerance)

Michael B. Dillencourt, Ph.D. University of Maryland, College Park, *Professor of Computer Science*

John Christopher Dobrian, Ph.D. University of California, San Diego, *Professor of Music; Informatics*

Rainer B. Doemer, Ph.D. Dortmund University, *Professor of Electrical Engineering and Computer Science; Computer Science* (system-level design, embedded computer systems, design methodologies, specification and modeling languages)

James P. Dourish, Ph.D. University College London, *Chancellor's Professor of Informatics; Computer Science* (human-computer interaction, computer-supported cooperative work)

Nikil D. Dutt, Ph.D. University of Illinois at Urbana-Champaign, *UCI Chancellor's Professor of Computer Science; Cognitive Sciences; Electrical Engineering and Computer Science* (embedded systems, computer architecture, electronic design automation, software systems, brain-inspired architectures and computing)

Magda S. El Zarki, Ph.D. Columbia University, *Professor of Computer Science; Electrical Engineering and Computer Science; Informatics* (telecommunications, networks, wireless communication, video transmission)

David A. Eppstein, Ph.D. Columbia University, *UCI Chancellor's Professor of Computer Science*

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

Charles C. Fowlkes, Ph.D. University of California, Berkeley, *Associate Professor of Computer Science; Cognitive Sciences; Electrical Engineering and Computer Science* (computer vision, machine learning, computational biology)

Michael S. Franz, Ph.D. Swiss Federal Institute of Technology in Zurich, *Professor of Computer Science; Electrical Engineering and Computer Science* (systems software, particularly compilers and virtual machines, trustworthy computing, software engineering)

Daniel H. Frost, M.S. University of California, Irvine, *Senior Lecturer of Computer Science; Informatics* (artificial intelligence, software engineering, computer graphics, teaching of programming)

Jean-Luc Gaudiot, Ph.D. University of California, Los Angeles, *Professor of Electrical Engineering and Computer Science; Computer Science* (parallel processing, computer architecture, processor architecture)

Daniel L. Gillen, Ph.D. University of Washington, *Department Chair and Professor of Statistics; Program in Public Health*

Tony D. Givargis, Ph.D. University of California, Riverside, *Professor of Computer Science* (embedded systems, platform-based system-on-a-chip design, low-power electronics)

Michael T. Goodrich, Ph.D. Purdue University, *UCI Chancellor's Professor of Computer Science; Electrical Engineering and Computer Science* (computer security, algorithm design, data structures, Internet algorithmics, geometric computing, graphic drawing)

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* (values in design, translational biomedical informatics, participatory design, design and emotion)

Michele Guindani, Ph.D. Università Luiga Bocconi, *Associate Professor of Statistics*

Vijay Gurbaxani, Ph.D. University of Rochester, *Taco Bell Chair in Information Technology Management and Professor of Paul Merage School of Business; Informatics* (economics of information systems management, impact of information technology on organization and market structure)

Matthew Harding, Ph.D. Massachusetts Institute of Technology, *Associate Professor of Economics; Statistics*

Ian G. Harris, Ph.D. University of California, San Diego, *Associate Professor of Computer Science; Electrical Engineering and Computer Science* (hardware/software covalidation, manufacturing test)

Gillian Hayes, Ph.D. Georgia Institute of Technology, *Robert A. and Barbara L. Kleist Professor of Informatics; Education* (interactive and collaborative technology, human-computer interaction, computer-supported cooperative work, educational technology, ubiquitous computing)

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

Dan S. Hirschberg, Ph.D. Princeton University, *Professor of Computer Science; Electrical Engineering and Computer Science* (analyses of algorithms, concrete complexity, data structures, models of computation)

Alexander T. Ihler, Ph.D. Massachusetts Institute of Technology, *Associate Professor of Computer Science*

Sandra S. Irani, Ph.D. University of California, Berkeley, *Professor of Computer Science*

Mizuko Ito, Ph.D. Stanford University, *John D. and Catherine T. MacArthur Foundation Chair in Digital Media and Learning and Professor in Residence of Anthropology; Education; Informatics* (ethnography, game studies, youth culture, learning sciences, online communities)

Jesse C. Jackson, M.A. University of Toronto, *Director of the Minor in Digital Arts and Associate Professor of Art; Informatics*

Ramesh Chandra Jain, Ph.D. Indian Institute of Technology Kharagpur, *Donald Bren Professor of Information & Computer Sciences and Professor of Computer Science*

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

Ivan G. Jeliazkov, Ph.D. Washington University, *Associate Professor of Economics; Statistics*

Wesley O. Johnson, Ph.D. University of Minnesota, *Professor Emeritus of Statistics*

James Jones, Ph.D. Georgia Institute of Technology, *Associate Professor of Informatics* (software engineering, software testing and analysis, debugging and fault localization, static and dynamic analysis, software visualization)

Scott A. Jordan, Ph.D. University of California, Berkeley, *Professor of Computer Science; Electrical Engineering and Computer Science* (pricing and differentiated services in the Internet, resource allocation in wireless networks, telecommunications policy)

David G. Kay, J.D. Loyola Marymount University, *Senior Lecturer Emeritus of Informatics; Computer Science* (computer law, computer science education)

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

Raymond O. Klefstad, Ph.D. University of California, Irvine, *Lecturer of Computer Science*

Cory P. Knobel, Ph.D. University of Michigan, *Assistant Adjunct Professor of Informatics* (interactive and collaborative technology, values in design, modes of knowledge representation, philosophy of science and technology)

Alfred Kobsa, Ph.D. University of Vienna, *Professor of Informatics; Computer Science* (user modeling, human-computer interaction, artificial intelligence, cognitive science, interdisciplinary computer science)

Peter O. Krapp, Ph.D. University of California, Santa Barbara, *Department Chair and Professor of Film and Media Studies; English; Informatics; Music; Visual Studies* (digital culture, media history, cultural memory)

Jeffrey L. Krichmar, Ph.D. George Mason University, *Professor of Cognitive Sciences; Computer Science* (computational neuroscience, robotics)

Fadi J. Kurdahi, Ph.D. University of Southern California, *Director, Center for Embedded Computer Systems and Associate Dean for Graduate and Professional Studies and Professor of Electrical Engineering and Computer Science; Computer Science* (VLSI system design, design automation of digital systems)

Richard H. Lathrop, Ph.D. Massachusetts Institute of Technology, *Professor of Computer Science* (modeling structure and function, machine learning, intelligent systems and molecular biology, protein structure/function prediction)

Marco Levorato, Ph.D. University of Padua, *Assistant Professor of Computer Science; Electrical Engineering and Computer Science*

Chen Li, Ph.D. Stanford University, *Professor of Computer Science*

Kwei-Jay Lin, Ph.D. University of Maryland, College Park, *Professor of Electrical Engineering and Computer Science; Computer Science* (real-time systems, distributed systems, service-oriented computing)

Cristina V. Lopes, Ph.D. Northeastern University, *Professor of Informatics; Computer Science* (programming languages, acoustic communications, operating systems, software engineering)

George S. Lueker, Ph.D. Princeton University, *Professor Emeritus of Computer Science*

Aditi Majumder, Ph.D. University of North Carolina at Chapel Hill, *Professor of Computer Science; Electrical Engineering and Computer Science* (novel displays and cameras for computer graphics and visualization, human-computer interaction, applied computer vision)

Gloria J. Mark, Ph.D. Columbia University, *Professor of Informatics* (computer-supported cooperative work, human-computer interaction)

Athina Markopoulou, Ph.D. Stanford University, *Associate Professor of Electrical Engineering and Computer Science; Computer Science* (networking—reliability and security, multimedia networking, measurement and control, design and analysis of network protocols and algorithms, internet reliability and security, multimedia streaming, network measurements and control)

Melissa Mazmanian, Ph.D. Massachusetts Institute of Technology, *Associate Professor of Informatics* (computer-mediated communication, organization studies, information and communication technologies in practice, social response to emerging technologies, work/non-work negotiations in the information age)

Gopi Meenakshisundaram, Ph.D. University of North Carolina at Chapel Hill, *Professor of Computer Science; Electrical Engineering and Computer Science* (geometry and topology for computer graphics, image-based rendering, object representation, surface reconstruction, collision detection, virtual reality, telepresence)

Sharad Mehrotra, Ph.D. University of Texas at Austin, *Professor of Computer Science*

Volodymyr Minin, Ph.D. University of California, Los Angeles, *Professor of Statistics*

Eric D. Mjolsness, Ph.D. California Institute of Technology, *Professor of Computer Science; Mathematics* (applied mathematics, mathematical biology, modeling languages)

Bin Nan, Ph.D. University of Washington, *Professor of Statistics*

Bonnie A. Nardi, Ph.D. University of California, Irvine, *Professor of Informatics* (computer-supported collaborative work, human-computer interaction, computer-mediated communication, user studies methods, activity theory, cultural responses to technology development)

Emily Navarro, Ph.D. University of California, Irvine, *Lecturer of Informatics*

Alexandru Nicolau, Ph.D. Yale University, *Department Chair and Professor of Computer Science; Electrical Engineering and Computer Science* (architecture, parallel computation, programming languages and compilers)

Gary Olson, Ph.D. Stanford University, *Professor Emeritus of Informatics* (interactive and collaborative technology, human-computer interaction, computer-supported cooperative work)

Judith Olson, Ph.D. University of Michigan, *Professor Emeritus of Informatics; Paul Merage School of Business; Urban Planning and Public Policy* (interactive and collaborative technology, human-computer interaction, computer-supported cooperative work)

Hernando C. Ombao, Ph.D. University of Michigan, *Professor Emeritus of Statistics; Cognitive Sciences*

Richard Pattis, M.S. Stanford University, *Senior Lecturer of Computer Science; Informatics* (MicroWorlds for teaching programming, debugging, computational tools for non-computer scientists)

Simon G. Penny, M.F.A. Hong Kong University of Science and Technology, *Professor of Art; Informatics* (informatics, robotic sculpture, interactive environments, electronic media)

Kavita S. Philip, Ph.D. Cornell University, *Associate Professor of History; Informatics* (history of modern South Asia, science and technology, political ecology, critical theoretical studies of race, gender, colonialism, new media, and globalization)

Dale J. Poirier, Ph.D. University of Wisconsin-Madison, *Professor Emeritus of Economics; Statistics*

David F. Redmiles, Ph.D. University of Colorado Boulder, *Professor of Informatics* (computer-supported cooperative work, human computer interaction, software engineering, globally distributed development teams, user interfaces, software tools)

Amelia C. Regan, Ph.D. University of Texas at Austin, *Professor of Computer Science; Civil and Environmental Engineering*

Stephanie Reich, Ph.D. Vanderbilt University, *Associate Professor of Education; Informatics; Psychology and Social Behavior* (child development, parenting, peer interactions, media, program evaluation)

Debra J. Richardson, Ph.D. University of Massachusetts, *Professor Emeritus of Informatics* (software engineering, program testing, life-cycle validation, software environments)

Katie Salen Tekinba#, M.F.A. Rhode Island School of Design, *Professor of Informatics* (game design, connected learning design, human-computer interaction)

Ardalan Amiri Sani, Ph.D. Rice University, *Assistant Professor of Computer Science* (involves building efficient, high performance, and reliable systems)

Isaac D. Scherson, Ph.D. Weizmann Institute of Science, *Professor of Computer Science; Electrical Engineering and Computer Science* (parallel computing architectures, massively parallel systems, parallel algorithms, interconnection networks, performance evaluation)

Patricia Seed, Ph.D. University of Wisconsin-Madison, *Professor of History; Informatics* (mapping: history and design, game design, navigation)

Babak Shahbaba, Ph.D. University of Toronto, *Associate Professor of Statistics; Computer Science*

Weining Shen, Ph.D. North Carolina State University, *Assistant Professor of Statistics*

Phillip C-Y Sheu, Ph.D. University of California, Berkeley, *Professor of Electrical Engineering and Computer Science; Biomedical Engineering; Computer Science* (database systems, interactive multimedia systems)

Alice Silverberg, Ph.D. Princeton University, *Professor of Mathematics; Computer Science* (algebra and number theory)

Patrick J. Smyth, Ph.D. California Institute of Technology, *Professor of Computer Science; Statistics*

Kurt Squire, Ph.D. Indiana University, *Professor of Informatics* (video game design, games for learning, mobile technologies, civic engagement, place-based learning)

Thomas A. Standish, Ph.D. Carnegie Institute of Technology, *Professor Emeritus of Information and Computer Sciences* (software testing and analysis, software semantics and epistemology, programming and cognition, software comprehension)

Constance Steinkuehler, Ph.D. University of Wisconsin, Madison, *Professor of Informatics* (video games for impact, game-mediated cognition and learning, online social interaction, video games and policy)

Hal S. Stern, Ph.D. Stanford University, *UCI Chancellor's Professor of Statistics; Cognitive Sciences*

Mark Steyvers, Ph.D. Indiana University, *Professor of Cognitive Sciences; Computer Science; Psychology and Social Behavior* (higher-order cognition, cognitive neuroscience, computational modeling, collective intelligence)

Joshua Tanenbaum, M.A. Simon Fraser University, *Assistant Professor of Informatics* (digital games and narrative, tangible and wearable interaction, maker and DIY culture, nonverbal communication and virtual worlds)

Richard N. Taylor, Ph.D. University of Colorado Boulder, *Professor Emeritus of Informatics* (software engineering, user interfaces, environments, team support)

Alexander W. Thornton, B.S. University of California, Irvine, *Lecturer of Computer Science*

Gene Y. Tsudik, Ph.D. University of Southern California, *UCI Chancellor's Professor of Computer Science*

Kojiro Umezaki, M.A. Dartmouth College, *Associate Professor of Music; Computer Science*

Jessica Utts, Ph.D. Pennsylvania State University, *Professor Emeritus of Statistics*

Joachim S. Vandekerckhove, Ph.D. University of Leuven, *Assistant Professor of Cognitive Sciences; Statistics* (response time modeling, model fitting, computational statistics, psychometrics, Bayesian statistics)

Alexander Veidenbaum, Ph.D. University of Illinois at Urbana-Champaign, *Professor of Computer Science*

Nalini Venkatasubramanian, Ph.D. University of Illinois at Urbana-Champaign, *Professor of Computer Science*

Alladi Venkatesh, Ph.D. Syracuse University, *Professor of Paul Merage School of Business; Informatics* (social impacts of information technology, Internet and the New Economy, Smart Home technologies, children and multimedia)

Richert Wang, Ph.D. University of California, Irvine, *Lecturer of Computer Science*

Mark J. Warschauer, Ph.D. University of Hawaii at Manoa, *Professor of Education; Informatics* (language, literacy, technology, STEM)

Xaiohui Xie, Ph.D. Massachusetts Institute of Technology, *Associate Professor of Computer Science; Developmental and Cell Biology* (computational biology, bioinformatics, genomics, neural computation, machine learning)

Guoqing Xu, Ph.D. Ohio State University, *Assistant Professor of Computer Science*

Yaming Yu, Ph.D. Harvard University, *Associate Professor of Statistics*

Zhaoxia Yu, Ph.D. William Marsh Rice University, *Associate Professor of Statistics*

Charles S. Zender, Ph.D. University of Colorado Boulder, *Professor of Earth System Science; Computer Science*

Hong-Kai Zhao, Ph.D. University of California, Los Angeles, *Department Chair and Chancellor's Professor of Mathematics; Computer Science* (applied and computational mathematics, inverse problems and imaging)

Shuang Zhao, Ph.D. Cornell University, *Assistant Professor of Computer Science* (computer graphics with a focus on material appearance modeling and physically-based rendering)

Hadar Ziv, Ph.D. University of California, Irvine, *Lecturer of Informatics* (software testing, requirements engineering, Bayesian modeling)

André W. van der Hoek, Ph.D. University of Colorado Boulder, *Professor of Informatics* (software engineering)

Computer Science Courses

COMPSCI 111. Digital Image Processing. 4 Units.

Introduction to the fundamental concepts of digital signal and image processing as applicable in areas such as multimedia, graphics, AI, data mining, databases, vision, or video games. Topics include image representation, space- and frequency-domain transformations, filters, segmentation, and compression.

Prerequisite: (I&C SCI 46 or CSE 46) and I&C SCI 6D and (MATH 6G or MATH 3A or I&C SCI 6N). I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better. I&C SCI 6D with a grade of C or better. MATH 6G with a grade of C or better. MATH 3A with a grade of C or better. I&C SCI 6N with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 112. Computer Graphics. 4 Units.

Introduction to the fundamental principles of 3D computer graphics including polygonal modeling, geometric transformations, visibility algorithms, illumination models, texturing, and rasterization. Use of an independently-learned 3D graphics API to implement these techniques.

Prerequisite: (I&C SCI 22 or CSE 22 or I&C SCI H22 or I&C SCI 33 or CSE 43) and (I&C SCI 45C or CSE 45C) and (MATH 6G or MATH 3A or I&C SCI 6N). I&C SCI 22 with a grade of C or better. CSE 22 with a grade of C or better. I&C SCI H22 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. I&C SCI 45C with a grade of C or better. CSE 45C with a grade of C or better. MATH 6G with a grade of C or better. MATH 3A with a grade of C or better. I&C SCI 6N with a grade of C or better

COMPSCI 113. Computer Game Development. 4 Units.

Introduction to the principles of interactive 2D and 3D computer game development. Concepts in computer graphics, algorithms, software engineering, art and graphics, music and sound, story analysis, and artificial intelligence are presented and are the basis for student work.

Prerequisite: COMPSCI 112 or COMPSCI 171 or IN4MATX 121 or ART 106B or I&C SCI 163 or I&C SCI 166

Same as IN4MATX 125.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 114. Projects in Advanced 3D Computer Graphics. 4 Units.

Projects in advanced 3D graphics such as illumination, geometric modeling, visualization, and animation. Topics include physically based and global illumination, solid modeling, curved surfaces, multiresolution modeling, image-based rendering, basic concepts of animation, and scientific visualization.

Prerequisite: COMPSCI 112 and (I&C SCI 45C or CSE 45C). I&C SCI 45C with a grade of C or better. CSE 45C with a grade of C or better.

Recommended: COMPSCI 161 or CSE 161 or COMPSCI 164 or COMPSCI 165.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 115. Computer Simulation. 4 Units.

Discrete event-driven simulation; continuous system simulation; basic probability as pertaining to input distributions and output analysis; stochastic and deterministic simulation; static and dynamic system simulation.

Prerequisite: I&C SCI 6B and I&C SCI 6N and (STATS 67 or (STATS 7 and STATS 120A)) and I&C SCI 51 and IN4MATX 43. I&C SCI 6B with a grade of C or better. I&C SCI 6N with a grade of C or better. STATS 67 with a grade of C or better. STATS 7 with a grade of C or better. STATS 120A with a grade of C or better. I&C SCI 51 with a grade of C or better. IN4MATX 43 with a grade of C or better

Restriction: Upper-division students only. School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 116. Computational Photography and Vision. 4 Units.

Introduces the problems of computer vision through the application of computational photography. Specific topics include photo-editing (image warping, compositing, hole filling), panoramic image stitching, and face detection for digital photographs.

Prerequisite: I&C SCI 6D and (MATH 6G or MATH 3A or I&C SCI 6N) and MATH 2B and (I&C SCI 46 or CSE 46). I&C SCI 6D with a grade of C or better. MATH 6G with a grade of C or better. MATH 3A with a grade of C or better. I&C SCI 6N with a grade of C or better. MATH 2B with a grade of C or better. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 117. Project in Computer Vision. 4 Units.

Students undertake construction of a computer vision system. Topics include automatically building 3D models from photographs, searching photo collections, robot navigation, and human motion tracking.

Prerequisite: I&C SCI 6D and (MATH 3A or I&C SCI 6N) and MATH 2B and (I&C SCI 46 or CSE 46) and (COMPSCI 112 or COMPSCI 116 or COMPSCI 171 or COMPSCI 178). I&C SCI 6D with a grade of C or better. MATH 3A with a grade of C or better. I&C SCI 6N with a grade of C or better. MATH 2B with a grade of C or better. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 121. Information Retrieval. 4 Units.

An introduction to information retrieval including indexing, retrieval, classifying, and clustering text and multimedia documents.

Prerequisite: (I&C SCI 45C or I&C SCI 45J) and (STATS 7 or STATS 67). I&C SCI 45C with a grade of C or better. I&C SCI 45J with a grade of C or better

Same as IN4MATX 141.

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 122A. Introduction to Data Management. 4 Units.

Introduction to the design of databases and the use of database management systems (DBMS) for applications. Topics include entity-relationship modeling for design, relational data model, relational algebra, relational design theory, and Structured Query Language (SQL) programming.

Prerequisite: I&C SCI 33 or CSE 43 or EECS 114. I&C SCI 33 with a grade of C or better. CSE 43 with a grade of C or better

Same as EECS 116.

Restriction: Computer Science Engineering Majors have first consideration for enrollment. School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 122B. Project in Databases and Web Applications. 4 Units.

Introduces students to advanced database technologies and Web applications. Topics include database connectivity (ODBC/JDBC), extending databases using stored procedures, database administration, Web servers, Web programming languages (Java servlets, XML, Ajax, and mobile platforms).

Prerequisite: (COMPSCI 122A or EECS 116) and I&C SCI 45J

Overlaps with COMPSCI 137, IN4MATX 124.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 122C. Principles of Data Management. 4 Units.

Covers fundamental principles underlying data management systems. Content includes key techniques including storage management, buffer management, record-oriented file system, access methods, query optimization, and query processing.

Prerequisite: COMPSCI 122A and (I&C SCI 53 or COMPSCI 143A)

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

Concurrent with COMPSCI 222.

COMPSCI 125. Next Generation Search Systems. 4 Units.

Discusses concepts and techniques related to all aspects of search systems. After considering basic search technology and the state-of-art systems, rapidly developing techniques for multimedia search, local search, event-search, and video-on-demand are explored.

Prerequisite: I&C SCI 21 or CSE 21 or IN4MATX 41 or I&C SCI 31

Restriction: Upper-division students only.

Concurrent with COMPSCI 225.

COMPSCI 131. Parallel and Distributed Computing. 4 Units.

Parallel and distributed computer systems. Parallel programming models. Common parallel and distributed programming issues. Specific topics include parallel programming, performance models, coordination and synchronization, consistency and replication, transactions, fault tolerance.

Prerequisite: (I&C SCI 53 and I&C SCI 53L) or COMPSCI 143A

COMPSCI 132. Computer Networks. 4 Units.

Computer network architectures, protocols, and applications. Internet congestion control, addressing, and routing. Local area networks. Multimedia networking.

Prerequisite: EECS 55 or STATS 67

Same as EECS 148.

Restriction: Computer Engineering Majors have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 133. Advanced Computer Networks. 4 Units.

Fundamental principles in computer networks are applied to obtain practical experience and skills necessary for designing and implementing computer networks, protocols, and network applications. Various network design techniques, simulation techniques, and UNIX network programming are covered.

Prerequisite: COMPSCI 132

COMPSCI 134. Computer and Network Security. 4 Units.

Overview of modern computer and networks security, attacks, and countermeasures. Authentication, identification, data secrecy, data integrity, authorization, access control, computer viruses, network security. Also covers secure e-commerce and applications of public key methods, digital certificates, and credentials.

Prerequisite: I&C SCI 6D and (I&C SCI 33 or CSE 43) and (COMPSCI 122A or EECS 116 or COMPSCI 132 or COMPSCI 143A)

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 137. Internet Applications Engineering. 4 Units.

Concepts in Internet applications engineering with emphasis on the Web. Peer-to-Peer and Interoperability. Topics include HTTP and REST, Remote Procedure/Method Calls, Web Services, data representations, content distribution networks, identity management, relevant W3C/IETF standards, and relevant new large-scale computing styles.

Prerequisite: (COMPSCI 132 or EECS 148) and I&C SCI 45J

Same as IN4MATX 124.

Overlaps with COMPSCI 122B.

Restriction: Upper-division students only. School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 141. Concepts in Programming Languages I. 4 Units.

In-depth study of several contemporary programming languages stressing variety in data structures, operations, notation, and control. Examination of different programming paradigms, such as logic programming, functional programming and object-oriented programming; implementation strategies, programming environments, and programming style.

Prerequisite: (I&C SCI 51 or CSE 31 or EECS 31) and (I&C SCI 46 or CSE 46). I&C SCI 51 with a grade of C or better. CSE 31 with a grade of C or better. EECS 31 with a grade of C or better. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Same as IN4MATX 101.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 142A. Compilers and Interpreters. 4 Units.

Introduction to the theory of programming language processors covering lexical analysis, syntax analysis, semantic analysis, intermediate representations, code generation, optimization, interpretation, and run-time support.

Prerequisite: CSE 141 or COMPSCI 141 or IN4MATX 101

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 142B. Language Processor Construction. 4 Units.

Project course which provides working laboratory experience with construction and behavior of compilers and interpreters. Students build actual language processors and perform experiments which reveal their behaviors.

Prerequisite: COMPSCI 142A or CSE 142

COMPSCI 143A. Principles of Operating Systems. 4 Units.

Principles and concepts of process and resource management, especially as seen in operating systems. Processes, memory management, protection, scheduling, file systems, and I/O systems are covered. Concepts illustrated in the context of several well-known systems.

Prerequisite: (I&C SCI 46 or CSE 46) and (I&C SCI 51 or EECS 31 or CSE 31)

Overlaps with EECS 111.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 143B. Project in Operating System Organization. 4 Units.

Detailed specification and design of critical components of an actual operating system including a memory manager, a process server, and a file/IO subsystem. Hardware/software tradeoffs. Emphasis on logical organization of system and communication.

Prerequisite: COMPSCI 143A

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 145. Embedded Software. 4 Units.

Principles of embedded computing systems: embedded systems architecture, hardware/software components, system software and interfacing, real-time operating systems, hardware/software co-development, and communication issues. Examples of embedded computing in real-world application domains. Simple programming using an embedded systems development environment.

Corequisite: COMPSCI 145L

Prerequisite: (CSE 46 or I&C SCI 46) and (I&C SCI 51 or CSE 132 or EECS 112)

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 145L. Embedded Software Laboratory. 2 Units.

Laboratory section to accompany COMPSCI 145.

Corequisite: COMPSCI 145

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 146. Programming in Multitasking Operating Systems. 4 Units.

User- and systems-level programming of modern Internet-connected, multi-user, multitasking operating systems. Shells, scripting, filters, pipelines, programmability, extensibility, concurrency, inter-process communication. Concrete examples of a modern operating system (such as, but not necessarily, Unix programmed in C) are used.

Prerequisite: (I&C SCI 46 or CSE 46) and I&C SCI 51. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better. I&C SCI 51 with a grade of C or better. Recommended: COMPSCI 143A.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 151. Digital Logic Design. 4 Units.

Boolean algebra. Design/analysis of combinational and sequential systems using SSI/MSI/LSI modules. Number systems. Error detecting and correction codes. Arithmetic algorithms. Hardware/ firmware implementation of algorithms.

Prerequisite: (I&C SCI 33 or CSE 43) and I&C SCI 51 and I&C SCI 6B and I&C SCI 6D. I&C SCI 33 with a grade of C or better. CSE 43 with a grade of C or better. I&C SCI 51 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 152. Computer Systems Architecture. 4 Units.

Design of computer elements; ALU, control unit, and arithmetic circuits. Memory hierarchy and organization. Caches. Function unit sharing and pipelining. I/O and interrupt processing. RTL and behavioral modeling using hardware description languages. Microprocessor organization and implementation techniques.

Prerequisite: COMPSCI 151

Overlaps with I&C SCI 160, EECS 112.

COMPSCI 153. Logic Design Laboratory. 4 Units.

Introduction to standard integrated circuits. Construction and debugging techniques. Design of digital systems using LSI and MSI components. Practical use of circuits in a laboratory environment, including implementation of small digital systems such as arithmetic modules, displays, and timers.

Prerequisite: COMPSCI 151

COMPSCI 154. Computer Design Laboratory. 4 Units.

Underlying primitives of computer instruction sets. Principles of microprogramming. Microprogramming. Microprograms written for one or more systems. Typical microprogramming applications discussed and implemented or simulated.

Prerequisite or corequisite: COMPSCI 151

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 161. Design and Analysis of Algorithms. 4 Units.

Techniques for efficient algorithm design, including divide-and-conquer and dynamic programming, and time/space analysis. Fast algorithms for problems applicable to networks, computer games, and scientific computing, such as sorting, shortest paths, minimum spanning trees, network flow, and pattern matching.

Prerequisite: (I&C SCI 46 or CSE 46) and I&C SCI 6B and I&C SCI 6D and MATH 2B. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 162. Formal Languages and Automata. 4 Units.

Formal aspects of describing and recognizing languages by grammars and automata. Parsing regular and context-free languages. Ambiguity, nondeterminism. Elements of computability; Turing machines, random access machines, undecidable problems, NP-completeness.

Prerequisite: (I&C SCI 46 or CSE 46) and MATH 2A and MATH 2B and I&C SCI 6B and I&C SCI 6D. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Same as LINGUIS 102.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Cognitive Sciences Majors have first consideration for enrollment. Language Science Majors have first consideration for enrollment.

COMPSCI 163. Graph Algorithms. 4 Units.

Algorithms for solving fundamental problems in graph theory. Graph representations, graph traversal, network flow, connectivity, graph layout, matching problems.

Prerequisite: COMPSCI 161 or CSE 161

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

Concurrent with COMPSCI 265.

COMPSCI 164. Computational Geometry and Geometric Modeling. 4 Units.

Algorithms and data structures for computational geometry and geometric modeling, with applications to game and graphics programming. Topics: convex hulls, Voronoi diagrams, algorithms for triangulation, motion planning, and data structures for geometric searching and modeling of 2D and 3D objects.

Prerequisite: I&C SCI 46 or CSE 46. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

COMPSCI 165. Project In Algorithms And Data Structures. 4 Units.

Design, implementation, execution, and analysis of algorithms for problems such as sorting, searching, data compression, and data encryption. Time-space-structure trade-offs.

Prerequisite: COMPSCI 161 or CSE 161. Recommended: I&C SCI 45C OR CSE 45C.

COMPSCI 167. Introduction to Applied Cryptography. 4 Units.

An introduction to the essential aspects of applied cryptography, as it is used in practice. Topics include classical cryptography, block ciphers, stream ciphers, public-key cryptography, digital signatures, one-way hash functions, basic cryptographic protocols, and digital certificates and credentials.

Prerequisite: COMPSCI 161 or CSE 161

Restriction: Upper-division students only.

COMPSCI 169. Introduction to Optimization. 4 Units.

A broad introduction to optimization. Unconstrained and constrained optimization. Equality and inequality constraints. Linear and integer programming. Stochastic dynamic programming.

Prerequisite: (I&C SCI 6N or MATH 3A) and (STATS 67 or (STATS 7 and STATS 120A))

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

Concurrent with COMPSCI 268.

COMPSCI 171. Introduction to Artificial Intelligence. 4 Units.

Different means of representing knowledge and uses of representations in heuristic problem solving. Representations considered include predicate logic, semantic nets, procedural representations, natural language grammars, and search trees.

Prerequisite or corequisite: (STATS 7 and STATS 120A) or STATS 67 and (I&C SCI 46 or CSE 46) and MATH 2B

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 172B. Neural Networks and Deep Learning . 4 Units.

Neural network and deep learning from multiple perspectives. Theory of parallel distributed processing systems, algorithmic approaches for learning from data in various manners, applications to difficult problems in AI from computer vision, to natural language understanding, to bioinformatics and cheminformatics.

Prerequisite: (STATS 120A and STATS 120B) or MATH 121A or COMPSCI 178 or COMPSCI 273A

Concurrent with COMPSCI 274C.

COMPSCI 175. Project in Artificial Intelligence. 4 Units.

Construction of a working artificial intelligence system. Evaluation of capabilities of the system including impact of knowledge representation.

Prerequisite: COMPSCI 171 and COMPSCI 178

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 177. Applications of Probability in Computer Science. 4 Units.

Application of probability to real-world problems in computer science. Typical topics include analysis of algorithms and graphs, probabilistic language models, network traffic modeling, data compression, and reliability modeling.

Prerequisite: MATH 2B and STATS 67 and I&C SCI 6B and I&C SCI 6D and (MATH 3A or I&C SCI 6N)

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 178. Machine Learning and Data-Mining. 4 Units.

Introduction to principles of machine learning and data-mining applied to real-world datasets. Typical applications include spam filtering, object recognition, and credit scoring.

Prerequisite: I&C SCI 6B and I&C SCI 6D and (I&C SCI 6N or MATH 3A) and MATH 2B and (STATS 67 or (STATS 7 and STATS 120A))

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

COMPSCI 179. Algorithms for Probabilistic and Deterministic Graphical Models. 4 Units.

Graphical model techniques dealing with probabilistic and deterministic knowledge representations. Focuses on graphical models such as constraint networks, Bayesian networks, and Markov networks that have become a central paradigm for knowledge representation and reasoning in AI and general computer science.

Prerequisite: COMPSCI 171

COMPSCI 183. Introduction to Computational Biology. 4 Units.

The use of theories and methods based on computer science, mathematics, and physics in molecular biology and biochemistry. Basics in biomolecular modeling. Analysis of sequence and structural data of biomolecules. Analysis of biomolecular functions.

Prerequisite: MATH 2D or MATH 3A or STATS 7 or STATS 8

Same as BME 132, BIO SCI M123.

Concurrent with MOL BIO 223 and BME 232.

COMPSCI 184A. Representations and Algorithms for Molecular Biology. 4 Units.

Introduction to computational methods in molecular biology, aimed at those interested in learning about this interdisciplinary area. Covers computational approaches to understanding and predicting the structure, function, interactions, and evolution of DNA, RNA, proteins, and related molecules and processes.

Prerequisite: I&C SCI 6N or MATH 3A or MATH 6G

Restriction: Upper-division students only.

Concurrent with COMPSCI 284A.

COMPSCI 184C. Computational Systems Biology. 4 Units.

Computational inference and modeling of gene regulation networks, signal transduction pathways, and the effects of regulatory networks in cellular processes, development, and disease. Introduction of required mathematical, computational, and data handling tools.

Prerequisite: COMPSCI 184A

Concurrent with COMPSCI 284C.

COMPSCI 189. Project in Bioinformatics. 4 Units.

Teaches problem definition and analysis, data representation, algorithm design, component integration, solution validation, and testability with teams specifying, designing, building, and testing a solution to a bioinformatics problem. Lectures include engineering values, discussions, and ethical ramifications of biomedical computing issues.

Prerequisite: COMPSCI 184A. COMPSCI 184A with a grade of C or better

COMPSCI 190. Special Topics in Information and Computer Science. 4 Units.

Studies in selected areas of Information and Computer Science. Topics addressed vary each quarter.

Prerequisite: Prerequisites vary.

Repeatability: Unlimited as topics vary.

COMPSCI H198. Honors Research. 4 Units.

Directed independent research in computer science for honors students.

Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.

Repeatability: May be repeated for credit unlimited times.

Restriction: Campuswide Honors Program students only. Bren School of ICS Honors students only. Upper-division students only.

COMPSCI 199. Individual Study. 2-5 Units.

Individual research or investigation with Computer Science faculty.

Repeatability: May be repeated for credit unlimited times.

COMPSCI 200S. Seminar in Computer Science Research. 1 Unit.

Graduate colloquium series. Includes weekly talks by notable computer scientists.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

COMPSCI 201. Foundations of Cryptographic Protocols. 4 Units.

Explores fundamental cryptographic tools, including encryption, signatures, and identification schemes. Students are introduced to the provable security paradigm of modern cryptography, focusing on understanding of security properties provided by cryptographic tools, and on proving security (or insecurity) of cryptographic constructions.

Prerequisite: COMPSCI 260 or COMPSCI 263

COMPSCI 201P. Introduction to Computer Security. 4 Units.

Introduction to computer security, including systems, technology, and management. Topics include authorization, authentication, data integrity, malware, operating systems security, network security, web security, and basic cryptography.

Prerequisite: Knowledge of Python or C++ programming is required.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 202. Applied Cryptography. 4 Units.

Design and analysis of algorithms for applied cryptography. Topics include symmetric and asymmetric key encryption, digital signatures, one-way hash functions, digital certificates and credentials, and techniques for authorization, non-repudiation, authentication, identification, data integrity, proofs of knowledge, and access control.

Prerequisite: COMPSCI 260 and COMPSCI 263

COMPSCI 202P. Applied Cryptography . 4 Units.

Design and analysis of algorithms for applied cryptography. Topics include symmetric and asymmetric key encryption, digital signatures, one-way hash functions, digital certificates and credentials, and techniques for authorization, non-repudiation, authentication, identification, data integrity, proofs of knowledge, and access control.

Restriction: Graduate students only.

COMPSCI 203. Network and Distributed Systems Security. 4 Units.

Modern computer and networks security: attacks and countermeasures, authentication, identification, data secrecy, data integrity, authorization, access control, computer viruses, network security. Group communication and multicast security techniques. Covers secure e-commerce and applications of public key methods, digital certificates, and credentials.

Prerequisite: EECS 148 or COMPSCI 132

Same as NET SYS 240.

COMPSCI 203P. Network Security. 4 Units.

Introduction to network security, including network threats and attacks, as well as defenses against such attacks. Topics include network infrastructure security, mobile and Wi-Fi security, spam, phishing, firewalls, anonymity, secure email, secure and private cloud computing, and web security.

Prerequisite: COMPSCI 201P or COMPSCI 202P

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 204. Usable Security and Privacy. 4 Units.

Introduces usability problems in security and privacy methods, tools, and software. Overviews prominent examples of both failures and successes in usable security and privacy. Surveys state-of-the-art techniques and evaluation methodologies.

Same as IN4MATX 237.

Overlaps with IN4MATX 231, COMPSCI 203.

Restriction: Informatics Majors have first consideration for enrollment. Computer Science Majors have first consideration for enrollment. Undergraduate degree in CompSci or Informatics is strongly recommended.

COMPSCI 206. Principles of Scientific Computing. 4 Units.

Overview of widely used principles and methods of numerical and scientific computing, including basic concepts and computational methods in linear algebra, optimization, and probability.

Prerequisite: Basic courses in multivariate calculus, linear algebra, and probability.

Overlaps with STATS 230.

COMPSCI 206P. Principles of Scientific Computing. 4 Units.

Overview of widely used principles and methods of numerical and scientific computing, including basic concepts and computational methods in floating-point, linear algebra, optimization, simulation, modeling, and probability/statistics as it relates to model evaluation.

Prerequisite: Basic knowledge of multivariate calculus, linear algebra, and familiarity with MATLAB.

Restriction: Graduate students only.

COMPSCI 210P. Computer Graphics and Visualization . 4 Units.

Interactive 3D graphics rendering pipeline, illumination and shading, ray tracing, texture-, bump-, mip-mapping, hidden surface removal, anti-aliasing, multiresolution representations, volume rendering techniques, iso-surface extraction.

Prerequisite: Familiarity with linear algebra is required.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 211A. Visual Computing. 4 Units.

Fundamentals of image processing (convolution, linear filters, spectral analysis), vision geometry (projective geometry, camera models and calibration, stereo reconstruction), radiometry (color, shading, illumination, BRDF), and visual content synthesis (graphics pipeline, texture- bump-, mip-mapping, hidden surface removal, anti-aliasing).

COMPSCI 211B. Computer Graphics and Visualization. 4 Units.

Interactive 3D graphics rendering pipeline, illumination and shading, ray tracing, texture-, bump-, mip-mapping, hidden surface removal, anti-aliasing, multiresolution representations, volume rendering techniques, iso-surface extraction.

Prerequisite: COMPSCI 211A

COMPSCI 211P. Visual Computing . 4 Units.

Develops a comprehensive understanding of fundamentals of image processing (convolution, linear filters, spectral analysis), vision geometry (projective geometry, camera models and calibration, stereo reconstruction), radiometry (color, shading, illumination, BRDF), visual content synthesis (graphics pipeline, texture- bump-, mip-mapping, hidden surface, anti-aliasing).

Prerequisite: Undergraduate-level familiarity with Linear algebra (matrices and operations), eigenvalue, eigenvectors, linear regression; basic of algorithms; programming in C/C++

Restriction: Graduate students only.

COMPSCI 212. Multimedia Systems and Applications. 4 Units.

Organization and structure of modern multimedia systems; audio and video encoding/compression; quality of service concepts; scheduling algorithms for multimedia; resource management in distributed and multimedia systems; multimedia protocols over high-speed networks; synchronization schemes; multimedia applications; and teleservices.

Prerequisite: COMPSCI 143A and COMPSCI 161. B.S. degree in Computer Science is also accepted. Recommended: COMPSCI 131 and COMPSCI 132 and COMPSCI 133.

COMPSCI 213. Introduction to Visual Perception. 4 Units.

Introduction to the process of human visual perception. Offers the physiological and psychophysical approach to understand vision, introducing concepts of perception of color, depth, movement. Examples of quantification and application of these models in computer vision, computer graphics, multimedia, HCI.

Prerequisite: MATH 121A

COMPSCI 216. Image Understanding. 4 Units.

The goal of image understanding is to extract useful semantic information from image data. Course covers low-level image and video processing techniques, feature descriptors, segmentation, objection recognition, and tracking.

Prerequisite: I&C SCI 6D and (I&C SCI 6N or MATH 6G or MATH 3A) and MATH 2B and I&C SCI 46

COMPSCI 217. Light and Geometry in Computer Vision. 4 Units.

Examines the issues of light transport and multiview geometry in computer vision. Applications include camera calibration, 3D understanding, stereo reconstruction, and illumination estimation.

Prerequisite: I&C SCI 6D and (I&C SCI 6N or MATH 6G or MATH 3A) and MATH 2B and I&C SCI 46 and COMPSCI 211A

COMPSCI 221. Information Retrieval, Filtering, and Classification. 4 Units.

Algorithms for the storage, retrieval, filtering, and classification of textual and multimedia data. The vector space model, Boolean and probabilistic queries, and relevance feedback. Latent semantic indexing; collaborative filtering; and relationship to machine learning methods.

Prerequisite: COMPSCI 161 and COMPSCI 171 and (I&C SCI 6N or MATH 3A or MATH 6G)

Same as IN4MATX 225.

Restriction: Graduate students only.

COMPSCI 222. Principles of Data Management. 4 Units.

Covers fundamental principles underlying data management systems. Content includes key techniques including storage management, buffer management, record-oriented file system, access methods, query optimization, and query processing.

Prerequisite: COMPSCI 122A and (I&C SCI 53 or COMPSCI 143A)

Concurrent with COMPSCI 122C.

COMPSCI 222P. Principles of Data Management. 4 Units.

Covers fundamental principles underlying data management systems. Understanding and implementation of key techniques including storage management, buffer management, record-oriented file system, access methods, query optimization, and query processing.

Prerequisite: C++ programming skills, understanding of Data Structures and Algorithms

Restriction: Graduate students only.

COMPSCI 223. Transaction Processing and Distributed Data Management. 4 Units.

Covers fundamental principles underlying transaction processing including database consistency, concurrency control, database recovery, and fault-tolerance. Includes transaction processing in centralized, distributed, parallel, and client-server environments.

Prerequisite: COMPSCI 222 and COMPSCI 131

COMPSCI 225. Next Generation Search Systems. 4 Units.

Discusses concepts and techniques related to all aspects of search systems. After considering basic search technology and the state-of-art systems, rapidly developing techniques for multimedia search, local search, event-search, and video-on-demand are explored.

Prerequisite: I&C SCI 21 or CSE 21 or IN4MATX 41 or I&C SCI 31 or CSE 41

Restriction: Upper-division students only. Graduate students only.

Concurrent with COMPSCI 125.

COMPSCI 230. Distributed Computer Systems. 4 Units.

Principles of distributed computing systems. Topics covered include message-passing, remote procedure calls, distributed shared memory synchronization, resource and process/thread management, distributed file systems, naming and security.

COMPSCI 232. Computer and Communication Networks. 4 Units.

Network architecture of the Internet, telephone networks, cable networks, and cell phone networks. Network performance models. Network performance models. Advanced concepts and implementations of flow and congestion control, addressing, internetworking, forwarding, routing, multiple access, streaming, and quality-of-service.

Prerequisite: EECS 148 or COMPSCI 132

Same as EECS 248A, NET SYS 201.

Restriction: Graduate students only.

COMPSCI 232P. Computer and Communication Networks . 4 Units.

Internet architecture, protocols, and services. Advanced concepts of IP and TCP, including addressing, internetworking, forwarding, routing, and implementations of flow and congestion control. Internet services such as Network Address Translation and Domain Name Servers. Overview of Local Area Networks.

Restriction: Graduate students only.

COMPSCI 233. Networking Laboratory. 4 Units.

A laboratory-based introduction to basic networking concepts such as addressing, sub-netting, bridging, ARP, and routing. Network simulation and design. Structured around weekly readings and laboratory assignments.

Prerequisite: EECS 148 or COMPSCI 132

Same as NET SYS 202.

COMPSCI 234. Advanced Networks. 4 Units.

Design principles of networked systems, advanced routing and congestion control algorithms, network algorithms, network measurement, management, security, Internet economics, and emerging networks.

Prerequisite: NET SYS 201 or COMPSCI 232 or EECS 248A

Same as NET SYS 210.

COMPSCI 236. Wireless and Mobile Networking. 4 Units.

Introduction to wireless networking. The focus is on layers 2 and 3 of the OSI reference model, design, performance analysis, and protocols. Topics covered include: an introduction to wireless networking, digital cellular, next generation cellular, wireless LANs, and mobile IP.

Prerequisite: EECS 148 or COMPSCI 132

Same as NET SYS 230.

COMPSCI 237. Middleware for Networked and Distributed Systems. 4 Units.

Discusses concepts, techniques, and issues in developing distributed systems middleware that provides high performance and Quality of Service for emerging applications. Also covers existing standards (e.g., CORBA, DCOM, Jini, Espeak) and their relative advantages and shortcomings.

Prerequisite: An undergraduate-level course in operating systems and networks.

Same as NET SYS 260.

COMPSCI 238. Advanced Operating Systems. 4 Units.

Focuses on advanced and graduate-level topics in operating systems. Presents important recent developments in operating systems, topics not covered in undergraduate operating systems courses. This includes novel operating system designs and techniques to improve existing ones.

Prerequisite: COMPSCI 143A

COMPSCI 238P. Operating Systems. 4 Units.

In-depth organization of the core operating system abstraction and its implementation (virtual memory, kernel and user mode, system calls, threads, context switches, interrupts, inter-process communication, hardware interface, etc.) and a range of recent developments in de-facto industry standard operating systems.

Prerequisite: Working knowledge of C and the Linux environment.

Restriction: School of Info & Computer Sci students only. Master of Computer Science Degree students only. Graduate students only.

COMPSCI 241. Advanced Compiler Construction. 4 Units.

Advanced study of programming language implementation techniques: optimizations such as common sub-expression elimination, register allocation, and instruction scheduling. Implementation of language features such as type-directed dispatch, garbage collection, dynamic linking, and just-in-time code generation.

Prerequisite: COMPSCI 142A

COMPSCI 242. Parallel Computing. 4 Units.

Definition of parallel processing systems. Theory and application of arrays, trees, and hypercubes. Computational models, applications: sorting, integer arithmetic, matrix operations, Fast Fourier Transform, and others. Interconnection networks: a framework for the description, analysis, and construction of hypercube-derived networks.

COMPSCI 242P. Compilers and Interpreters. 4 Units.

Provides in-depth study of compilers and interpreters which are the primary forms of programming language processing in computing.

Prerequisite: Knowledge of C++ programming is required.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 243. High-Performance Architectures and Their Compilers. 4 Units.

Emphasis on the development of automatic tools (i.e., compilers/environments) for the efficient exploitation of parallel machines, and the trade-offs between hardware and software in the design of supercomputing and high-performance machines.

COMPSCI 244. Introduction to Embedded and Ubiquitous Systems. 4 Units.

Embedded and ubiquitous system technologies including processors, DSP, memory, and software. System interfacing basics; communication strategies; sensors and actuators, mobile and wireless technology. Using pre-designed hardware and software components. Design case studies in wireless, multimedia, and/or networking domains.

Prerequisite: I&C SCI 51 and COMPSCI 152 and COMPSCI 161 and (I&C SCI 6N or MATH 3A or MATH 6G or I&C SCI 6D). B.S. degree in Computer Science is also accepted.

Same as IN4MATX 244.

COMPSCI 244P. Introduction to the Internet of Things. 4 Units.

Develops a comprehensive understanding of the hardware and software technology, the communication protocols, and the security and privacy requirements underlying the Internet of Things ecosystem, particularly those using computing elements (processors, DSPs/ ASIPs), sensors, and accessing cloud services.

Prerequisite: Undergraduate-level familiarity with fundamentals of integrated circuit blocks, processors, optimization/algorithm design, and some programming experience.

Restriction: Graduate students only.

COMPSCI 245. Software for Embedded Systems. 4 Units.

Embedded computing elements, device interfaces, time-critical IO handling. Embedded software design under size, performance, and reliability constraints. Software timing and functional validation. Programming methods and compilation for embeddable software. Embedded runtime systems. Case studies of real-time software systems.

Prerequisite: I&C SCI 51 and COMPSCI 152 and COMPSCI 161 and (I&C SCI 6N or MATH 3A or MATH 6G or I&C SCI 6D). B.S. degree in Computer Science is also accepted.

COMPSCI 246. Dependability, Validation, and Testing of Embedded Systems. 4 Units.

Embedded system building blocks, including IP cores. Dependability and Resilience. Co-simulation. Formal verification using model checking. Verification environments. Test challenges in core integration: compliance, feature, random, and collision testing. Core access and test integration. Interface-based verification and standards.

Prerequisite: B.S. degree in Computer Science or basic courses in algorithms and data structures, calculus, discrete math, linear algebra, symbolic logic.

COMPSCI 248A. Introduction to Ubiquitous Computing. 4 Units.

The "disappearing computer" paradigm. Differences to the desktop computing model: applications, interaction in augmented environments, security, alternate media, small operating systems, sensors, and embedded systems design. Evaluation by project work and class participation.

Same as IN4MATX 241.

COMPSCI 248B. Ubiquitous Computing and Interaction. 4 Units.

Principles and design techniques for ubiquitous computing applications. Conceptual basis for tangible and embodied interaction. Interaction in virtual and augmented environments. Design methods and techniques. Design case studies. Examination by project work.

Prerequisite: IN4MATX 231 and IN4MATX 241

Same as IN4MATX 242.

COMPSCI 250A. Computer Systems Architecture. 4 Units.

Study of architectural issues and their relation to technology and software: design of processor, interconnections, and memory hierarchies.

Prerequisite: COMPSCI 152

COMPSCI 250B. Modern Microprocessors. 4 Units.

Fundamental concepts and recent advances in computer architecture necessary to understand and use modern microprocessors. Topics span out-of-order execution, multiple instruction issue, control/data speculation, predication, advanced cache and DRAM organizations, embedded systems, DSP and multi-media instructions.

Prerequisite: COMPSCI 250A

Overlaps with COMPSCI 243.

COMPSCI 250P. Computer Systems Architecture . 4 Units.

Study of architectural issues and their relation to technology and software: design of processor, interconnections, and memory hierarchies.

Prerequisite: Undergraduate-level familiarity with fundamentals of integrated circuit blocks, processors, and optimization/algorithm design, and some programming experience.

Restriction: Graduate students only.

COMPSCI 252. Introduction to Computer Design. 4 Units.

The methodology and use of CAD tools for computer design, accomplished by a lab in which students practice design using commercially available silicon compilers and other tools.

Prerequisite: COMPSCI 151 and COMPSCI 152

COMPSCI 253. Analysis of Programming Languages. 4 Units.

Concepts in modern programming languages, their interaction, and the relationship between programming languages and methods for large-scale, extensible software development. Empirical analysis of programming language usage.

Same as IN4MATX 212.

COMPSCI 253P. Advanced Programming and Problem Solving. 4 Units.

Provides in-depth preparation for industry interviews requiring demonstration of problem solving and programming skills. Emphasis is on understanding problem statements, considering edge cases, developing effective test cases, designing correct solutions, explaining these clearly, and implementing a solution correctly.

Corequisite: COMPSCI 260P

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 259S. Seminar in Design Science. 2 Units.

Current research and research trends in design science. Forum for presentation and criticism by students of research work in progress.

Repeatability: May be taken for credit 18 times.

COMPSCI 260. Fundamentals of the Design and Analysis of Algorithms. 4 Units.

Covers fundamental concepts in the design and analysis of algorithms and is geared toward non-specialists in theoretical computer science. Topics include: deterministic and randomized graph algorithms, fundamental algorithmic techniques like divide-and-conquer strategies and dynamic programming, and NP-completeness.

Prerequisite: COMPSCI 161

COMPSCI 260P. Fundamentals of Algorithms with Applications. 4 Units.

Covers fundamental concepts in the design and analysis of algorithms and is geared toward practical application and implementation. Topics include greedy algorithms, deterministic and randomized graph algorithms, models of network flow, fundamental algorithmic techniques, and NP-completeness.

Restriction: Graduate students only.

COMPSCI 261. Data Structures. 4 Units.

An in-depth treatment of data structures and their associated management algorithms including resource complexity analysis.

Prerequisite: I&C SCI 46 and COMPSCI 161

COMPSCI 261P. Data Structures with Applications . 4 Units.

Data structures and their associated management algorithms, including their applications and analysis.

Prerequisite: COMPSCI 260P

Restriction: Graduate students only.

COMPSCI 262. Computational Complexity. 4 Units.

Advanced course in computational models and complexity classes. Covers the fundamentals of Turing Machines, Decidability, and NP-completeness. Includes discussion of more advanced topics including polynomial hierarchy, randomized complexity classes, #P-completeness and hardness of approximation.

Prerequisite: COMPSCI 162

COMPSCI 262P. Automata and Grammars. 4 Units.

Principles and applications of automata, grammars, and formal languages. Topics include finite state machines, regular expressions, context-free grammars, pushdown automata, Turing machines, and the limits of computation, as well as text-processing applications in lexical analyzers and parsers.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 263. Analysis of Algorithms. 4 Units.

Analysis of correctness and complexity of various efficient algorithms; discussion of problems for which no efficient solutions are known.

Prerequisite: COMPSCI 161 and COMPSCI 261

COMPSCI 264. Quantum Computation and Information. 4 Units.

Basic models for quantum computation and their foundations in quantum mechanics. Quantum complexity classes and quantum algorithms, including algorithms for factoring and quantum simulation. Introduction to quantum information theory and quantum entanglement.

Prerequisite: Basic courses in linear algebra and algorithms.

COMPSCI 265. Graph Algorithms. 4 Units.

Graph definitions, representation methods, graph problems, algorithms, approximation methods, and applications.

Prerequisite: COMPSCI 161 and COMPSCI 261

Concurrent with COMPSCI 163.

COMPSCI 266. Computational Geometry. 4 Units.

An overview of some of the basic problems in computational geometry and of some algorithmic and data-structuring techniques appropriate to their solution.

Prerequisite: COMPSCI 161 and COMPSCI 261

COMPSCI 267P. Data Compression. 4 Units.

An introduction to the theory and practice of modern data compression techniques. Topics include codes, coding, modeling, text compression, lossless and lossy image compression standards and systems, audio compression.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 268. Introduction to Optimization. 4 Units.

A broad introduction to optimization. Unconstrained and constrained optimization. Equality and inequality constraints. Linear and integer programming. Stochastic dynamic programming.

Prerequisite: STATS 67 or (STATS 7 and STATS 120A) and (I&C SCI 6N or MATH 3A)

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

Concurrent with COMPSCI 169.

COMPSCI 268P. Introduction to Optimization Modeling . 4 Units.

A broad introduction to optimization modeling. Unconstrained and constrained optimization. Equality and inequality constraints. Linear and integer programming. Practical implementation of combinatorial optimization, metaheuristics.

Restriction: Graduate students only.

COMPSCI 269S. Seminar in the Theory of Algorithms and Data Structures. 2 Units.

Current research and research trends in the Theory of algorithms and data structures.

Repeatability: May be taken for credit 18 times.

COMPSCI 271. Introduction to Artificial Intelligence. 4 Units.

The study of theories and computational models for systems which behave and act in an intelligent manner. Fundamental subdisciplines of artificial intelligence including knowledge representation, search, deduction, planning, probabilistic reasoning, natural language parsing and comprehension, knowledge-based systems, and learning.

COMPSCI 271P. Introduction to Artificial Intelligence. 4 Units.

The study of theories and computational models for systems which behave and act in an intelligent manner. Fundamental sub-disciplines of artificial intelligence, including knowledge representation, search, deduction, planning, probabilistic reasoning, natural language parsing and comprehension, knowledge-based systems, and learning.

Restriction: Graduate students only.

COMPSCI 272. Statistical Natural Language Processing. 4 Units.

Statistical models, machine learning algorithms, and computational tasks involved in natural language processing. Focuses on approaches that learn these models from data, and covers applications such as information extraction, dialog systems, machine translation, and question answering.

Prerequisite: COMPSCI 171 and COMPSCI 178

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Graduate students only.

COMPSCI 273A. Machine Learning. 4 Units.

Computational approaches to learning algorithms for classifications, regression, and clustering. Emphasis is on discriminative classification methods such as decision trees, rules, nearest neighbor, linear models, and naive Bayes.

Prerequisite: COMPSCI 271 and COMPSCI 206

COMPSCI 273P. Machine Learning and Data Mining . 4 Units.

Introduction to principles of machine learning and data-mining. Learning algorithms for classifications, regression, and clustering. Emphasis is on discriminative classification methods such as decision trees, rules, nearest neighbor, linear models, and naive Bayes.

Prerequisite: COMPSCI 271. COMPSCI 271 with a grade of B or better. Python programming knowledge is required.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 274A. Probabilistic Learning: Theory and Algorithms. 4 Units.

An introduction to probabilistic and statistical techniques for learning from data, including parameter estimation, density estimation, regression, classification, and mixture modeling.

Prerequisite: COMPSCI 206

COMPSCI 274B. Learning in Graphical Models. 4 Units.

Models for data analysis are presented in the unifying framework of graphical models. The emphasis is on learning from data but inference is also covered. Real world examples are used to illustrate the material.

Prerequisite: COMPSCI 274A

COMPSCI 274C. Neural Networks and Deep Learning. 4 Units.

Neural network and deep learning from multiple perspectives. Theory of parallel distributed processing systems, algorithmic approaches for learning from data in various manners, applications to difficult problems in AI from computer vision, to natural language understanding, to bioinformatics and cheminformatics.

Prerequisite: (STATS 120A and STATS 120B) or MATH 121A or COMPSCI 178 or COMPSCI 273A

Overlaps with COMPSCI 274A, COMPSCI 279S, COMPSCI 277, COMPSCI 276, COMPSCI 278, COMPSCI 274B.

Concurrent with COMPSCI 172B.

COMPSCI 274P. Neural Networks and Deep Learning. 4 Units.

Introduction to principles of machine learning and neural networks. Architecture design. Feedforward and recurrent networks. Learning models and algorithms. Applications to data analysis and prediction problems in areas such as machine vision, natural language processing, biomed, and finance.

Prerequisite: COMPSCI 271P. Knowledge of Python programming is required.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 275. Network-based Reasoning/Constraint Networks. 4 Units.

Study of the theory and techniques of constraint network model. Covers techniques for solving constraint satisfaction problems: backtracking techniques, consistency algorithms, and structure-based techniques. Tractable subclasses. Extensions into applications such as temporal reasoning, diagnosis, and scheduling.

Prerequisite: Basic course in algorithm design and analysis.

COMPSCI 276. Reasoning in Probabilistic Graphical Models. 4 Units.

Focuses on algorithms for probabilistic reasoning using graphical models such as Bayesian Networks and Markov Networks that encode knowledge as local probabilistic relations. Tasks include finding most likely scenarios over a subset of variables, or updating posterior probability, given observations.

Prerequisite: A basic course in probability.

COMPSCI 277. Data Mining. 4 Units.

Introduction to the general principles of inferring useful knowledge from large data sets (commonly known as data mining or knowledge discovery). Relevant concepts from statistics, databases and data structures, optimization, artificial intelligence, and visualization are discussed in an integrated manner.

Prerequisite: COMPSCI 273A or COMPSCI 274A

COMPSCI 278. Probability Models. 4 Units.

Advanced probability, discrete time Markov chains, Poisson processes, continuous time Markov chains. Queuing or simulation as time permits.

Prerequisite: STATS 120A

Concurrent with STATS 121.

COMPSCI 284A. Representations and Algorithms for Molecular Biology. 4 Units.

Introduction to computational methods in molecular biology, aimed at those interested in learning about this interdisciplinary area. Covers computational approaches to understanding and predicting the structure, function, interactions, and evolution of DNA, RNA, proteins, and related molecules and processes.

Prerequisite: A Basic course in algorithms, or a basic course in molecular biology.

Concurrent with COMPSCI 184A.

COMPSCI 284C. Computational Systems Biology. 4 Units.

Computational inference and modeling of gene regulation networks, signal transduction pathways, and the effects of regulatory networks in cellular processes, development, and disease. Introduction of required mathematical, computational, and data handling tools.

Prerequisite: COMPSCI 284A or (BIO SCI 99 and MATH 2D)

Concurrent with COMPSCI 184C.

COMPSCI 285. Mathematical and Computational Biology . 4 Units.

Analytical and numerical methods for dynamical systems, temporal-spatial dynamics, steady state, stability, stochasticity. Application to life sciences: genetics, tissue growth and patterning, cancers, ion channels gating, signaling networks, morphogen gradients. Probabilistic methods.

Prerequisite: MATH 227A

Same as MATH 227C.

COMPSCI 290. Research Seminar. 2 Units.

Forum for presentation and criticism by students of research work in progress. Presentation of problem areas and related work. Specific goals and progress of research.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

COMPSCI 295. Special Topics in Information and Computer Science . 4 Units.

Studies in selected areas of Information and Computer Science. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

COMPSCI 296. Elements of Scientific Writing. 4 Units.

Introduces the concepts and principles of good scientific writing, demonstrates them by examples drawn from the literature, and uses a hands-on approach to apply them to documents being written by the participants.

Grading Option: Satisfactory/unsatisfactory only.

COMPSCI 296P. Capstone Professional Writing and Communication for Computer Science Careers . 6 Units.

Written and oral communication for computer science and IT careers. Production of the detailed design and development document for the concurrent capstone design class and refinement of written documents and oral communications skills needed for a successful job search.

Corequisite: COMPSCI 297P

Prerequisite: Successful completion of 24 units in the Master of Computer Science program.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 297P. Capstone Design Project for Computer Science . 6 Units.

Design and development of app, software system, or hardware component of system based on students' prior knowledge of advanced computer science principles. Implement at least a working prototype and test this using relevant use cases and/or input data.

Corequisite: COMPSCI 296P

Prerequisite: Successful completion of 24 units in the Master of Computer Science program.

Restriction: Master of Computer Science Degree students only. Graduate students only.

COMPSCI 298. Thesis Supervision. 2-12 Units.

Individual research or investigation conducted in preparation for the M.S. thesis option or the dissertation requirements for the Ph.D. program.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only. School of Information and Computer Science majors only.

COMPSCI 298P. Computer Science Practicum. 1-4 Units.

Internship in which students work individually at an outside organization to gain experience with the challenges involved in technology-related work.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: School of Info & Computer Sci students only. Master of Computer Science Degree students only. Graduate students only.

COMPSCI 299. Individual Study. 1-12 Units.

Individual research or investigation with Computer Science faculty.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only. School of Information and Computer Science majors only.

COMPSCI 299P. Individual Study. 4-8 Units.

Supervised individual study in computer science.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be taken for credit 4 times.

Restriction: Master of Computer Science Degree students have first consideration for enrollment. Graduate students only.

Informatics Courses**IN4MATX 12. Barter to Bitcoin: Society, Technology and the Future of Money. 4 Units.**

Digital money has captured the broad imagination of speculators, coders, regulators, criminals and the mass media. Course puts this change in context: how do we understand money as a social, political and technological phenomenon?.

Same as SOC SCI 11A.

(II and III).

IN4MATX 43. Introduction to Software Engineering. 4 Units.

Concepts, methods, and current practice of software engineering. Large-scale software production, software life cycle models, principles and techniques for each stage of development.

Prerequisite: I&C SCI 32

Overlaps with I&C SCI 105.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

IN4MATX 101. Concepts in Programming Languages I. 4 Units.

In-depth study of several contemporary programming languages stressing variety in data structures, operations, notation, and control. Examination of different programming paradigms, such as logic programming, functional programming and object-oriented programming; implementation strategies, programming environments, and programming style.

Prerequisite: (I&C SCI 51 or CSE 31 or EECS 31) and (I&C SCI 46 or CSE 46). I&C SCI 51 with a grade of C or better. CSE 31 with a grade of C or better. EECS 31 with a grade of C or better. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better

Same as COMPSCI 141.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

IN4MATX 102. Concepts of Programming Language II. 4 Units.

In-depth study of major programming paradigms: imperative, functional, declarative, object-oriented, and aspect-oriented. Understanding the role of programming languages in software development and the suitability of languages in context. Domain-specific languages. Designing new languages for better software development support.

Prerequisite: IN4MATX 101 or COMPSCI 141 or CSE 141. CSE 141 with a grade of C or better

IN4MATX 113. Requirements Analysis and Engineering. 4 Units.

Aims to equip students to develop techniques of software-intensive systems through successful requirements analysis techniques and requirements engineering. Students learn systematic process of developing requirements through cooperative problem analysis, representation, and validation.

Prerequisite: IN4MATX 42 or I&C SCI 22 or CSE 22 or I&C SCI 33 or CSE 43 and (IN4MATX 43 or I&C SCI 52). IN4MATX 42 with a grade of C or better. I&C SCI 22 with a grade of C or better. CSE 22 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. IN4MATX 43 with a grade of C or better. I&C SCI 52 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

IN4MATX 115. Software Testing, Analysis, and Quality Assurance. 4 Units.

Preparation for developing high-quality software through successful verification and validation techniques. Fundamental principles of software testing, implementing software testing practices, ensuring the thoroughness of testing to gain confidence in the correctness of the software.

Prerequisite: (I&C SCI 45J or I&C SCI 45C or I&C SCI 46 or CSE 46) and IN4MATX 43. I&C SCI 45J with a grade of C or better. I&C SCI 45C with a grade of C or better. I&C SCI 46 with a grade of C or better. CSE 46 with a grade of C or better. IN4MATX 43 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

IN4MATX 117. Project in Software System Design. 4 Units.

Specification, design, construction, testing, and documentation of a complete software system. Special emphasis on the need for and use of teamwork, careful planning, and other techniques for working with large systems.

Prerequisite: (IN4MATX 43 or I&C SCI 52) and (I&C SCI 33 or CSE 43 or I&C SCI 22 or CSE 22 or IN4MATX 42). I&C SCI 52 with a grade of C or better. IN4MATX 42 with a grade of C or better

Restriction: Upper-division students only.

IN4MATX 121. Software Design: Applications. 4 Units.

Introduction to application design: designing the overall functionality of a software application. Topics include general design theory, software design theory, and software architecture. Includes practice in designing and case studies of existing designs.

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

Restriction: Upper-division students only. School of Info & Computer Sci students have first consideration for enrollment.

IN4MATX 122. Software Design: Structure and Implementation. 4 Units.

Introduction to implementation design: designing the internals of a software application. Topics include design aesthetics, design implementation, design recovery, design patterns, and component reuse. Includes practice in designing and case studies of existing designs.

Prerequisite: (I&C SCI 45J or I&C SCI 46 or IN4MATX 45) and (IN4MATX 101 or COMPSCI 141 or CSE 141)

IN4MATX 123. Software Architecture. 4 Units.

Prepares students to engineer well-structured software systems. Students learn a wide range of software architectural styles, architectural platforms that provide standard services to applications, and formal architecture description languages.

Prerequisite: (IN4MATX 122 or IN4MATX 101 or COMPSCI 141 or CSE 141) and IN4MATX 113

IN4MATX 124. Internet Applications Engineering. 4 Units.

Concepts in Internet applications engineering with emphasis on the Web. Peer-to-Peer and Interoperability. Topics include HTTP and REST, Remote Procedure/Method Calls, Web Services, data representations, content distribution networks, identity management, relevant W3C/IETF standards, and relevant new large-scale computing styles.

Prerequisite: (COMPSCI 132 or EECS 148) and I&C SCI 45J

Same as COMPSCI 137.

Overlaps with COMPSCI 122B.

Restriction: Upper-division students only. School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

IN4MATX 125. Computer Game Development. 4 Units.

Introduction to the principles of interactive 2D and 3D computer game development. Concepts in computer graphics, algorithms, software engineering, art and graphics, music and sound, story analysis, and artificial intelligence are presented and are the basis for student work.

Prerequisite: COMPSCI 112 or COMPSCI 171 or IN4MATX 121 or ART 106B or I&C SCI 163 or I&C SCI 166

Same as COMPSCI 113.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

IN4MATX 131. Human Computer Interaction. 4 Units.

Basic principles of human-computer interaction (HCI). Introduces students to user interface design techniques, design guidelines, and usability testing. Students gain the ability to design and evaluate user interfaces and become familiar with some of the outstanding research problems in HCI.

Prerequisite: IN4MATX 41 or I&C SCI 10 or I&C SCI 21 or CSE 21 or I&C SCI H21 or I&C SCI 31 or CSE 41 or ENGR 10 or ENGRMAE 10 or EECS 10. IN4MATX 41 with a grade of C or better. 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. I&C SCI 31 with a grade of C or better. CSE 41 with a grade of C or better. ENGR 10 with a grade of C or better. ENGRMAE 10 with a grade of C or better. EECS 10 with a grade of C or better

Restriction: Upper-division students only.

IN4MATX 132. Project in Human-Computer Interaction Requirements and Evaluation. 4 Units.

Students undertake significant projects in the elicitation and specification of HCI requirements and the thorough evaluation of user interfaces.

Prerequisite: IN4MATX 131

IN4MATX 133. User Interaction Software. 4 Units.

Introduction to human-computer interaction programming. Emphasis on current tools, standards, methodologies for implementing effective interaction designs. Widget toolkits, Web interface programming, geo-spatial and map interfaces, mobile phone interfaces.

Prerequisite: I&C SCI 45J. I&C SCI 45J with a grade of C or better

IN4MATX 134. Project in User Interaction Software. 4 Units.

Students complete an end-to-end user interface programming project based on an iterative design paradigm. Topics may include requirements brainstorming, paper prototyping, iterative development, cognitive walk-through, quantitative evaluation, and acceptance testing. Materials fee.

Prerequisite: IN4MATX 131 and IN4MATX 133

IN4MATX 141. Information Retrieval. 4 Units.

An introduction to information retrieval including indexing, retrieval, classifying, and clustering text and multimedia documents.

Prerequisite: (I&C SCI 45C or I&C SCI 45J) and (STATS 7 or STATS 67). I&C SCI 45C with a grade of C or better. I&C SCI 45J with a grade of C or better

Same as COMPSCI 121.

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

IN4MATX 143. Information Visualization. 4 Units.

Introduction to interactive visual interfaces for large datasets, and to principles of human visual perception and human computer interaction that inform their design. Various applications for data analysis and monitoring are discussed.

Prerequisite: IN4MATX 131 or I&C SCI 52 or (IN4MATX 43 and I&C SCI 31 or CSE 41 or I&C SCI 21 or CSE 21 or IN4MATX 41). IN4MATX 131 with a grade of C or better. I&C SCI 52 with a grade of C or better. IN4MATX 43 with a grade of C or better. I&C SCI 31 with a grade of C or better. CSE 41 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. IN4MATX 41 with a grade of C or better

IN4MATX 148. Project in Ubiquitous Computing. 4 Units.

Introduction to ubiquitous computing research methods, tools, and techniques. Prototyping, design, and evaluation of physical computing applications, smart environments, embedded systems, and future computing scenarios. Includes hands-on in-class laboratory exercises. Materials fee.

Prerequisite: I&C SCI 10 or I&C SCI 21 or CSE 21 or I&C SCI 31 or CSE 41 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 31 with a grade of C or better. CSE 41 with a grade of C or better. IN4MATX 41 with a grade of C or better

Restriction: Upper-division students only.

IN4MATX 151. Project Management. 4 Units.

Introduces theoretical and practical aspects of project management. Topics include organizational theory, group behavior, project management skills, case studies, personal and group productivity tools, management of distributed work, stakeholders, consultants, and knowledge management. Students do a project exercise.

Prerequisite: IN4MATX 43 or I&C SCI 52. I&C SCI 52 with a grade of C or better

Restriction: Upper-division students only.

IN4MATX 153. Computer Supported Cooperative Work. 4 Units.

Introduces concepts and principles of collaborative systems. Topics may include shared workspaces, group interaction, workflow, architectures, interaction between social and technical features of group work, and examples of collaborative systems used in real-world settings. Students develop a simple collaborative application.

Prerequisite: (IN4MATX 161 or I&C SCI 52 or IN4MATX 43) and (I&C SCI 31 or CSE 41 or I&C SCI 21 or CSE 21 or IN4MATX 41). I&C SCI 52 with a grade of C or better. I&C SCI 31 with a grade of C or better. CSE 41 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. IN4MATX 41 with a grade of C or better

IN4MATX 161. Social Analysis of Computing. 4 Units.

Introduction of computing as a social process. Examines the social opportunities and problems raised by new information technologies, and the consequences of different ways of organizing. Topics include computing and work life, privacy, virtual communities, productivity paradox, systems risks.

Prerequisite: IN4MATX 41 or I&C SCI 10 or I&C SCI 21 or CSE 21 or I&C SCI 31 or CSE 41 or ENGR 10 or EECS 10 or ENGRMAE 10. IN4MATX 41 with a grade of C or better. 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 31 with a grade of C or better. CSE 41 with a grade of C or better. ENGR 10 with a grade of C or better. EECS 10 with a grade of C or better. ENGRMAE 10 with a grade of C or better. Satisfactory completion of the Lower-Division Writing requirement.

IN4MATX 162W. Organizational Information Systems. 4 Units.

Introduction to role of information systems in organizations, components and structure of organizational information systems, and techniques used in information systems analysis, design, and implementation.

Prerequisite: IN4MATX 161. Satisfactory completion of the Lower-Division Writing requirement.

(Ib)

IN4MATX 163. Project in the Social and Organizational Impacts of Computing . 4 Units.

Students undertake projects intended to gather and analyze data from situations in which computers are used, organize and conduct experiments intended to test hypotheses about impacts, and explore the application of concepts learned in previous courses.

Prerequisite: IN4MATX 162

IN4MATX 171. Introduction to Medical Informatics. 4 Units.

Broad overview of medical informatics for students with varied backgrounds. Electronic medical records, online resources, mobile technologies, patient safety, and computational design. Legal, ethical, and public policy issues. Health systems management. Evaluation and fieldwork for health systems.

Same as PUBHLTH 105.

Restriction: Upper-division students only.

IN4MATX 172. Project in Health Informatics. 4 Units.

Students undertake significant quarter-long projects related to health informatics. Topics may include field evaluations of health care technologies, prototypes, iterative design, and system implementations.

Prerequisite: PUBHLTH 105 or IN4MATX 171

Same as PUBHLTH 106.

IN4MATX 190. Special Topics in Informatics. 4 Units.

Studies in selected areas of informatics. Topics addressed vary each quarter.

Prerequisite: Prerequisites vary.

Repeatability: Unlimited as topics vary.

IN4MATX 191A. Senior Design Project. 4 Units.

Group supervised project in which students analyze, specify, design, construct, evaluate, and adapt a significant information processing system. Topics include team management, professional ethics, and systems analysis.

Prerequisite: IN4MATX 113 and IN4MATX 121 and IN4MATX 131 and IN4MATX 151 and IN4MATX 161

Grading Option: In Progress (Letter Grade with P/NP).

Restriction: Seniors only. Software Engineering Majors have first consideration for enrollment. Informatics Majors have first consideration for enrollment.

IN4MATX 191B. Senior Design Project. 4 Units.

Group supervised project in which students analyze, specify, design, construct, evaluate, and adapt a significant information processing system. Topics include team management, professional ethics, and systems analysis.

Prerequisite: IN4MATX 191A

Restriction: Seniors only.

IN4MATX H198. Honors Research. 4 Units.

Directed independent research in Informatics for honors students.

Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.

Repeatability: May be repeated for credit unlimited times.

Restriction: Bren School of ICS Honors students only. Campuswide Honors Program students only.

IN4MATX 199. Individual Study. 2-5 Units.

Individual research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.

IN4MATX 201. Research Methodology for Informatics. 4 Units.

Introduction to strategies and idioms of research in Informatics. Includes examination of issues in scientific inquiry, qualitative and quantitative methods, and research design. Both classic texts and contemporary research literature are read and analyzed.

IN4MATX 203. Qualitative Research Methods in Information Systems. 4 Units.

Introduction to qualitative research methods used to study computerization and information systems, such as open-ended interviewing, participant observation, and ethnography. Studies of the methods in practice through examination of research literature.

Prerequisite: IN4MATX 261 or IN4MATX 251

IN4MATX 205. Quantitative Research Methods in Information Systems. 4 Units.

Quantitative research methods used to study computerization and information systems. Design of instruments, sampling, sample sizes, and data analysis. Validity and reliability. Longitudinal versus cross-sectional designs. Analysis of secondary data. Studies of the methods through examination of research literature.

Prerequisite: IN4MATX 251 or IN4MATX 261. Basic knowledge of elementary statistics is also required.

IN4MATX 207S. Doctoral Seminar on Research and Writing. 2 Units.

Doctoral seminar centered on original research and writing. Provides a chance for doctoral students at all levels to present original work, brainstorm ongoing issues, and learn to provide and receive critical feedback from peers.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

IN4MATX 209S. Seminar in Informatics. 2 Units.

Current research and research trends in informatics. Forum for presentation and criticism by students of research work in progress.

Repeatability: Unlimited as topics vary.

IN4MATX 211. Software Engineering. 4 Units.

Study of the concepts, methods, and tools for the analysis, design, construction, and measurement of complex software-intensive systems. Underlying principles emphasized. State-of-the-art software engineering and promising research areas covered, including project management.

IN4MATX 212. Analysis of Programming Languages. 4 Units.

Concepts in modern programming languages, their interaction, and the relationship between programming languages and methods for large-scale, extensible software development. Empirical analysis of programming language usage.

Same as COMPSCI 253.

IN4MATX 213. Requirements Engineering and Specification. 4 Units.

Study of rigorous techniques in requirements engineering - requirements definition phase of software development - with focus on modeling and specification. Topics include notations and models for requirements specification; and methods, tools and processes for software requirements elicitation, representation, analysis.

Restriction: Graduate students only.

IN4MATX 215. Software Analysis and Testing. 4 Units.

Studies techniques for developing confidence in software from traditional testing schemes to integrated, multitechnique analytic approaches. Considers strengths and weaknesses and explores opportunities for synergistic technique application. Emphasis is on approaches integrated into the software process.

IN4MATX 219. Software Environments. 4 Units.

Study of the requirements, concepts, and architectures of comprehensive, integrated, software development and maintenance environments. Major topics include process support, object management, communication, interoperability, measurement, analysis, and user interfaces in the environment context.

IN4MATX 221. Software Architecture. 4 Units.

Study of the concepts, representation techniques, development methods, and tools for architecture-centric software engineering. Topics include domain-specific software architectures, architectural styles, architecture description languages, software connectors, and dynamism in architectures.

IN4MATX 223. Applied Software Design Techniques. 4 Units.

Study of concepts, representations, techniques, and case studies in structuring software systems, with an emphasis on design considerations. Topics include static and dynamic system structure, data models, abstractions, naming, protocols and application programmer interfaces.

IN4MATX 225. Information Retrieval, Filtering, and Classification. 4 Units.

Algorithms for the storage, retrieval, filtering, and classification of textual and multimedia data. The vector space model, Boolean and probabilistic queries, and relevance feedback. Latent semantic indexing; collaborative filtering; and relationship to machine learning methods.

Prerequisite: COMPSCI 161 and COMPSCI 171 and (I&C SCI 6N or MATH 3A or MATH 6G)

Same as COMPSCI 221.

Restriction: Graduate students only.

IN4MATX 231. User Interface Design and Evaluation. 4 Units.

Introduction to the design and evaluation of user interfaces, with an emphasis on methodology. Cognitive principles, design life cycle, on-line and off-line prototyping techniques. Toolkits and architectures for interactive systems. Evaluation techniques, including heuristic and laboratory methods.

IN4MATX 232. Research in Human-Centered Computing. 4 Units.

Introduction to contemporary topics in human-computer interaction, including methods, technologies, design, and evaluation. Emerging application domains and their challenges to traditional research methods. Advanced architectures and technologies. Critical issues.

Prerequisite: Some familiarity with HCI principles.

IN4MATX 233. Intelligent User Interfaces. 4 Units.

Explores example software systems and their underlying concepts that leverage computing to empower and augment human individuals in their activities. Topics span the fields of user interface design, human-computer interaction, software engineering, and cognitive computing.

Prerequisite: COMPSCI 171

IN4MATX 235. Advanced User Interface Architecture. 4 Units.

Architectural concerns in advanced interactive systems. The design of current and emerging platforms for novel interactive systems. Paradigms such as constraint-based programming, multimodal interaction, and perceptual user interfaces for individual, distributed, and ubiquitous applications.

IN4MATX 237. Usable Security and Privacy. 4 Units.

Introduces usability problems in security and privacy methods, tools, and software. Overviews prominent examples of both failures and successes in usable security and privacy. Surveys state-of-the-art techniques and evaluation methodologies.

Same as COMPSCI 204.

Overlaps with IN4MATX 231, COMPSCI 203.

Restriction: Informatics Majors have first consideration for enrollment. Computer Science Majors have first consideration for enrollment. Undergraduate degree in CompSci or Informatics is strongly recommended.

IN4MATX 241. Introduction to Ubiquitous Computing. 4 Units.

The "disappearing computer" paradigm. Differences to the desktop computing model: applications, interaction in augmented environments, security, alternate media, small operating systems, sensors, and embedded systems design. Evaluation by project work and class participation.

Same as COMPSCI 248A.

IN4MATX 242. Ubiquitous Computing and Interaction. 4 Units.

Principles and design techniques for ubiquitous computing applications. Conceptual basis for tangible and embodied interaction. Interaction in virtual and augmented environments. Design methods and techniques. Design case studies. Examination by project work.

Prerequisite: IN4MATX 231 and IN4MATX 241

Same as COMPSCI 248B.

IN4MATX 244. Introduction to Embedded and Ubiquitous Systems. 4 Units.

Embedded and ubiquitous system technologies including processors, DSP, memory, and software. System interfacing basics; communication strategies; sensors and actuators, mobile and wireless technology. Using pre-designed hardware and software components. Design case studies in wireless, multimedia, and/or networking domains.

Prerequisite: I&C SCI 51 and COMPSCI 152 and COMPSCI 161 and (I&C SCI 6N or MATH 3A or MATH 6G or I&C SCI 6D). B.S. degree in Computer Science is also accepted.

Same as COMPSCI 244.

IN4MATX 251. Computer-Supported Cooperative Work. 4 Units.

The role of information systems in supporting work in groups and organizations. Examines various technologies designed to support communication, information sharing, and coordination. Focuses on behavioral and social aspects of designing and using group support technologies.

IN4MATX 261. Social Analysis of Computing. 4 Units.

The social and economic impacts of computing and information technologies on groups, organizations, and society. Topics include computerization and changes in the character of work, social control and privacy, electronic communities, and risks of safety-critical systems to people.

IN4MATX 263. Computerization, Work, and Organizations. 4 Units.

Selected topics in the influence of computerization and information systems in transforming work and organizations. Theories of organization and organizational change. Processes by which diverse information technologies influence changes in work and organizations over short and long time periods.

Prerequisite: IN4MATX 251 or IN4MATX 261

IN4MATX 265. Theories of Information Society . 4 Units.

Social and economic conceptions of information technology. Macrosocial and economic conditions that foster changes in information technologies. Social construction of information and computer technology in professional worlds. Theories of information technology and large-scale social change.

Prerequisite: IN4MATX 251 or IN4MATX 261

IN4MATX 267. Digital Media and Society. 4 Units.

Selected topics in the technological and social aspects of online interactions, and policy including online games, social media, electronic activism, e-commerce, and digital libraries. Media-theoretic approaches to digital technology. Architectures, infrastructure considerations, and their consequences.

Prerequisite: IN4MATX 251 or IN4MATX 261

IN4MATX 269. Computer Law. 4 Units.

The American legal system and its provisions affecting computer systems, computer networks, and information processing. Intellectual property, contracts, privacy, liability for malfunction, computer crime, constitutional issues, transborder data flow, computer-based evidence, and litigation.

Restriction: Graduate students only.

IN4MATX 273. Information Technology in Global Sustainability. 4 Units.

Explores the relationship between recent developments in information technology and the global transition to sustainability. Topics include the role of IT systems in the provision of human needs and wants (e.g., smart grids, food systems, and other IT-enabled infrastructure).

Restriction: Graduate students only.

IN4MATX 280. Overview of Human-Computer Interaction and Design . 4 Units.

Introduction to human-computer interaction and user-centered design. The material is focused on laying the groundwork for understanding the history, importance, and methods of human-computer interaction and design.

IN4MATX 281. User Needs Analysis . 4 Units.

Understanding the user's context, needs, and preferences. Topics include interviews and observations, modeling the context, flow, culture, space and artifacts involved in an endeavor, ways of aggregating what is found, and presenting these findings to others.

Prerequisite: IN4MATX 280

IN4MATX 282. Design and Prototyping . 4 Units.

Introduction to user-centered design and prototyping. Focused on practical methods for interaction design. Topics include the nature of design and the challenges to creating and evaluating good designs, as well specific skills for designing interactive systems.

Prerequisite: IN4MATX 280

IN4MATX 283. User Experience Evaluation . 4 Units.

Evaluating prototypes and completed systems. Topics include comparative analysis, laboratory experiments, heuristic evaluation, cognitive walkthroughs, surveys, clickstreams, and help-desk.

Prerequisite: IN4MATX 280

IN4MATX 284. Advanced Design and Prototyping . 4 Units.

Develop and communicate interactive technology design prototypes. Moving concepts from brainstorming and paper prototypes to wireframe and limited functionality mock-ups.

Prerequisite: IN4MATX 282

IN4MATX 285. Interactive Technology Studio . 4 Units.

Technologies, languages, and skills required for creating prototypes to communicate interactive technology concepts. Topics include HTTP, CSS, CSS scripting, AJAX, Design Patterns, Javascript, Javascript libraries such as jQuery, SQL, MVC, and cloud architectures.

Prerequisite: IN4MATX 280

IN4MATX 286. Innovations in HCI and Design . 4 Units.

Recent social and technological developments in human-computer interaction and design. Topics will vary as the field progresses but include novel input techniques, novel platforms, and innovations in theory and methods of design.

Prerequisite: IN4MATX 280

IN4MATX 287. Capstone Project in HCI and Design . 4 Units.

Group project that reinforces all concepts learned in this program, including knowing where user experience work is most appropriate and essential, and executing the appropriate steps.

Prerequisite: IN4MATX 283 and IN4MATX 284

IN4MATX 288. Capstone Project and Portfolio . 4 Units.

Completion of capstone projects and development of portfolios. Ideation, critique, development, and critique.

Prerequisite: IN4MATX 287

IN4MATX 290. Research Seminar. 2 Units.

Forum for presentation and criticism by students of research work in progress. Presentation of problem areas and related work. Specific goals and progress of research.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

IN4MATX 291S. Literature Survey in Software Engineering. 2 Units.

Reading and analysis of relevant literature in Software Engineering under the direction of a faculty member.

Repeatability: May be repeated for credit unlimited times.

IN4MATX 295. Special Topics in Informatics. 4 Units.

Studies in selected areas of informatics. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

IN4MATX 298. Thesis Supervision. 2-12 Units.

Individual research or investigation conducted in preparation for the M.S. thesis option or the dissertation requirements for the Ph.D. program.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

IN4MATX 299. Individual Study. 1-12 Units.

Individual research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

Information and Computer Sci 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.

(III)

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

Principles of human-computer interaction in evaluating, designing, and developing information presented on the World Wide Web. User characteristics, usability analysis, navigation and organization. Color, typography, multimedia, information visualization, prototyping, user studies, evaluation strategies. Web accessibility.

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

(II)

I&C SCI 5. Global Disruption and Information Technology. 4 Units.

Explores how new forms of information technology may support transition to a sustainable civilization. Topics include design and implementation of IT systems, science of global change, online community building, and "green IT". Activities involve reading, writing, discussion, and final project.

(II)

I&C SCI 6B. Boolean Logic and Discrete Structures. 4 Units.

Relations and their properties; Boolean algebras, formal languages; finite automata.

Prerequisite: High school mathematics through trigonometry.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(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: Recommended: I&C SCI 6B

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment. Computer Engineering majors have second consideration.

(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 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 20. Invitation to Computing. 4 Units.

Foundational principles of computer science for students with no computing background that are interested in a related career. Big ideas of computing explored, including programming through use of sequential, conditional, iterative logic. Good computational practices, problem solving, and organization discussed.

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 pragmatics of programming.

Overlaps with EECS 10, EECS 12, ENGRMAE 10.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(II and VB).

I&C SCI 32. Programming with Software Libraries. 4 Units.

Construction of programs for problems and computing environments more varied than in I&C SCI 31. Using library modules for applications such as graphics, sound, GUI, database, Web, and network programming. Language features beyond those in I&C SCI 31 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

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(II and (VA or VB)).

I&C SCI 32A. Python Programming and Libraries (Accelerated). 4 Units.

Introduces Python syntax and semantics for fundamental programming concepts. Constructing programs for varied problems and environments. Using library modules for applications such as graphics, sound, GUI, database, Web, and network programming. Accelerated course for students with previous programming background.

Prerequisite: AP Computer Science A. AP Computer Science A with a minimum score of 3. Placement via a transfer course in computer programming or equivalent experience may also be accepted upon review.

Overlaps with I&C SCI 31, I&C SCI 32.

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(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

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(II and VB).

I&C SCI 45C. Programming in C/C++ as a Second Language. 4 Units.

An introduction to the lexical, syntactic, semantic, and pragmatic characteristics of the C/C++ languages for experienced programmers. Emphasis on object-oriented programming, using standard libraries, and programming with manual garbage collection.

Prerequisite: I&C SCI 33 or CSE 43 or EECS 40. I&C SCI 33 with a grade of C or better. CSE 43 with a grade of C or better. EECS 40 with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

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. CSE 45C with a grade of C or better. I&C SCI 45C with a grade of C or better

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment.

(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.

Prerequisite: (I&C SCI 21 or CSE 21 or I&C SCI 31 or CSE 41 or IN4MATX 42) and I&C SCI 6B. IN4MATX 42 with a grade of C or better

(II)**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.

Prerequisite: Satisfaction of the UC Entry Level Writing Requirement.

(III)**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.

(II)**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 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.

(Ib)**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 CSE 45C

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

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 or corequisite: I&C SCI 33 and (I&C SCI 6N or MATH 3A) and I&C SCI 61

Restriction: School of Info & Computer Sci students have first consideration for enrollment.

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 Systems. 4 Units.

Foundations and technologies that enable multiuser, networked, and persistent virtual environments. Emphasis on database design and management, network protocols, and concurrency control to accommodate large numbers of simultaneous users.

Prerequisite: I&C SCI 51

I&C SCI 168. Multiplayer Game Project. 4 Units.

Designing and implementing a multiuser, 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 (Letter Grade with P/NP).

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 students only. 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: I&C SCI 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.

Statistics Courses

STATS 5. Seminar in Data Science. 1 Unit.

An introduction to the field of Data Science; intended for entering freshman and transfers.

Grading Option: Pass/no pass only.

Restriction: Information Computer Science Majors only.

STATS 7. Basic Statistics. 4 Units.

Introduces basic inferential statistics including confidence intervals and hypothesis testing on means and proportions, t-distribution, Chi Square, regression and correlation. F-distribution and nonparametric statistics included if time permits.

Overlaps with STATS 8, MGMT 7, SOCECOL 13.

Restriction: STATS 7 may not be taken for credit concurrently with or after STATS 110, STATS 111, STATS 112.

(Va)

STATS 8. Introduction to Biological Statistics . 4 Units.

Introductory statistical techniques used to collect and analyze experimental and observational data from health sciences and biology. Includes exploration of data, probability and sampling distributions, basic statistical inference for means and proportions, linear regression, and analysis of variance.

Overlaps with SOCECOL 13, MGMT 7, STATS 7.

Restriction: STATS 8 may not be taken for credit concurrently with or after STATS 110, STATS 111, STATS 112.

(Va)

STATS 67. Introduction to Probability and Statistics for Computer Science. 4 Units.

Introduction to the basic concepts of probability and statistics with discussion of applications to computer science.

Prerequisite: MATH 2B

Restriction: School of Info & Computer Sci students have first consideration for enrollment. Computer Science Engineering Majors have first consideration for enrollment. STATS 67 may not be taken for credit concurrently with or after STATS 120B.

(Va)

STATS 68. Statistical Computing and Exploratory Data Analysis. 4 Units.

Introduces key concepts in statistical computing. Techniques such as exploratory data analysis, data visualization, simulation, and optimization methods, will be presented in the context of data analysis within a statistical computing environment.

Prerequisite: STATS 7 and I&C SCI 31

STATS 110. Statistical Methods for Data Analysis I. 4 Units.

Introduction to statistical methods for analyzing data from experiments and surveys. Methods covered include two-sample procedures, analysis of variance, simple and multiple linear regression.

Prerequisite: STATS 7 or STATS 8 or AP90 or (STATS 120A and STATS 120B and STATS 120C). AP90 with a minimum score of 3

Restriction: School of Info & Computer Sci students only.

STATS 111. Statistical Methods for Data Analysis II. 4 Units.

Introduction to statistical methods for analyzing data from surveys or experiments. Emphasizes application and understanding of methods for categorical data including contingency tables, logistic and Poisson regression, loglinear models.

Prerequisite: STATS 110

Concurrent with STATS 202.

STATS 112. Statistical Methods for Data Analysis III. 4 Units.

Introduction to statistical methods for analyzing longitudinal data from experiments and cohort studies. Topics covered include survival methods for censored time-to-event data, linear mixed models, non-linear mixed effects models, and generalized estimating equations.

Prerequisite: STATS 111

Concurrent with STATS 203.

STATS 115. Introduction to Bayesian Data Analysis. 4 Units.

Basic Bayesian concepts and methods with emphasis on data analysis. Special emphasis on specification of prior distributions. Development for one-two samples and on to binary, Poisson, and linear regression. Analyses performed using free OpenBUGS software.

Prerequisite: STATS 120C. Recommended: STATS 110.

Concurrent with STATS 205.

STATS 120A. Introduction to Probability and Statistics I. 4 Units.

Introduction to basic principles of probability and statistical inference. Axiomatic definition of probability, random variables, probability distributions, expectation.

Prerequisite: MATH 2A and MATH 2B and (MATH 2D or MATH 4)

Overlaps with MATH 130A.

Restriction: Data Science Majors have first consideration for enrollment. Quantitative Economics majors have second consideration.

Concurrent with STATS 281A.

STATS 120B. Introduction to Probability and Statistics II. 4 Units.

Introduction to basic principles of probability and statistical inference. Point estimation, interval estimating, and testing hypotheses, Bayesian approaches to inference.

Prerequisite: STATS 120A

Restriction: Data Science Majors have first consideration for enrollment. Quantitative Economics majors have second consideration.

Concurrent with STATS 281B.

STATS 120C. Introduction to Probability and Statistics III. 4 Units.

Introduction to basic principles of probability and statistical inference. Linear regression, analysis of variance, model checking.

Prerequisite: STATS 120B and (MATH 3A or MATH 6G or I&C SCI 6N)

Restriction: Data Science Majors have first consideration for enrollment. Quantitative Economics majors have second consideration.

Concurrent with STATS 281C.

STATS 140. Multivariate Statistical Methods. 4 Units.

Theory and application of multivariate statistical methods. Topics include statistical inference for the multivariate normal model and its extensions to multiple samples and regression, use of statistical packages for data visualization and reduction, discriminant analysis, cluster analysis, and factor analysis.

Prerequisite: STATS 120C and (MATH 3A or I&C SCI 6N)

Concurrent with STATS 240.

STATS 170A. Project in Data Science I. 4 Units.

Problem definition and analysis, data representation, algorithm selection, solution validation, and results presentation. Students do team projects and lectures cover analysis alternatives, project planning, and data analysis issues. First quarter emphasizes approach selection, project planning, and experimental design.

Prerequisite: STATS 68 and STATS 112 and IN4MATX 43 and COMPSCI 122A and COMPSCI 161 and COMPSCI 178

Grading Option: In Progress (Letter Grade with P/NP).

Restriction: Seniors only. Data Science Majors have first consideration for enrollment.

STATS 170B. Project in Data Science II. 4 Units.

Problem definition and analysis, data representation, algorithm selection, solution validation, and results presentation. Students do team projects and lectures cover analysis alternatives, project planning, and data analysis issues. Second quarter emphasizes project execution and analysis, and presentation of results.

Prerequisite: STATS 170A

Restriction: Seniors only. Data Science Majors have first consideration for enrollment.

STATS 199. Individual Study. 2-5 Units.

Individual research or investigations under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.

STATS 200A. Intermediate Probability and Statistical Theory. 4 Units.

Basics of probability theory, random variables and basic transformations, univariate distributions—discrete and continuous, multivariate distributions.

Prerequisite: STATS 120C

STATS 200B. Intermediate Probability and Statistical Theory. 4 Units.

Random samples, transformations, limit laws, normal distribution theory, introduction to stochastic processes, data reduction, point estimation (maximum likelihood).

Prerequisite: STATS 200A

STATS 200C. Intermediate Probability and Statistical Theory. 4 Units.

Interval estimation, hypothesis testing, decision theory and Bayesian inference, basic linear model theory.

Prerequisite: STATS 200B

STATS 201. Statistical Methods for Data Analysis I. 4 Units.

Introduction to statistical methods for analyzing data from experiments and surveys. Methods covered include two-sample procedures, analysis of variance, simple and multiple linear regression.

Prerequisite: STATS 7 or STATS 8

Restriction: STATS 201 cannot be taken for credit after taking STATS 210.

STATS 202. Statistical Methods for Data Analysis II. 4 Units.

Introduction to statistical methods for analyzing data from surveys or experiments. Emphasizes application and understanding of methods for categorical data including contingency tables, logistic and Poisson regression, loglinear models.

Prerequisite: STATS 201 or STATS 210

Concurrent with STATS 111.

STATS 203. Statistical Methods for Data Analysis III. 4 Units.

Introduction to statistical methods for analyzing longitudinal data from experiments and cohort studies. Topics covered include survival methods for censored time-to-event data, linear mixed models, non-linear mixed effects models, and generalized estimating equations.

Prerequisite: STATS 202

Concurrent with STATS 112.

STATS 205. Introduction to Bayesian Data Analysis. 4 Units.

Basic Bayesian concepts and methods with emphasis on data analysis. Special emphasis on specification of prior distributions. Development for one-two samples and on to binary, Poisson and linear regression. Analyses performed using free OpenBugs software.

Prerequisite: STATS 120C. Recommended: STATS 201 or STATS 210.

Concurrent with STATS 115.

STATS 210. Statistical Methods I: Linear Models. 4 Units.

Statistical methods for analyzing data from surveys and experiments. Topics include randomization and model-based inference, two-sample methods, analysis of variance, linear regression and model diagnostics.

Prerequisite: Knowledge of basic statistics, calculus, linear algebra.

STATS 210A. Statistical Methods I: Linear Models. 4 Units.

Statistical methods for analyzing data from surveys and experiments. Topics include randomization and model-based inference, two-sample methods, analysis of variance, linear regression, and model diagnostics.

Prerequisite: Knowledge of basic statistics (at the level of STATS 7), calculus, and linear algebra.

Restriction: Graduate students only.

STATS 210B. Statistical Methods II: Categorical Data. 4 Units.

Introduction to statistical methods for analyzing discrete and non-normal outcomes. Emphasizes the development and application of methods for categorical data, including contingency tables, logistic and Poisson regression, loglinear models.

Prerequisite: STATS 210. May not be taken for graduate credit by Ph.D. students in Statistics.

Restriction: Graduate students only.

STATS 210C. Statistical Methods III: Longitudinal Data. 4 Units.

Introduction to statistical methods for analyzing longitudinal outcomes. Emphasizes the development and application of regression methods for correlated and censored outcomes. Methods for continuous and discrete correlated outcomes, as well as censored outcomes, are covered.

Prerequisite: STATS 210B. May not be taken for graduate credit by Ph.D. students in Statistics.

Restriction: Graduate students only.

STATS 211. Statistical Methods II: Generalized Linear Models. 4 Units.

Development of the theory and application of generalized linear models. Topics include likelihood estimation and asymptotic distributional theory for exponential families, quasi-likelihood and mixed model development. Emphasizes methodological development and application to real scientific problems.

Prerequisite or corequisite: STATS 210

STATS 212. Statistical Methods III: Methods for Correlated Data. 4 Units.

Development and application of statistical methods for analyzing corrected data. Topics covered include repeated measures ANOVA, linear mixed models, non-linear mixed effects models, and generalized estimating equations. Emphasizes both theoretical development and application of the presented methodology.

Prerequisite: STATS 211

STATS 220A. Advanced Probability and Statistics Topics. 4 Units.

Advanced topics in probability and statistical inference including measure theoretic probability, large sample theory, decision theory, resampling and Monte Carlo methods, nonparametric methods.

Prerequisite: STATS 200C

STATS 220B. Advanced Probability and Statistics Topics. 4 Units.

Advanced topics in probability and statistical inference, including measure theoretic probability, large sample theory, decision theory, resampling and Monte Carlo methods, nonparametric methods.

Prerequisite: STATS 220A and MATH 140B

STATS 225. Bayesian Statistical Analysis. 4 Units.

Introduction to the Bayesian approach to statistical inference. Topics include univariate and multivariate models, choice of prior distributions, hierarchical models, computation including Markov chain Monte Carlo, model checking, and model selection.

Prerequisite: STATS 205 and STATS 230

STATS 226. Advanced Topics in Modern Bayesian Statistical Inference. 4 Units.

Modern Bayesian Statistics: selected topics from theory of Markov chains, application of theory to modern methods of Markov chain Monte Carlo sampling; Bayesian non-parametric and semiparametric modeling, including Dirichlet Process Mixtures; Mixtures of Polya Trees.

Prerequisite: STATS 200C and STATS 225

STATS 230. Statistical Computing Methods. 4 Units.

Numerical computations and algorithms with applications in statistics. Topics include optimization methods including the EM algorithm, random number generation and simulation, Markov chain simulation tools, and numerical integration.

Prerequisite: Two quarters of upper-division or graduate training in probability and statistics.

Overlaps with COMPSCI 206.

STATS 235. Modern Data Analysis Methods . 4 Units.

Introduces selected modern tools for data analysis. Emphasizes use of computational and resampling techniques for data analyses when the data do not conform to standard toolbox of regression models and/or complexity of modeling problem threatens validity of standard methods.

Prerequisite: STATS 120C and STATS 205 and (STATS 201 or STATS 210)

Restriction: Graduate students only.

STATS 240. Multivariate Statistical Methods. 4 Units.

Theory and application of multivariate statistical methods. Topics include statistical inference for the multivariate normal model and its extensions to multiple samples and regression, use of statistical packages for data visualization and reduction, discriminant analysis, cluster analysis, and factor analysis.

Prerequisite: STATS 120C and (MATH 3A or I&C SCI 6N)

Concurrent with STATS 140.

STATS 245. Time Series Analysis. 4 Units.

Statistical models for analysis of time series from time and frequency domain perspectives. Emphasizes theory and application of time series data analysis methods. Topics include ARMA/ARIMA models, model identification/estimation, linear operators, Fourier analysis, spectral estimation, state space models, Kalman filter.

Corequisite: STATS 200C

Prerequisite or corequisite: STATS 201 or STATS 210

STATS 246. Spectral Analysis . 4 Units.

Spectral methods that are most commonly utilized for analyzing univariate and multivariate time series and signals. These methods include spectral and coherence estimation, transfer function modeling, classification and discrimination of time series, non-stationary time series, time-frequency analysis, and wavelets analysis.

Prerequisite: STATS 200B and (STATS 201 or STATS 210)

STATS 250. Biostatistics. 4 Units.

Statistical methods commonly used to analyze data arising from clinical studies. Topics include analysis of observational studies and randomized clinical trials, techniques in the analysis of survival and longitudinal data, approaches to handling missing data, meta-analysis, nonparametric methods.

Prerequisite: STATS 210

STATS 255. Statistical Methods for Survival Data. 4 Units.

Statistical methods for analyzing survival data from cohort studies. Topics include parametric and nonparametric methods, the Kaplan-Meier estimator, log-rank tests, regression models, the Cox proportional hazards model and accelerated failure time models, efficient sampling designs, discrete survival models.

Corequisite: STATS 202 or STATS 211.

Prerequisite: STATS 210

STATS 257. Introduction to Statistical Genetics. 4 Units.

Provides students with knowledge of the basic principles, concepts, and methods used in statistical genetic research. Topics include principles of population genetics, and statistical methods for family- and population-based studies.

Prerequisite: Two quarters of upper-division or graduate training in statistical methods.

Same as EPIDEM 215.

STATS 260. Inference with Missing Data. 4 Units.

Statistical methods and theory useful for analysis of multivariate data with partially observed variables. Bayesian and likelihood-based methods developed. Topics include EM-type algorithms, MCMC samplers, multiple imputation, and general location model. Applications from economics, education, and medicine are discussed.

Prerequisite or corequisite: STATS 210 or STATS 200C. STATS 230.

STATS 262. Theory and Practice of Sample Surveys. 4 Units.

Basic techniques and statistical methods used in designing surveys and analyzing collected survey data. Topics include simple random sampling, ratio and regression estimates, stratified sampling, cluster sampling, sampling with unequal probabilities, multistage sampling, and methods to handle nonresponse.

Prerequisite: STATS 120C

STATS 265. Causal Inference. 4 Units.

Various approaches to causal inference focusing on the Rubin causal model and propensity-score methods. Topics include randomized experiments, observational studies, non-compliance, ignorable and non-ignorable treatment assignment, instrumental variables, and sensitivity analysis. Applications from economics, politics, education, and medicine.

Prerequisite: STATS 200C and STATS 210

STATS 270. Stochastic Processes. 4 Units.

Introduction to the theory and application of stochastic processes. Topics include Markov chains, continuous-time Markov processes, Poisson processes, and Brownian motion. Applications include Markov chain Monte Carlo methods and financial modeling (for example, option pricing).

Prerequisite: STATS 120C

Overlaps with MATH 271A, MATH 271B, MATH 271C.

STATS 275. Statistical Consulting. 4 Units.

Training in collaborative research and practical application of statistics. Emphasis on effective communication as it relates to identifying scientific objectives, formulating a statistical analysis plan, choice of statistical methods, and interpretation of results and their limitations to non-statisticians.

Prerequisite: STATS 203 or STATS 212

Repeatability: May be taken for credit 2 times.

STATS 280. Seminar in Statistics. 0.5 Units.

Periodic seminar series covering topics of current research in statistics and its application.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

STATS 281A. Introduction to Probability and Statistics I. 4 Units.

Introduction to basic principles of probability and statistical inference. Axiomatic definition of probability, random variables, probability distributions, expectation.

Restriction: Graduate students only.

Concurrent with STATS 120A.

STATS 281B. Introduction to Probability and Statistics II. 4 Units.

Introduction to basic principles of probability and statistical inference. Point estimation, interval estimating, and testing hypotheses, Bayesian approaches to inference.

Restriction: Graduate students only.

Concurrent with STATS 120B.

STATS 281C. Introduction to Probability and Statistics III. 4 Units.

Introduction to basic principles of probability and statistical inference. Contingency table analysis, linear regression, analysis of variance, model checking.

Restriction: Graduate students only.

Concurrent with STATS 120C.

STATS 295. Special Topics in Statistics. 4 Units.

Studies in selected areas of statistics. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

STATS 298. Thesis Supervision. 2-12 Units.

Individual research or investigation conducted in preparation for the M.S. thesis option or the dissertation requirements for the Ph.D. program.

Repeatability: May be repeated for credit unlimited times.

STATS 299. Individual Study. 2-12 Units.

Individual research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.