

Computer Science and Information Systems

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The Department offers graduate programs leading to the degrees of Master of Science in computer science and Master of Science in computer information systems. These courses of study are designed to prepare students for professional careers in the field of computing and information processing or for further study and research.

Computer science is the study of theoretical and algorithmic foundations used in software engineering and development. Students are taught how to gather and analyze requirements, design and develop software, and devise new innovations and applications in computing. Computer information systems is a discipline that focuses on information technology and a wide variety of scientific and business applications; the mathematical requirements for computer information systems are not as rigorous as they are for computer science because there is less focus on theoretical foundations.

Students can concentrate their study on specific applications such as software engineering, computer security, computer gaming, Web applications development, intelligent systems, and databases.

Computer science and computer information systems graduates are employed by a variety of industries and non-profit organizations as software engineers and developers, Web application developers, software test engineers, network analysts and administrators, system analysts, data analysts, and database developers and administrators.

In addition to satisfying all the Graduate School requirements for the degree, all candidates for the master's degree must satisfy the following departmental requirements:

1. At least 33 hours of graduate-level coursework. The course CS 502 does not count as part of the total hours needed.
2. No "D" grades can be counted in the completion of requirements for the degree.
3. Every student must pass a written comprehensive examination that will be based on the core requirements for the program pursued.

Interested and qualified students are offered the option of writing a master's thesis. Students selecting this option are encouraged to choose an advisor and topic as early

as possible in order to plan the thesis development and any needed supporting coursework. The following policies apply to these:

1. A minimum grade point average of 3.5 in computer science and computer information systems graduate courses is required for students enrolling in CS 699 (Thesis).
2. No student may register for CS 699 until 9 hours of graduate courses have been completed in the department.
3. Six credit hours of CS 699 are required and, upon completion, the thesis must be defended in an oral examination. No grade will be given for CS 699 until after the oral defense.
4. A written outline of the thesis project and a tentative schedule must be submitted to and approved by the graduate coordinator and the chair prior to the registration for CS 699.

Admission requirements and graduation requirements specific to computer science and computer information systems are given below. In addition, applicants must submit GRE General Test scores taken within the last five years. The applicant may request a GRE waiver under certain circumstances. Note that prospective students who do not meet the conditions for admission may be admitted conditionally, in which case the department will prescribe a program for the removal of such admission conditions. Conditional status must be removed prior to graduation.

Computer Science

In addition to meeting all the general requirements of the Graduate School and of the department as stated above, candidates for the master's degree in computer science must satisfy the following requirements.

1. At least 27 of the 33 hours required must be in computer science courses. At most, six hours may be earned in approved courses other than those labeled CS.
2. To satisfy the core (breadth) requirement, four courses must be taken, one from each pair given below. (either by taking the course or showing evidence of the completion of an equivalent course elsewhere): CS 520 or CS 625; CS 590 or CS 591; CS 514 or CS 612; CS 561 or CS 670.
3. To satisfy the depth requirements, the student must take two courses from one of the following three tracks:

Systems/Net-Centric: CS 531, CS 532, CS 635;

Software Engineering: CS 592, CS 593, CS 690;

Intelligent Systems/Information Retrieval:
CS 562, CS 563, CS 570.

For admission into the computer science program, a student must have completed discrete mathematics, at least two semesters of calculus, matrix or linear algebra, and at least one semester of calculus-based statistics; must have at least 15 hours of computer science coursework including knowledge of one structured or object-oriented programming language, elementary data structures, assembly language, advanced data structures, and introductory computer architecture; and must have approval of the department.

Computer Information Systems

In addition to meeting all the general requirements of the Graduate School and of the department as stated above, candidates for the master's degree in computer information systems must satisfy the following requirements:

1. At least 21 of the 33 hours required must be in computer information systems or computer science courses.
2. A minimum of 9 hours must be taken in courses outside the department. These courses must form a coherent program in an applications area and must be approved by the graduate coordinator.
3. The following core requirements must be met (either by taking the course or by showing evidence of having completed an equivalent course elsewhere): CIS 571, CIS 572, CIS 588, CIS 607, CS 592, and CS 670. (CS 531 and CS 590 are recommended).

The admission requirements for the computer information systems program are one semester of calculus, one semester of calculus-based statistics, two semesters of accounting, one semester of finance, two semesters of programming and data structures in a structured or object-oriented programming language, and one semester of data communications.

Course Descriptions

Computer Information Systems

CIS 571 Computer Law 3 hrs.

Ethical considerations of computer scientists and computer-related security and privacy issues; copyright, patent, trademark, and trade secret issues, deceptive trade practices, computer crime, contract issues, venture capitalists, tax issues, computer torts, constitutional issues, and international trade considerations. Prerequisite: one semester of programming.

CIS 572 Computing Services Management 3 hrs.

Management of computing resources: planning for computing services; operational considerations; evaluation of service. Prerequisites: CS 310 or equivalent.

CIS 588 Introduction to Expert Systems and Artificial Intelligence 3 hrs.

Knowledge-based systems design and implementation; expert systems shells and programming environments; validation and implementation of expert systems; case studies/laboratories. Cross-listed as IME 568. Prerequisites: two semesters of programming and one semester of statistics, or consent of instructor.

CIS 607 File Organization and Management 3 hrs.

File organizations and access methods. Sort/merge operations; hashing schemes for storage and retrieval. Projects involve data validation; creation and updating of files; simulation and/or implementation of direct and indexed files. Prerequisite: CS 102 or equivalent.

Computer Science

CS 502 Advanced Programming 3 hrs.

Introduces the fundamental concepts of programming from an object-oriented perspective with emphasis on advanced programming skills and good software development principles in a closed laboratory setting. Covers topics including object-oriented paradigm, design and programming, fundamental data structures and computing algorithms, and software development principles. Prerequisites: consent of graduate program coordinator; at least two semesters of programming experience.

CS 503 Programming Methodology 3 hrs.

Predicate calculus, Dijkstra's methodology of algorithm development. Algorithm development. Algorithmic language characteristics; syntax, semantics. Postconditions and preconditions. Verification of postcondition states satisfied by algorithmic programs executed from preconditions. Problems. Prerequisites: a grade of C or better in both MTH 120 and CS 102.

CS 510 Numerical Methods I 3 hrs.

Introduction to numerical and computational aspects of various mathematical topics: finite precision, solutions to nonlinear equations, interpolation, approximation, linear systems of equations, and integration. Cross-listed as MTH 510. Prerequisites: CS 101; MTH 207 and 223.

CS 511 Numerical Methods II 3 hrs.

Continuation of CS/MTH 510: further techniques of integration, ordinary differential equations, numerical linear algebra, nonlinear systems of equations, boundary value problems, and optimization. Cross-listed as MTH 511. Prerequisites: MTH 224 or 345; CS 510.

CS 514 Algorithms 3 hrs.

Design and analysis of algorithms. Dynamic structures maintenance and hashing. Searching, sorting, and traversal. Time and space requirements; simplification; computational complexity; proof theory and testing; NP-

hard and NP-complete problems. Prerequisites: CS 210 or equivalent; one semester of statistics.

CS 516 Programming Languages 3 hrs.

Design concepts of high-level languages. Description languages; grammars and syntax; expressions and data structures; selection and control structures; constructs for input and output; subprograms and parameter communications. Prerequisite: CS 210 or 310.

CS 518 Programming Language Translation 3 hrs.

Overview of programming language translation with emphasis on modern compiler construction. Lexical analysis, parsing, syntax and semantic analysis, code generation, garbage collection, and optimization. Prerequisite: grade of C or better in CS 210. Corequisite: CS 516.

CS 520 Advanced Computer Architecture 3 hrs.

Fundamental computer sub-systems: central processing unit; memory systems; control and input-output units. General purpose computing systems design. Examples from existing typical computers. Prerequisite: CS 220 or equivalent.

CS 531 Web Development Technologies 3 hrs.

Introduction to PERL/CGI, XHTML, XML, JavaScript, and scripting languages. Web page design and layout. Client and server side development of Web applications. Database connectivity, Java Database Connectivity (JDBC). Prerequisites: CS 102 or equivalent.

CS 532 Advanced Java Computing 3 hrs.

Developing Web-based systems using J2EE Java technologies. Topics include Java Security, Java GUI development using IDE, Java Servlets, and JavaServer Pages, Java Enterprise JavaBeans, XML and Java Web Services, and Java Transaction Service, and Java Message Service. Prerequisites: CS 531 or equivalent.

CS 535 Introduction to Computer Graphics 3 hrs.

Mathematics and algorithms of computer graphics. Device differences, lines, arcs, curves, transformations, input and output primitives. Data structures for geometric entities. Prerequisites: MTH 207, 223; CS 210.

CS 561 Introduction to Artificial Intelligence 3 hrs.

Advanced topics in artificial intelligence; pattern recognition, search strategies, game playing, knowledge representation; logic programming, uncertainty, vision, natural language processing, robotics, programming in LISP and PROLOG. Prerequisites: CS 210 or equivalent.

CS 562 Intelligent Systems and Applications 3 hrs.

Gives the necessary background and practice for building intelligent systems using three of the most commercially successful applications of AI: the logical approach (expert systems, fuzzy logic, and fuzzy expert systems), the biological approach (neural networks, evolutionary programming, and genetic algorithms), and the statistical approach

(Bayesian networks, belief networks, Markov chain, Hidden Markov models, and statistical and neural-based clustering). Students will have the opportunity to build integrated, hybrid intelligent systems to solve problems in a variety of applications including in the medical domain, financial domain and stock market, and autonomous robotics systems. Prerequisites: CS 210 or equivalent; one course in statistics.

CS 563 Knowledge Discovery and Data Mining 3 hrs.

Brings together the latest research in statistics, databases, machine learning, and artificial intelligence that are part of the rapidly growing field of knowledge discovery and data mining. Topics covered include fundamental issues, classification and clustering, machine learning algorithms, trend and deviation analysis, dependency modeling, integrated discovery systems, next generation database systems, data warehousing, and OLAP and application case studies. Prerequisites: CS 210 or equivalent; one course in statistics.

CS 570 Advanced Topics in Databases 3 hrs.

Designing and building enterprise-wide data warehouses. Techniques for analyzing data in data warehouses. Study different types of data models including logic and object-oriented databases. Advanced topics in relational databases such as multimedia databases, distributed databases, concurrency, security, etc. Prerequisite: 370 or equivalent.

CS 590 Fundamentals of Software Engineering 3 hrs.

Software engineering: software product; prescriptive process models; system engineering; analysis modeling; design engineering; architectural design; user interface design; testing strategies and techniques; software systems' implementation; software systems' maintenance. Prerequisites: CS 390 or equivalent.

CS 591 Software Project Management 3 hrs.

Software Project Management: large software systems' projects; project planning; project management concepts; managerial skills; software project metrics and estimates; software process metrics; software product metrics; project scheduling; CASE tools for software project management; software documentation. Prerequisites: CS 390 or equivalent.

CS 592 Requirements Engineering 3 hrs.

Covers topics including basic concepts and principles of software requirements engineering, the requirements engineering process—requirements elicitation, requirements analysis, requirements specification, system modeling, requirements validation and requirements management, and techniques, methods, and tools for requirements engineering and software systems requirements modeling (including structured, object-oriented and formal approaches to requirements modeling and analysis). Prerequisites: CS 102 or equivalent.

CS 593 Software Engineering of Web-Based Applications 3 hrs.

Software engineering of Web-based applications: Web engineering; formulation and planning of Web-based applications; analysis modeling; design modeling for Web-based applications; testing Web-based applications; security of Web-based applications; implementation and maintenance of Web-based applications. Prerequisites: CS 390 or equivalent.

CS 610 Advanced Topics 3 hrs.

Special projects under staff supervision on advanced problems in numerical or nonnumerical branches of computer science. May be taken more than once under different topics. Prerequisite: consent of instructor.

CS 611 Directed Individual Studies 1-3 hrs.

Individual study in an area of computer science relevant to the student's professional goals and not covered in a formal course offered by the department. May be repeated twice for a maximum of 6 hours credit. Prerequisites: consent of the department.

CS 612 Automata, Computation, and Complexity 3 hrs.

Theory of formal languages and computability, Automata, Turing machines, grammars. Context free and context sensitive languages; parsing. Recursion theory; limits of effective computability, P and NP class of problems, NP-complete problems. Non Turing computable problems, reducibility, complexity. Prerequisites: CS 502 or equivalent.

CS 614 Parallel Algorithms 3 hrs.

Parallel algorithms for multi-processor computer architectures: concurrent programming, SIMD and MIMD systems, and time complexity. Prerequisite: CS 514.

CS 625 Operating Systems Design 3 hrs.

Advanced concepts in operating system design. Topics include process and thread management, virtual memory, interprocess communication, distributed systems, parallel and distributed file system designs, resource management, and security and protection. Prerequisites: CS 321 or equivalent.

CS 635 Data Communications and Networks 3 hrs.

Fundamentals of data communication, computer network architectures and protocols, wireless networks, network programming, and network security. Emphasis on OSI, TCP/IP, ATM, and IEEE 802 LAN layered architectures, and TCP/IP network programming. Prerequisite: CS 330 or equivalent.

CS 670 Database Management Systems 3 hrs.

Relational database design, including entity relationship modeling and normalization. Structured query language (SQL) for creating and querying databases. Other topics include the theory of relational databases, including relational algebra, various loading and reporting utilities, and the implementation of database management systems, e.g., how query optimization works. Prerequisites: CS 210 or CIS 607 or equivalent.

CS 690 Advanced Topics on Software Engineering 3 hrs.

Special software engineering research and development projects under staff supervision. Emphasis on a specific topic and emerging technologies in the software engineering area. Prerequisites: CS 590 or CS 591.

CS 699 Thesis 3-6 hrs.

Computer science research and thesis preparation. Required of candidates choosing the thesis option. Total of 6 semester hrs. to be taken in one or two semesters. Prerequisite: consent of department chair.