

# Department of Computer Science and Information Systems

**FACULTY** Professors Haghighi, Liu, Nikolopoulos, Park, V. Uskov; Associate Professors Dolins (chair), Miller; Assistant Professor Patton; Visiting Assistant Professor A. Uskov; Lecturer Tennyson.

The department offers baccalaureate degree programs in computer science and in computer information systems.

Computer Science is the study of theoretical and algorithmic foundations used in software engineering and development. Students are trained to design and implement software, devise new innovations and applications in computing, and solve scientific and business problems requiring computer applications. As software engineers, students need a strong mathematical and scientific background.

Computer information systems is a discipline that focuses on information technology and applications, i.e., on technology and tools for generating, processing, and distributing information. Students can concentrate their study on specific applications such as software engineering, computer security, Web development, intelligent systems, and databases. Computer information systems has a wide variety of applications, but the mathematical requirements are not as rigorous as they are for computer science because there is less focus on theoretical foundations.

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

For students not majoring in the department, we offer a minor which can be tailored to the individual's goals and needs.

Students intending to take only one course in the department should enroll in CIS 102 if they desire a detailed treatment of a programming language, or CIS 300 if they desire a general discussion of computers and their impact on society.

## Computer Science

The department has course offerings of sufficient breadth to allow specialization in a number of areas including software engineering, intelligent systems, database concepts, computer systems and architecture, net-centric computing, and Web development. Majors are encouraged to choose an area of specialization based upon their career goals and to select electives, with guidance from their advisor, to support that choice. The general requirements for the computer science major are:

1. Computer Science:
  - a. 45 semester hours including CS 101, CS 102, CS 140, CS 210, CS 215, CS 220, CS 321, CS 330, CS 370, CS 390, CS 480, CS 490, CS 491;
  - b. at least 24 semester hours must be 300 level or higher;
  - c. a grade of C or better is required in all computer science courses submitted in fulfillment of the major requirements.
2. Mathematics and Science
  - a. 12 semester hours of mathematics, including MTH 120, MTH 121, MTH 122, and one elective at the 200 level or higher;
  - b. MTH 325, or IME 311, or QM 262;
  - c. 12 semester hours of science, including a two-semester (eight semester hours) laboratory sequence designated for science or engineering majors.

## Computer Information Systems

The general requirements for the computer information systems major are:

1. Computer Science and Computer Information Systems:
  - a. 33 semester hours including CIS 203, CS 101, CS 102, CS 220, CS 310, CS 330, CS 370, and CS 403. (CS 390 is strongly recommended.);
  - b. at least 21 hours must be at or above the 300 level;
  - c. a grade of C or better is required in all computer science and computer information systems courses presented in fulfillment of the major requirements.
2. Mathematics: MTH 105 (or equivalent) and either MTH 115 or MTH 121 (MTH 116 or MTH 122 is recommended), and MTH 120.
3. Statistics: QM 262 and QM 263 (or equivalents).
4. Accounting: ATG 157 and ATG 158.
5. Business: BMA 352.
6. Economics: ECO 221 (or ECO 100).
7. Finance: FIN 322.
8. Psychology: PSY 104.
9. Supporting Area: Each computer information systems major must select a minor, or at least 18 semester hours in an approved sequence of courses in a supporting area; at least 12 of these hours must be above the freshman level. A frequent choice is the business administration minor. Several other options exist and interested students should consult with their major advisor for assistance in selecting one suitable to their goals and needs. Students should also consult the department offering the minor. Students choosing the business administration minor must have that choice approved by the Foster College of Business Administration.

## Computer Science and Information Systems Minor

The requirements for a minor in computer science and information systems are:

1. a total of 21 hours in computer science or computer information systems courses;
2. at least 12 of these hours must be in courses numbered 300 or above.

Non-majors interested in the minor should consult the department and develop an individualized plan. For example, a student seeking to achieve a working competence in Web development might select CS 101, CS 102, CS 140, CS 210, CS 330, CS 370, CS 531, and CS 532. Plans to meet other objectives can be worked out with a department advisor.

## Course Descriptions

### Computer Information Systems

**CIS 102 Introduction to Computer Information Systems with BASIC 3 hrs.** Fundamental concepts of computer programming and design of algorithms. Problem solving using BASIC. Introduction to flow chart language and use of software packages. Functional limitations and capacities of computers.

### CIS 203 Data Processing with COBOL 3 hrs.

Solution of data processing problems using COBOL. Introduction to file handling and use of computers in a business environment. Prerequisites: Previous high school or college programming courses.

**CIS 215 Introduction to Scripting Languages 3 hrs.**

A non-technical introduction to the use of scripting languages in a web-based environment. An overview of current scripting languages such as Javascript, VBScript, and PERL. Cross-listed as IM 215. Prerequisites: one semester of programming, or IM 213 and IM 365, or equivalent.

**CIS 230 Introduction to Computer Forensics 3 hrs.**

Provides an overview of computer forensics, investigation techniques, and relevant laws. Covers computer operating system architectures and disk structures and their relevance to computer forensics. Cross listed as ACJ 230. Prerequisite: previous computer class or consent of instructor.

**CIS 330 Advanced Computer Forensics 3 hrs.**

Provides students an extensive look at computer forensics and formal techniques used in computer forensics in a lab environment. Formal techniques for conducting a computer forensics investigation including record-keeping are covered. Students will conduct computer forensic exams and participate in practical computer forensic examination exercises. Cross listed as ACJ 330. Prerequisites: CIS 230 or ACJ 330.

**CIS 275 Business Applications with Visual Basic 3 hrs.**

Object-oriented business application development using Visual Basic. Emphasis on object classes, events and properties, data structures, controls, and objects. Dual listed as BMA 275. Prerequisites: CIS 102, BMA 272, or consent of instructor.

**CIS 300 Computers and Society 3 hrs. (Gen. Ed. TS)**

History of computers; their use, limitations, and impact on society; Internet and the World Wide Web; creation of Web content. Prerequisite: Junior standing or consent of instructor.

**CIS 377 Advanced COBOL Systems & Environments 3 hrs.**

Design and implementation of production-oriented COBOL system projects. Environments for development and implementation of COBOL systems in both batch and interactive modes. JCL for resource management, file processing, and multi-key file processing. Comparison and portability issues in different COBOL system environments. Prerequisite: CIS 203.

**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 computer resources; planning for computing services; operational considerations; evaluation of service. Prerequisite: CS 310 or equivalent.

**CIS 588 Introduction to Expert Systems 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 IE 588. Prerequisites: two semesters of computer programming and one semester of statistics, or consent of instructor.

**Computer Science****CS 101 Introduction to Programming 4 hrs.**

Introduces the fundamental concepts of programming from an object-oriented perspective. Topics include simple data types, control structures (if-else loops, switch statements), introduction to array and string data structures, algorithms, debugging and testing techniques, and social implications of computing. The course emphasizes good software engineering principles and practices, breaking the programming process into analysis, design, implementation, and testing, with primary focus on implementation and development of fundamental programming skills. Prerequisite: MTH 109 or MTH 112 or equivalent.

**CS 102 Data Structures 3 hrs.**

Introduction to concepts of object-oriented programming with review of control structures and data types and array processing. Introduction to the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design. Overview of programming principles, simple analysis of algorithms, searching and sorting techniques, and an introduction to software engineering issues. Prerequisites: a grade of C or better in CS 101 or equivalent.

**CS 140 Programming in C++ 1 hr.**

Introduction to C++ programming for students who are knowledgeable in an object-oriented language (most likely Java). Corequisite: CS 102.

**CS 210 Data Structures and Algorithms 3 hrs.**

Builds on the introduction to object-oriented programming begun in CS 101 and CS 102 (and CS 140) with an emphasis on algorithms, data structures, and software engineering. Prerequisites: a grade of C or better in CS 102 or equivalent; MTH 120.

**CS 215 Computability, Formal Languages, and Heuristics 3 hrs.**

Theory of computation and formal languages, grammars, computability, complexity, algorithms, heuristics, and foundations of intelligent systems. Prerequisites: CS 210; MTH 122.

**CS 220 Computer Architecture 3 hrs.**

Basics of logic circuit design, modern processor architecture, and assembly language. Overview of principle issues of internal system architecture, including memory, buses, and peripherals. Prerequisite: CS 210.

**CS 310 Information Structures 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 or indexed files. Prerequisite: CS 102.

**CS 320 Symbolic Logic 3 hrs.**

Logical systems; propositional and predicate calculi. Truth tables, proofs, tautologies, principles of inference, Boolean algebra, DeMorgan's Laws, quantifiers, representations, and set theory. Cross-listed as PHL 320. Prerequisite: MTH 120.

**CS 321 Operating Systems 3 hrs.**

Fundamentals of operating systems concepts, design, and implementation. Topics include operating system components and structures, process and thread model, mutual exclusion and synchronization, scheduling algorithms, memory management, I/O controls, file systems, and security. Prerequisites: CS 220.

**CS 330 Net-Centric Computing 3 hrs.**

Fundamentals of data communications: data transmission, data encoding, digital data communication techniques, data link control, and multiplexing. The Web as a client-server system, building Web applications, network management and security, compression and decompression. Multimedia data technologies, wireless and mobile computing, and event-driven programming. Prerequisite: CS 210.

**CS 370 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. Prerequisite: CS 102.

**CS 390 Software Development 3 hrs.**

Introduction to software development. Emphasis on software design, software tools and environments, software evolution, software project management, software processes, software testing and validation, software life cycle and its phases, basics of human-computer interaction and graphic user interface. Prerequisite: CS 210.

**CS 403 Systems Design and Analysis 3 hrs.**

Methodology of building a complete computer-based system. Case studies. Prerequisite: CS 210 or CS 310 or 302.

**CS 410 Directed Individual Studies 1-6 hrs.**

Individual project developed under supervision of a CS faculty member. May be repeated under a different topic once. Maximum of three semester hours per semester. Prerequisite: consent of department.

**CS 412 Topics in Computer Science 3 hrs.**

Topics of special interest which may vary each time course is offered. Repeatable under a different topic for a maximum of six hours. Prerequisites: consent of instructor.

**CS 480 Social and Professional Issues 2 hrs.**

Introduction to the social and professional issues and practices that arise in the context of computing. Prerequisites: CS 210

**CS 490 Capstone Project I 3 hrs.**

Applies the concepts and skills learned by undergraduate computer science majors at Bradley University. Students are required to work on a team on a significant software project. Prerequisites: CS 370, CS 390.

**CS 491 Capstone Project II 1-3 hrs.**

Applies the concepts and skills learned by undergraduate computer science majors at Bradley University. Students are required to work on a team on a significant software project. Prerequisites: CS 490.

**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 121 or 102.

**CS 510 Numerical Methods I 3 hrs.**

Introduction to numerical and computational aspects of various mathematical topics: finite precision, solutions to nonlinear equations, and interpolation, approximation, linear systems of equations, and integration. Cross listed as MTH 510. Prerequisites: CS 106 101; 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/MTH 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: 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. Prerequisite: 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. Prerequisite: 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: CS 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. Prerequisite: 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. Prerequisite: 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). Prerequisite: 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. Prerequisite: CS 390 or equivalent.