Course Catalog

Computer Science

Faculty

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Overview

The department offers several programs designed to serve a range of student interests and needs:

- The Bachelor of Science in Computer Science is a four-year degree program intended to prepare students for either a career requiring a thorough background in the field or for graduate school. It is modeled to some extent on the curricular recommendations of the Association for Computing Machinery (ACM) and provides both considerable breadth and depth.
- Computing as a Second Major is also a four-year degree program, but one that (like the Interdisciplinary Second Major) cannot serve as a primary (stand-alone) major. It is intended for students whose primary interest is in another field but who also need or want thorough preparation in using computers. Such students will combine a primary major in the chosen field with Computing as a Second Major.
- The Minor in Computer Science is designed to provide students with elementary skills in computing as well as a substantial computing background for graduate studies in fields where computers have become primary research tools.
- The Minor in Management Information Systems is intended for business-oriented students and is designed to give them the technical background needed to manage and transmit information through the use of computers.

Requirements

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Bachelor of Science in Computer Science

Requirements for the degree of Bachelor of Science with a major in Computer Science are as follows:

I. Departmental requirements: 49 credit hours including:

    A. Core Principles: CSCI 1120, 1320, 1321, 1323, 2320, 2321, 2322, 3320, 3321, 3322.

    B. Departmental Colloquium: Four semesters of CSCI 2094.

    C. Curricular Groups: At least three hours from each of the following groups:

        i. Applications Group: CSCI 3311, 3342, 3343, 3344, 3352, 3353, 3366, 3-95
        ii. Systems Group: CSCI 3323, 3-96
        iii. Design Group: CSCI 3312, 3345, 3362, 3-97

    D. Capstone: One of the following options:

        i. Senior Software Project: CSCI 4385 and 4386.
        ii. Senior Thesis: CSCI 3398, 4398, and 4399 plus additional requirements listed in the section "Senior Thesis" below.

    E. Electives: Additional upper-division computer science hours sufficient to total at least 49 credit hours.

II. Mathematics requirement:

Six hours from the following: any MATH course (excluding 1301, 1310, 1330, 3194, 3195); CSCI 2324; PHIL 3340, 3343.

III. University requirements: completion of all other required elements of the Pathways curriculum and at least 120 hours.

Computing as a Second Major

The requirements for Computing as a Second major are as follows:

I. Completion of a first major from another department.

II. Departmental requirements: 34 hours of computer science including:

    A. Required courses: CSCI 1120, 1320, 1321, 1323, 2320.
    B. Departmental Colloquium: two semesters of CSCI 2094.
    C. 21 additional hours of computer science including at least 18 upper-division hours.

III. Mathematics requirement:

Six hours from the following: any MATH Course (except 1301, 1310, 1330, 3194, 3195); CSCI 2324; PHIL 3340, 3343; PSYC 2401; BAT 2301. At most one of the following courses may be counted for this requirement: MATH 1320, PSYC 2401, and BUSN 2301.

IV. University requirements: completion of all other required elements of the Pathways curriculum and at least 120 credit hours.

Minor in Computer Science

The requirements for the Minor in Computer Science are as follows:

I. Departmental requirements: 22 hours of Computer Science including:

    A. Required courses: CSCI 1120, 1320, 1321, 1323, 2320.;
    B. Departmental Colloquium: one semester of CSCI 2094;
    C. Nine additional hours of upper division Computer Science

II. Mathematics requirement: As described for Computing as a Second Major.

Minor in Management Information Systems

The requirements for the Minor in Management Information Systems are:

I. Completion of a B.A., B.S., or minor in Business Administration.

II. Departmental requirements: 16 hours of Computer Science including:

    A. CSCI 1120, 1320, 1321, 2320;
    B. Departmental Colloquium: one semester of CSCI 2094;
    C. Two upper division Computer Science courses from the following list: CSCI 3311, 3321, 3342, 3343, 3345

Senior Thesis

Requirements:

I. Overall grade point average of 3.0 or better at the time the thesis option is selected.

II. Grade point average in computer science of 3.0 or better at the time the thesis option is selected.

III. Successful completion of CSCI 3398, and 4399 (normally taken in consecutive semesters beginning in the Spring semester of the junior year).

IV. Selection of a faculty committee consisting of a thesis chair chosen from the computer science faculty and two additional faculty members during the semester in which CSCI 3398 is taken.

V. A public formal presentation and defense of the thesis during the semester in which CSCI 4399 is taken.

Honors in Computer Science

To be eligible for the distinction of graduation with Honors in Computer Science the requirements are:

I. Completion of the requirements for the Bachelor of Science in Computer Science.

II. Completion of the requirements for the Senior Thesis described above.

III. Grade point average of at least 3.33 or better in all courses prior to the semester of graduation.

IV. Grade point average of 3.33 or better in all computer science courses prior to the semester of graduation.

V. A written request for honors consideration, submitted to the department chair in the semester prior to the semester of graduation.

The decision of whether or not to confer the honors designation will be made by the departmental faculty and will be determined by departmental vote. The criteria include quality of the written thesis, quality of the oral presentation, and contribution to the field.

When a thesis receives the honors designation, this designation is so noted on the student's transcript and announced at graduation.

Students who successfully complete CSCI 4399 with a grade of C or better, but fail to achieve honors status or fail to meet the deadline for submitting a thesis for departmental honors will be considered to have met the capstone requirement for the Bachelor of Science in Computer Science provided that they submit a completed thesis by the end of the semester.

Courses

CSCI-1120 Low-Level Computing

Seminar on concepts of computing that are close to the machine level. The course teaches skills such as command line processing and programming in a language that exposes more of the underlying machine. Internal data representations will also be explored. Prerequisite: CSCI 1311 or 1320, or consent of instructor

CSCI-1300 Essential Information Technology

Introduction to computers and technology in an academic environment, including critical analysis regarding the nature of information itself. Computing hardware, software, files, and formats. Text processing and quantitative analysis. Information management. Graphics, image processing, and visualization. Communication, networking, and the internet. Information ethics, privacy, and legal use of software and data. Solution of problems in these areas with emphasis on information literacy. No credit after completion of CSCI 1321.

CSCI-1304 Computers and Society

An examination of the impact of computer technology on issues of society and culture. The course will contain several components: an introduction to computing (software and hardware concepts); an introduction to problem-solving using one or more high-level languages/software applications to include information retrieval and processing (numeric, text, and graphics); computer communications; and discussions of the uses and ethical issues surrounding computers in our society. No credit after completion of CSCI 1300, 1320 or 1321.

CSCI-1311 Introduction to Programming Logic

Introduction to the basics of computer programming and algorithmic thinking for non-science majors. The course focuses on the logic and problem decomposition skills that are critical for understanding computation. Use of a high-level programming language will stress creativity in problem solving using computation, and impart a hands-on understanding of the process of programming. The course will cover many of the most important concepts in programming and computer science, including choice, repetition, and abstraction. No prior experience in programming is necessary. This course assumes familiarity with high school algebra, geometry, and trigonometry.

CSCI-1312 Introduction to Programming for Engineering

Introduction to programming and algorithmic thinking, taught using tools that emphasize an understanding of the hardware. Top-down design and analysis of algorithms. Computer organization and data representation. Computer programming solutions to several laboratory exercises.

CSCI-1320 Principles of Computer Science I

Intended for Computer Science majors and others who need this specific course to meet requirements in other departments. The course is a concept--oriented introduction to programming and algorithmic problem solving principles. Topics include top--down design; searching and sorting strategies; recursion; computational complexity and analysis of algorithms; and the limits of computation. Aspects of computer organization; computer solutions to problems in graphics, user interfaces, and file manipulation. Computer programming solutions to several laboratory exercises. Prerequisites: First--Year or Sophomore standing; or consent of instructor.

CSCI-1321 Principles of Computer Science II

Focus on object-oriented programming and the development of software to solve larger problems that can benefit from this approach. Abstraction, polymorphism, multithreading, and networking. Program correctness and program verification, algorithm analysis, and computational complexity. User defined structures, data types. Abstract data types including stacks, queues, linked lists, trees, and heaps. Computer programming solutions to several laboratory exercises. Prerequisite: CSCI 1320 or consent of instructor.

CSCI-1323 Discrete Structures

Elements of discrete mathematics of particular importance in computer science: propositional and predicate logic; proof techniques, including mathematical induction; recursive functions, definitions, and algorithms; proofs of program correctness; algebra of sets; relations and functions; and elements of the theory of directed and undirected graphs. Application of these structures to various areas of computer science. Prerequisite: CSCI 1311, 1320, or consent of instructor.

CSCI-2094 Computer Science Colloquium

Departmental Colloquium on research, professional issues, ethics, and other topics.

CSCI-2195 Competitive Programming

Approaches to algorithmic problem solving; practice with problems that are commonly found in programming competitions. Focuses on the languages and tools used in the annual ACM International Collegiate Programming Competition. May be taken a maximum of four (4) semester hours of credit. Prerequisite: CSCI 1320 or knowledge of programming

CSCI-2320 Principles of Data Abstraction

Abstract data types and their implementation in an object-oriented environment. Axiomatic systems describing the classical computer science data structures: stacks, queues, lists, trees, graphs, and the like. Analysis of the computational complexity of alternative implementation strategies in the context of the typical algorithmic applications. Prerequisite: CSCI 1321 and 1120

CSCI-2321 Principles of Computer Design

A study of computer organization and design including emphasis on logical design, the role of performance, the structure of instructions, computer arithmetic, processor control, and methods of performance enhancement. Some attention will also be given to assembly programming. Prerequisite: CSCI 1321,CSCI 1120.

CSCI-2322 Principles of Functional Languages

An introduction to functional programming. Functional composition, recursion, and iteration. Procedure and data abstraction using functions. Managing state, streams, delayed evaluation, and continuations. Using functional languages as an analytic notation for reasoning about programs. Solution of several laboratory problems.

CSCI-2323 Scientific Computing

Numerical and text processing methods with problems chosen from the sciences and mathematics. Focuses on the general idea of how computational science has expanded the realm of what is possible in the sciences. Builds on basic programming knowledge to give students understanding and skills as to how computers are used in the sciences. Prerequisite: CSCI 1320, MATH 1311.

CSCI-2324 Numerical Calculus

Introduction to the numerical algorithms fundamental to scientific computer work. Elementary error analysis, interpolation, quadrature, linear systems of equations, and introduction to the numerical solution of ordinary differential equations. (Also listed as MATH 2324.) Prerequisites: CSCI 1320, MATH 1311.

CSCI-3311 Information Assurance and Security

A contemporary introduction to the broad area of security in computing systems, exploring issues that abound when attempting to secure information in an interconnected society. An information- based examination of risk modeling, assessment and management; ethics; policies and behaviors; cryptography; code security; data security; operating system security; and network security. Approaches to assure information confidentiality, integrity, and availability(CIA). Prerequisite: CSCI 1321 or BAT 2302

CSCI-3312 Introduction to Game Development

An introduction to the various aspects of the computer game creation process including coding, game play, narrative development, and artwork. Students will explore the tools and methods of game design and will also work in groups to design and implement a two-dimensional, non-networked game. Prerequisite: CSCI 2320, 3321 is recommended.

CSCI-3320 Principles of Theoretical Computer Science

Core topics from finite automata, languages and the theory of computation. The Chomsky hierarchy, abstract machines and their associated grammars. Models of computation (e.g., Turing machines), Church's thesis, unsolvability, and undecidability. Computational complexity, intractability, and NP-completeness. Prerequisites: CSCI 1323

CSCI-3321 Principles of Software Engineering

Issues involved in developing large-scale software systems. Models for the software lifecycle; techniques and tools of analysis, design, programming, testing, debugging, and maintenance. May include formal methods, CASE, expert systems, case studies. Prerequisites: CSCI 2320, 1323, and Junior standing.

CSCI-3322 Principles of Algorithms

Exploration of standard algorithm construction methods for solving varied problems including a comparison of the different efficiencies of these algorithms when implemented using different data structures. Methods will include branch and bound, backtracking, memoization, greedy algorithms, and dynamic programming. Heuristic-based methods to find non-optimal solutions are also explored, especially for intractable problems. Prerequisite: CSCI 2320

CSCI-3323 Principles of Operating Systems

Introduction to operating systems. Role and purpose of operating systems. History of operating systems. Processes and process management, including a discussion of concurrency and related issues. Memory management. Input/output and device management. File systems. Operating system security. Prerequisite: CSCI 2321.

CSCI-3342 Computer Networks

Local area networks, high-speed networks and bridges. Wide area networks and internetworking. Network protocols including OSI protocols. Network security, reliability and performance. Laboratory experience with one or more network protocols. Prerequisite: CSCI 2320.

CSCI-3343 Database Systems

The goals of DBMS including data independence, relationships, logical and physical organizations, schema and subschema. Entity relationship diagrams. Hierarchical, network, and relations models. Data definition and data manipulation languages. Query languages, relational algebra, and relational calculus. Data normalization techniques, data security integrity, and recovery. Case studies of several existing systems. Prerequisite: CSCI 2320.

CSCI-3344 Artificial Intelligence

The purpose of this course is to update the student on state-of-the-art artificial intelligence concepts, such as heuristic programming, state-space search techniques, and/or graphs for problem solving, game playing techniques, theorem proving procedures for propositions and first-order logic, knowledge representation, and examples of knowledge-based systems. Prerequisites: CSCI 1323, 2320.

CSCI-3345 Web Application Design

An introduction to the development of Web applications and cloud computing. Basics of information sharing on the web and an introduction to a standard Web application framework. Students will work in groups to analyze, design, and implement a Web application. Prerequisites: CSCI 2320, 3321 is recommended

CSCI-3351 Numerical Analysis I

Methods of solution of algebraic and transcendental equations, simultaneous linear algebraic equations, numerical integration and differentiation, initial and boundary value problems or ordinary differential equations. (Also listed as MATH 3351.) Prerequisites: CSCI 1321, MATH 3316.

CSCI-3353 Graphics

Survey of display devices, display data structures, graphics input, 2D transformations, windowing, clipping, viewing,

3D transformations, perspective, depth, hidden line removal. Graphics programming techniques and several laboratory problems using available graphics devices. Prerequisites: MATH 1311, CSCI 2320.

CSCI-3354 Big Data and Machine Learning

This course explores the field of big data computation and machine learning using appropriate frameworks for processing large datasets across clusters of computers. Students will learn the mathematical underpinnings of a variety of machine learning models and use machine learning to do predictive analysis on various datasets. (Offered every fall.) Prerequisites: CSCI 1321 and MATH 2308

CSCI-3361 Analysis of Algorithms

Complexity of algorithms, time and space requirements, and trade-offs. Searching and sorting, mathematical algorithms, graph and combinational algorithms. Divide and conquer, branch and bound, dynamic programming, exhaustive search. Limitations, intractability and NP-completeness, approximation algorithms. Prerequisites: CSCI 1321, 1323.

CSCI-3362 Effective Programming Techniques

Effective strategies for programming in contemporary languages, including material on design patterns and other techniques that improve abstraction and reusability of code. Includes a significant group project that requires students to apply material learned in the course. Prerequisite: CSCI 2320, 3321 is recommended

CSCI-3366 Parallel and Distributed Programming

An introduction to parallel and distributed programming with particular emphasis on algorithm development. Comparison between sequential and parallel algorithm development. Survey of hardware and software for parallel and distributed computing. Comparison of different architectures and programming models. Design, analysis, and development of parallel algorithms. Students will be expected to implement several projects in one or more suitable parallel programming environments. Prerequisites: CSCI 2320

CSCI-3368 Principles of Programming Languages

An introduction to the syntax and semantics of programming languages. This will include a study of data structures and control structures, proof of programs, a comparison of functional and imperative programming languages, parameter passing, storage allocation schemes, and concurrent language features. Prerequisite: CSCI 2320.

CSCI-3-90 Directed Study

Credit will vary depending on work done. Prerequisites: CSCI 1323, 2320, and Junior standing

CSCI-3-93 Special Topics in Theory

Topics will vary depending on student and faculty interest. May be taken for a maximum of six (6)semester hours of credit. Prerequisite: CSCI 1321 and 1323, or consent of instructor.

CSCI-3-94 Seminar

Topics will vary depending on student interest. May be taken for a maximum of six (6) semester hours of credit. Prerequisites: CSCI 1323, 2320, and junior standing.

CSCI-3-95 Special Topics in Applications

Topics will vary depending on student and faculty interest. May be taken for a maximum of six (6)semester hours of credit. Prerequisite: CSCI 1321 and 1323, or consent of instructor.

CSCI-3-96 Special Topics Systems

Topics will vary depending on student and faculty interest. May be taken for a maximum of six (6) semester hours of credit. Prerequisite: CSCI 1321 and 1323, or consent of instructor.

CSCI-3-97 Special Topics in Design

Topics will vary depending on student and faculty interest. May be taken for a maximum of six (6) semester hours of credit. Prerequisites: CSCI 1321 and 1323, or consent of Instructor; CSCI 3321 is recommended

CSCI-3398 Thesis Reading

Independent study in selected areas in preparation for Thesis. Spring. Prerequisites: Junior standing, CSCI 1323 and CSCI 2320 and Consent of Instructor.

CSCI-4312 Advanced Game Development

A deeper exploration of the concepts presented in CSCI 3312 that provides a setting for students to work in groups on the design and implementation of a three-dimensional or networked game. Includes discussion of 3-D graphics options as well as networking options. Groups will be subdivided into coding, game play, and art subgroups and will work in a structure intended to model professional game studios. Prerequisite: CSCI 3312

CSCI-4353 Advanced Graphics

Geometric modeling, algorithms for hidden surface removal, shading models, rendering, texture mapping, reflectance mapping, ray tracing, and radiosity. Introduction to animation. Several laboratory programming problems using available graphics devices. Prerequisite: CSCI 3353.

CSCI-4365 Advanced Theoretical Computer Science

Advanced topics in theory. Closure properties, ambiguity, contact-sensitive and recursively enumerable languages, alternate models of computation, non-determinism, decidability, Ackermann's function, computational complexity speed-up. Prerequisite: CSCI 3320.

CSCI-4385 Senior Software Project I

The analysis and design of an actual large-scale software system. Application of the analysis and design tools within the software life cycle presented in CSCI 3321 (Principles of Software Engineering). Students work in teams under direct supervision of the faculty. Prerequisite: 21 hours of Computer Science

CSCI-4386 Senior Software Project II

The implementation, testing, and maintenance of the large-scale software systems designed in CSCI 4385. Students working in teams under direct supervision of faculty implement and demonstrate the deliverable software package. Prerequisite: CSCI 4385.

CSCI-4398 Thesis I

Individual research and scholarly investigation under faculty supervision leading to the preparation of a senior thesis. To be taken only by students committed to the preparation of a thesis and those who wish to earn the Honors in Computer Science designation. Serves as a part of the departmental capstone requirement. Fall. Prerequisite: CSCI 3398 and Consent of Instructor.

CSCI-4399 Thesis II

Continuation of CSCI 4398. Must be taken by students who desire honors in computer science. Serves as a part of the departmental capstone requirement. Thesis presentation to departmental faculty and students and a separate thesis defense are requirements for the completion of this course. Prerequisite: CSCI 4398 and Consent of Instructor.