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### Computer Science

Computers are a very prominent part of modern business and society. Many of the most important and exciting technological developments today involve computers and computer systems. The expanding role of computer-based systems has caused a high demand for computer professionals, a situation that is expected to continue well into the future.

Computer Science is an extremely exciting, challenging and rewarding area of study. It incorporates an excellent combination of theoretical and intellectual content on the one hand, and practical application and societal importance on the other. By some standards, it is the strongest discipline in academia today, and has been for the past three decades.

Computer Science is a broad and multidisciplinary field. Its general focus is on the design, analysis and use of computer hardware and software. As an academic discipline, it does not focus on just one technology, programming language, or computer architecture. Rather, it seeks to ground the student in fundamental concepts that are applicable to many environments.

Our curriculum prepares graduates for positions in the computer industry, as well as for advanced studies and research. We offer an undergraduate major leading to the Bachelor of Science and Bachelor of Arts degrees, an undergraduate minor, and graduate programs leading to the Master of Science degree and Doctor of Philosophy degree in computer science.

The bachelor's degree programs in computer science provide students with the technical background necessary to use, design, analyze and implement computer software and systems. All students must complete the required University Core Curriculum and satisfy the School of Computing requirements. Computer Science majors are required to take a core set of courses dealing with programming, data structures and algorithms, computer organization, operating systems, social issues of computing, and a senior project.

Along with taking the core courses, computer science majors may choose from a broad selection of computer-based courses in order to complete their course requirements. This broad selection of courses covers all principal areas of computer science: languages, networks, databases, architecture, graphics, software engineering, artificial intelligence, bioinformatics, web development, cyber security, robotics and parallel computing. The curriculum for the Bachelor of Science degree is more traditional and somewhat more flexible than that for the Bachelor of Arts degree. It prepares students for a wide range of technical careers as software developers, systems administrators, database administrators, network administrators, etc. It also prepares students for entry into graduate degree programs in computer science. The Bachelor of Science degree in Computer Science is accredited by the Computing Accreditation Commission (CAC) of the Accreditation Board for Engineering and Technology (ABET), [abet.org](http://abet.org). The Bachelor of Arts degree program is more specifically oriented toward the interdisciplinary aspect of computer science in which students select a secondary concentration such as: business, engineering, science, education, liberal arts, or mass communication. One possible secondary concentration in the area of business applications is designed to enable students to pursue a fifth year of studies leading to an MBA degree.

### Program Educational Objectives

1. Our graduates will establish themselves as computing professionals or engage in advanced study.
2. Our graduates will have the depth and breadth of knowledge and skill to think creatively, collaborate effectively, and succeed interdisciplinarily.
3. Our graduates will have life-long learning skills to adapt to the evolving technologies throughout their professional careers.
4. Our graduates will bring positive impact on the society responsibly and ethically.

## Student Outcomes

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

The School of Computing also offers a minor in computer science. Students can choose from a variety of option tracks. Service courses are also available for students who wish to acquire some computer literacy but are not pursuing a career as a computer professional. Computer science majors can enrich their computer science degree with a secondary concentration, minor, or double major in areas such as mathematics, engineering, business, communications, etc.

Students interested in computer science will be advised with respect to computer science courses by the school so they may profitably pursue their academic and professional interests.

The School of Computing enforces the following retention policy: a computer science major will not be permitted to enter any of the courses CS 220, CS 306, CS 311, CS 320, CS 330 and CS 335, unless that student has achieved a grade point average of at least 2.00 for all required precedent computer science courses. Any exceptions to this policy will require the written approval of the Undergraduate Program Director.

Permission to enroll in computer science courses is subject to the restriction that a student who receives a grade of F or WF two times in the same course cannot take the course again. An exception to this policy may be granted by written approval of the Undergraduate Program Director, but such exceptions will be rare.

The School of Computing also enforces the following restriction on students repeating its courses: a student cannot repeat a course or its equivalent, in which a grade of B or better was earned, without the consent of the Undergraduate Program Director.

## Bachelor of Science (B.S.) in Computer Science Degree Requirements

Degree Requirements	Credit Hours
University Core Curriculum Requirements <sup>1</sup>	39
Requirements for Major in Computer Science <sup>2</sup>	71
Computer Science Core <sup>3</sup>	32
CS 202, CS 215, CS 220, CS 221, CS 306, CS 311, CS 320, CS 330, CS 335, each with a grade of C or better	
Computer Science Electives <sup>4</sup>	21
To build on the Core and to provide breadth and depth, seven 400-level computer science courses must be chosen	

Degree Requirements	Credit Hours
Senior Project 498 and 499/499B	5
MATH 150, MATH 250, MATH 221 <sup>5</sup>	8
Laboratory Science Sequence - PHYS 205A, PHYS 205B and PHYS 255A, PHYS 255B	5
Additional School of Computing Academic Requirements	9
Biological Sciences (3 hours completed in UCC)	3
Mathematics (completed with computer science major) Physical Sciences (completed with computer science major)	
Supportive Skills - CS 290 and CS 280 or CS 480	6
General Electives	1
<b>Total</b>	<b>120</b>

<sup>1</sup> The supportive skills are also required for a major.

<sup>2</sup> The supportive skills are also required for a major. At least half of the computer science credit hours must be taken at SIU.

<sup>3</sup> At least half of the computer science credit hours must be taken at SIU.

<sup>4</sup> At least half of the computer science credit hours must be taken at SIU. CS 300 and CS 393 cannot be used to fulfill the elective requirement. Use of CS 490, CS 492, or CS 493 requires program director's approval. At most one of CS 447, CS 449, CS 471, CS 472, and CS 475 can be used as an elective. Up to two of the seven 400-level courses could be replaced by 300-level computer science courses.

<sup>5</sup> The supportive skills are also required for a major. Prerequisite is MATH 111 or MATH 108 and MATH 109. The elective hours are reduced by 3-6 hours for students who place into a course lower than calculus.

### Bachelor of Arts (B.A.) in Computer Science Degree Requirements

Degree Requirements	Credit Hours
University Core Curriculum Requirements	39
Requirements for Major in Computer Science <sup>1</sup>	69
Computer Science Core <sup>2</sup>	32
CS 201, CS 202, CS 215, CS 220, CS 221, CS 304 or CS 305, CS 306, CS 330, CS 335 each with a grade of C or better	

Degree Requirements	Credit Hours
Computer Science Electives <sup>3</sup>	18
To build on the Core and to provide breadth and depth, two additional 300- and four 400-level computer science courses must be chosen.	
MATH 111 (3 hours completed in UCC) <sup>4</sup>	1
Secondary Concentration <sup>5</sup>	18
18 credit hours approved by the School of Computing in one of the following areas: business, engineering, science, education, liberal arts, or mass communication. Pre-med, pre-law or a minor in any of the above areas may fully or partially satisfy this requirement depending on credit hours.	
Additional School of Computing Academic Requirements	12
Biological Sciences (3 hours completed in UCC)	3
Mathematics - completed with computer science major Physical Sciences (3 hours completed in UCC)	3
Supportive Skills - CS 290 and CS 280 or CS 480	6
<b>Total</b>	<b>120</b>

<sup>1</sup> The supportive skills are also required for a major.

<sup>2</sup> At least half of the computer science credit hours must be taken at SIU. Students must take either CS 304 or CS 305.

<sup>3</sup> At least half of the computer science credit hours must be taken at SIU. CS 300 and CS 393 cannot be used to fulfill the elective requirement. Use of CS 490, CS 492, or CS 493 requires programs director's approval. At most one of CS 447, CS 449, CS 471, CS 472, and CS 475 can be used as an elective. The 300-level electives could be replaced by 400-level computer science courses.

<sup>4</sup> MATH 111 could be replaced by MATH 108 and MATH 109, or by MATH 150.

<sup>5</sup> MBA Foundation: MATH 150 (instead of MATH 111), ACCT 220, FIN 270 and FIN 330, MGMT 304 or MGMT 318, MKTG 304, and ECON 240 and ECON 241. MGMT 304 allows a student to earn a minor in Business and Administration. MGMT 318 is required for entry into the Master in Business Administration degree program. Six credit hours must be at 300-level or above.

For your individualized curricular guide, see your Student Education Planner in DegreeWorks.

## Tracks for B.S. and B.A. Programs:

Computer science majors can use their electives to form an optional track in five different computer science areas: cyber security; data science; artificial intelligence and machine learning; software

engineering and system development; and computer networks and distributed systems. Computer science majors must take three courses (out of their 400-level electives) from a particular topic to complete a track in that area. Computer science is a very dynamic field; therefore see [cs.siu.edu](http://cs.siu.edu) for current tracks and their relevant courses.

## Computer Science Minor

A minor consists of CS 202, CS 215, CS 220, and at least nine hours of 300-level computer science coursework. At least nine of these hours must be taken at SIU.

## Computer Science Courses

**CS105 - Introduction to Application Software** This course is designed to provide a detailed exposure to various computer applications software including word processing, database management, spreadsheet, presentation, Web design software, and programming concepts. The course is designed to help students to better use the computer as a tool in their own fields and to help prepare students for Microsoft Office Specialist Certification examinations. Credit Hours: 3

**CS200B - Computer Concepts** [IAI Course: BUS 902] The course is designed to provide participants with a broad overview of computer concepts including key terminology and components of computer hardware, software, and operating systems. Topics will include, but are not limited to computer architecture, peripheral devices, networking components, system software, information system analysis, application software including word processing, database management, spreadsheet, and presentation software. Discussion will also include the Internet and Web page development. Credit Hours: 3

**CS201 - Problem Solving with Computers** This course provides an introduction to problem solving using computers. It goes beyond basic computer literacy and application software experiences, but is less intensive than a first course devoted solely to programming. The course focuses on problem solving in the context of an introduction to computer programming and includes coverage of topics from computer literacy, word processing, spreadsheet and database packages. A preliminary treatment of the Internet and World Wide Web is also included. Students cannot get credit for both CS 201 and CS 201B. Course fee: \$60. Credit Hours: 3

**CS201B - The Beauty and Joy of Computing** This course serves as an introductory course to the beauty and joy of computing for non-CS majors as well as first year CS majors. The history, social implications, principles, and applications of computing in addition to programming basics will be discussed. The joy of programming a computer will be delivered to the students using a friendly, visual programming language that does not require keyboard instead a simple drag-and-drop window interface. There will be many fun programming assignments and one team project related to student's interests. Students cannot get credit for both CS 201 and CS 201B. Credit Hours: 3

**CS202 - Introduction to Computer Science** [IAI Course: CS 911] An introduction to computers and programming using a high-level structured language including a discussion of programming constructs and data representation. Primary emphasis will be given to problem solving, algorithm design, and program development. Three one-hour lectures and one two-hour lab per week. Prerequisite: Mathematics 111 or equivalent with a grade of C or better. Course fee: \$60. Credit Hours: 4

**CS215 - Discrete Mathematics** [IAI Course: M1 905] Introduction to topics relevant to the study of computer science including: number systems, sets, sequences, summations, logic and truth tables, proofs, functions, relations, matrix operations, combinations, permutations, counting techniques, discrete probability, algorithmic complexity, recurrence relations, Boolean algebra, simple combinational circuits, simplification techniques. Prerequisites: MATH 111 or equivalent with grade of C or better. Course fee: \$60. Credit Hours: 4

**CS220 - Programming with Data Structures** [IAI Course: CS 912] Advanced programming, data structures and algorithm design. Topics included advanced language features, data abstraction and object-oriented programming, recursion, stacks, queues, linked lists, trees and graphs, sorting and

searching. The course meets for three lecture hours and two laboratory hours per week. Prerequisites: CS 202 and CS 215 each with a grade of C or better. Course fee: \$60. Credit Hours: 4

**CS221 - Introduction to Internet and Mobile Computing** As a preparation course for students to prepare for higher level core curricula, this course provides a comprehensive introduction to a broad range of fundamental computer system concepts and principles. Coverage includes operating system concepts; fundamentals of network, internet, and world-wide-web; C programming; core Linux/Unix systems concepts and tools; and a little taste of Android App development. Prerequisite: CS 202 with a grade of C or better. CS fee: \$100. Credit Hours: 4

**CS280 - Computational Statistics I** This course provides a basic introduction to probability and statistics as well as related computational approaches. Topics include basic probability models, combinatorics, random variables, discrete and continuous probability distributions, statistical estimation and hypotheses testing, confidence intervals and linear regression. Some selected computational approaches for statistical problems such as simulation of random variables from probability distributions, the visualization of multivariate data, Monte Carlo integration and methods in inference will also be discussed. The R language will be used for programming assignments. Prerequisite: MATH 108 with a grade of C or better. Credit Hours: 3

**CS290 - Communication Skills and Ethics for Computer Science** Effective writing, reading, presentation and oral communication skills for computer science professionals. Evaluation and analysis of technical material. Communicating with stakeholders and team members. Professional ethics and responsibilities in society and industry. Legal and sustainability impact. Discussions and assignments utilizing technical materials and case studies pertaining to history, research, practice and ethics in the discipline. Prerequisites: CS 201 or CS 202 with a grade of C or better or consent of the instructor. Credit Hours: 3

**CS300 - Introduction to Linux** A gentle introduction to the Linux operating system. Computer programming experience is not required. Students will gain the knowledge and hands-on experience needed to install, configure, and use Linux. Emphasis will be placed on administration skills and security. Software for Linux will be surveyed, particularly to identify replacements for standard Windows applications. Prior experience with Windows or Macintosh operating systems is assumed. Credit Hours: 3

**CS304 - Advanced Object-Oriented Programming** Advanced features of object-oriented programming are covered in depth. The topics covered include, but are not limited to, the following: polymorphism, inheritance, overloading, generic programming, exception handling, file I/O, GUI development. A group project is an integral part of the course. Prerequisite: CS 220 with a grade of C or better. Credit Hours: 3

**CS305 - Software Development Practices** Agile software development approach, tools, methodologies, and technical writing are addressed. Understanding of object-oriented design principles, implementation, and testing to meet customer requirements are enhanced through agile practices using modern development tools. A team project is an integral part of this course. Prerequisite: CS 220 with a grade of C or better. Credit Hours: 3

**CS306 - Linux/UNIX Programming** This course will prepare students to develop software in and for Linux/UNIX environments. Topics to be covered include basic operating system concepts, effective command line usage, shell programming, the C language, programming development tools, system programming, network programming (client-server model and sockets), and GUI programming. Prerequisites: CS 220 and CS 221 with a grade of C or better. CS fee: \$60. Credit Hours: 4

**CS311 - The Theory and Implementation of Programming Languages** Introduction to the theory and implementation of programming languages including finite automata, regular grammars, lexical analysis, parsing, syntax-directed translation, semantic analysis, binding variables, data types, static and dynamic scope, subprograms, abstraction, and concurrency. Study of object-oriented, functional, and logic programming languages. Lab work is essential. Prerequisite: CS 220 with a grade of C or better. Credit Hours: 3

**CS315 - Computer Logic and Digital Design** Introduction to switching algebra and its applications. Combinational logic and combinational circuit components. Sequential logic and sequential circuit

components. Asynchronous sequential circuits. Prerequisite: CS 215 with a grade of C or better. Credit Hours: 3

**CS320 - Computer Organization and Architecture** Overview of the basic logic circuits needed in constructing a computer. Fundamental computer operations: machine and assembly language instructions, stacks, procedures and macros. The translation process: assembly, linking and loading. Hardware elements for processing, transferring, and storing information. Data path and control unit for a simple processor. Prerequisite: CS 220 with grade of C or better. Credit Hours: 3

**CS330 - Introduction to the Design and Analysis of Algorithms** A detailed treatment of the design, analysis, and complexity of algorithms, including greedy algorithms, divide and conquer, dynamic programming, and limitations of algorithms as problems get larger or more complex. Prerequisite: CS 220 with a grade of C or better. Credit Hours: 3

**CS335 - Operating Systems** An extended treatment of the components of operating systems including process management, concurrency, memory management, device management, file management, and security. Prerequisites: CS 220 and CS 221 with a grade of C or better. Credit Hours: 3

**CS350 - Web Application Development** A comprehensive introduction to languages and tools used to create client side and server side Web applications. Topics include, but are not limited to, markup languages, server-side and client-side scripting languages, web programming languages, web development architectures, frameworks and technologies, and database access. Prerequisites: CS 202 and CS 221 with a grade of C or better or consent of instructor. Credit Hours: 3

**CS391 - Current Topics in Computer Science** Selected current topics from various fields of computer science. Only maximum of 6 credit hours can be counted toward degree. Credit Hours: 1-3

**CS393 - Internship in Computer Science** Credit for participation in a formalized internship program involving computer science related work. Hours do not count toward requirements for computer science major. Mandatory Pass/Fail. Prerequisite: Prior approval of the sponsoring agency and the School of Computing. Restricted to Computer Science major. Credit Hours: 1-6

**CS401 - Computer Architecture** Review of logical circuit design. Hardware description languages. Algorithms for high-speed addition, multiplication and division. Pipelined arithmetic. Implementation and control issues using PLA's and microprogramming control. Cache and main memory design. Input/Output. Introduction to interconnection networks and multiprocessor organization. Prerequisite: CS 320 with a grade of C or better or graduate standing. Credit Hours: 3

**CS404 - Autonomous Mobile Robots** This course is a comprehensive introduction to modern robotics with an emphasis on autonomous mobile robotics. Fundamentals of sensors and actuators as well as algorithms for top level control are discussed. Multi-robotics and human-robot interaction issues are explored. A group project is an integral part of this course. Prerequisite: CS 330 with a grade of C or better or graduate standing. CS fee: \$125. Credit Hours: 3

**CS406 - Basic Linux System Administration** This course will be an introduction to the administration of Linux systems, with emphasis on security for networked systems. Topics to be covered include: installation and configuration of Linux distributions, typical maintenance activities, and security measures for networked systems. Students will have access to lab machines for hands on practice. Prerequisite: CS 306 with a grade of C or better or graduate standing. Credit Hours: 3

**CS407 - Advanced Linux/UNIX Programming** This course builds on the knowledge gained in CS 306, to prepare students to do advanced development on Linux/UNIX platforms. The topics studied are critical for achieving high performance in large-scale, high-load networked software systems. These topics include development techniques such as profiling, concurrent programming and synchronization, network programming for high-load servers, advanced I/O alternatives, and IPC such as shared memory. The course will involve the study of code from Open Source projects like Apache and Nginx. The focus will be on the C language, but other languages will also be considered. Students must complete a significant network software project. Prerequisites: CS 306 and CS 335, with grades of C or better, or graduate standing with C language and Linux system programming experience. Credit Hours: 3

**CS408 - Applied Cryptography** This course is a comprehensive introduction to modern cryptography, with an emphasis on the application and implementation of various techniques for achieving message confidentiality, integrity, authentication and non-repudiation. Applications to Internet security and electronic commerce will be discussed. All background mathematics will be covered in the course. Prerequisite: CS 330 with a grade of C or better and MATH 221 or graduate standing. Credit Hours: 3

**CS409 - Ethical Hacking** This course will explore the various means that an intruder has available to gain access to computer resources. We will investigate weaknesses by discussing the theoretical background, and whenever possible, actually performing the attack. We will then discuss methods to prevent/reduce the vulnerabilities. This course is targeted specifically for Certified Ethical Hacking (CEH) exam candidates, matching the CEH exam objectives with the effective and popular Cert Guide method of study. Prerequisite: CS 202 with a grade of C or better or graduate standing. Credit Hours: 3

**CS410 - Computer Security** A broad overview of the principles, mechanisms, and implementations of computer security. Topics include cryptography, access control, software security and malicious code, trusted systems, network security and electronic commerce, audit and monitoring, risk management and disaster recovery, military security and information warfare, physical security, privacy and copyrights, and legal issues. Prerequisite: CS 306 with a grade of C or better or graduate standing. Credit Hours: 3

**CS412 - Programming Distributed Applications** This course uses advanced features of the Java programming language to develop networked, distributed, and web-based applications. Topics covered include, but are not limited to, sockets, datagrams, the Java security model, threads, multi-tier architectures, Java RMI, Java database connectivity, and Java-based mobile agents. Prerequisite: CS 306 with a grade of C or better or graduate standing. Credit Hours: 3

**CS413 - Digital Forensics** Cybersecurity has become a ubiquitous concern well beyond finding solutions to post-mortem threat analysis. The course provides a broad overview of security objectives and will cover fundamentals in confidentiality, integrity, and availability. Lectures will offer a broad range of topics on digital forensics. Students will be trained for an investigation mindset. Contemporary tools and techniques for digital forensics and investigations are reviewed. Security for stationary and mobile platforms are foci of current course in both forensic and active modes. There will be multiple hands-on homework and laboratories as well as a practical project as an integral part of this course. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS415 - Network Forensics** With the proliferation of wireless networks, security is at odds with privacy and integrity. The course provides a broad overview of security strategies for wireless networks. Topics will range from intrusion detection and network security protocols to collaborative computing. Contemporary tools and techniques for wireless network security are reviewed. A hands-on project will be an integral part of this course. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS416 - Compiler Construction** Introduction to compiler construction. Design of a simple complete compiler, including lexical analysis, syntactical analysis, type checking, and code generation. Prerequisite: CS 306 and 311 each with a grade of C or better or graduate standing. Credit Hours: 3

**CS420 - Distributed Systems** A top-down approach addressing the issues to be resolved in the design of distributed systems. Concepts and existing approaches are described using a variety of methods including case studies, abstract models, algorithms and implementation exercises. Prerequisite: CS 335 with a grade of C or better or graduate standing. Credit Hours: 3

**CS425 - Principles of Virtualization and Cloud Computing** Cloud Computing (CC) represents a recent major strategic shift in computing and Information Technology. This course explores fundamental principles, foundational technologies, architecture, design, and business values of CC. Understanding will be reinforced through multiple angles including: analysis of real world case studies, hands-on projects and in-depth study of research developments. Prerequisites: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS430 - Database Systems** The course concentrates on the relational model, database design, and database programming. Topics include relational model, relational algebra, SQL, constraints and integrity, transaction support, concurrency control, database design, normalization, backup, recovery, and security.



A comprehensive product-like project is an integral part of the course. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS431 - Cyber-Physical Systems** The goal of this course is to introduce and develop an understanding of the computing and communication for Internet of Things as a subset of Cyber-Physical systems. Connectivity among devices in our daily lives such as WiFi-enabled thermostats, smart grids, and driverless cars is ushering in an era of sociality that transcends human social networks to machine to machine networks. Prerequisites: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS434 - Learning From Data** An introduction to classical machine learning theory and practical techniques. Topics to be covered include computational learning theory (VC theory), linear classification and regression models, SVMs and kernel methods, decision trees, the bias-variance tradeoff, overfitting, and regularization. Prerequisites: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS435 - Software Engineering** Principles, practices and methodology for development of large software systems. Object-oriented principles, design notations, design patterns and coping with changing requirements in the software process. Experiences with modern development tools and methodologies. A team project is an integral part of this course. Prerequisite: CS 330 with a grade of C or better or graduate standing; CS 306 with a grade of C or better recommended. Credit Hours: 3

**CS436 - Artificial Intelligence I** Search and heuristics, problem reduction. Predicate calculus, automated theorem proving. Knowledge representation. Applications of artificial intelligence. Parallel processing in artificial intelligence. Prerequisite: CS 311 and 330 each with a grade of C or better or graduate standing. Credit Hours: 3

**CS437 - Machine Learning and Soft Computing** An introduction to the field of machine learning and soft computing. It covers rule-based expert systems, fuzzy expert systems, artificial neural networks, evolutionary computation, and hybrid systems. Students will develop rule-based expert systems, design a fuzzy system, explore artificial neural networks, and implement genetic algorithms. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS438 - Bioinformatics Algorithms** This course is an introductory course on bioinformatics algorithms and the computational ideas that have driven them. The course includes discussions of different techniques that can be used to solve a large number of practical problems in biology. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS440 - Computer Networks** Design and analysis of computer communication networks. Topics to be covered include queuing systems, data transmission, data link protocols, topological design, routing, flow control, security and privacy, and network performance evaluation. Prerequisite: CS 330 with a grade of C or better or graduate standing; CS 306 recommended. Credit Hours: 3

**CS441 - Mobile and Wireless Computing** Concepts of mobile and wireless systems are presented. These concepts include, but are not limited to, Routing and Medium Access for Mobile Ad hoc and Wireless Sensor Networks, Mobile IP, Wireless LAN and IEEE 802.11. Hands-on group lab experience is an integral component in the course. Prerequisite: CS 330 with a grade of C or better, or graduate standing or consent of the instructor. Credit Hours: 3

**CS447 - Introduction to Graph Theory** (Same as MATH 447) Graph theory is an area of mathematics which is fundamental to future problems such as computer security, parallel processing, the structure of the World Wide Web, traffic flow and scheduling problems. It also plays an increasingly important role within computer science. Topics include: trees, coverings, planarity, colorability, digraphs, depth-first and breadth-first searches. Prerequisite: MATH 349 with C or better. Credit Hours: 3

**CS449 - Introduction to Combinatorics** (Same as MATH 449) This course will introduce the student to various basic topics in combinatorics that are widely used throughout applicable mathematics. Possible topics include: elementary counting techniques, pigeonhole principle, multinomial principle, inclusion and exclusion, recurrence relations, generating functions, partitions, designs, graphs, finite geometry, codes and cryptography. Prerequisite: MATH 349 with C or better. Credit Hours: 3

**CS451 - Theory of Computing** The fundamental concepts of the theory of computation including finite state acceptors, formal grammars, Turing machines, and recursive functions. The relationship between grammars and machines with emphasis on regular expressions and context-free languages. Prerequisite: CS 311 and 330 each with a grade of C or better or graduate standing. Credit Hours: 3

**CS455 - Advanced Algorithm Design and Analysis** An in-depth treatment of the design, analysis and complexity of algorithms with an emphasis on problem analysis and design techniques. Prerequisites: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS471 - Optimization Techniques** (Same as MATH 471) Introduction to algorithms for finding extreme values of nonlinear multivariable functions with or without constraints. Topics include: convex sets and functions; the arithmetic-geometric mean inequality; Taylor's theorem for multivariable functions; positive definite, negative definite, and indefinite matrices; iterative methods for unconstrained optimization. Prerequisite: MATH 221 and MATH 250 with C or better. Credit Hours: 3

**CS472 - Linear Programming** (Same as MATH 472) Introduction to finding extreme values of linear functionals subject to linear constraints. Topics include: recognition, formulation, and solution of real problems via the simplex algorithm; development of the simplex algorithm; artificial variables; the dual problem and duality theorem; complementary slackness; sensitivity analysis; and selected applications of linear programming. Prerequisite: MATH 221 with C or better. Credit Hours: 3

**CS475 - Numerical Analysis I** (Same as MATH 475) Introduction to theory & techniques for computation with digital computers. Topics include: solution of nonlinear equations; interpolation & approximation; solution of systems of linear equations; numerical integration. Students will use MATLAB to study the numerical performance of the algorithms introduced in the course. Prerequisites: MATH 221 and MATH 250 with C or better. Credit Hours: 3

**CS480 - Computational Statistics II** This course utilizes computational and graphical approaches to solve statistical problems. A comprehensive coverage on modern and classical methods of statistical computing will be given. Case studies in various disciplines such as science, engineering and education will be discussed. Various topics such as numerical integration and simulation, optimization and maximum likelihood estimation, density estimation and smoothing as well as re-sampling will be presented. Students will be able to create graphical and numerical display based on their data analysis results using R programming language. Prerequisite: MATH 250 and CS 306 or CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS484 - User Interface Design and Development** Problems and processes in the design of highly usable systems. Understanding stakeholders, requirements, tasks, prototyping, evaluation, guidelines and design process and heuristics. Interactive software concepts and implementation considerations. A group project is an integral part of this course. Prerequisite: CS 306 with a grade of C or better or graduate standing. Credit Hours: 3

**CS485 - Computer Graphics** Principles and techniques of computer graphics. Interactive graphics software development using a modern graphics standard. Topics include: primitives, transforms, clipping, modeling, viewing, rendering, texture, animation and ray tracing. A group project is an integral part of this course. Prerequisite: CS 306 with a grade of C or better or graduate standing; MATH 150 and 221 are recommended. Credit Hours: 3

**CS487 - Software Aspects of Game Development** This course focuses on software implementation and development aspects of game production including: software process, system architecture, frameworks, entity management and interaction design, game design, production and business issues as well as technical foundations in graphics modeling and rendering, collision detection, physics, artificial intelligence, and multiplayer techniques. Prerequisite: CS 330 with a grade of C or better or graduate standing. Credit Hours: 3

**CS490 - Readings** Supervised readings in selected subjects. Not for graduate credit. Mandatory Pass/Fail. Special approval needed from the instructor. Credit Hours: 1-3

**CS491 - Special Topics** Selected advanced topics from the various fields of computer science. Credit Hours: 1-6

**CS492 - Special Problems** Individual projects involving independent work. Special approval needed from the instructor. Credit Hours: 1-6

**CS493 - Seminar** Supervised study. Preparation and presentation of reports. Special approval needed from the instructor. Credit Hours: 1-6

**CS498 - Senior Seminar in Computer Science** This course consists of diverse presentations by faculty, students, and invited speakers from industry, and prepares students for CS 499 (Senior Project in Computer Science) or CS 499B (Senior Thesis in Computer Science). Students in CS project track will select and plan a real world team project, while students in CS thesis track will select a research topic, under advisement of a Computer Science faculty, and will present a research proposal. Prerequisite: completion of or concurrent enrollment in at least two other 400-level Computer Science courses. Restricted to senior standing in Computer Science. Credit Hours: 2

**CS499 - Senior Project in Computer Science** A continuation of CS 498, performing exercise in the design, implementation, documentation, and deployment of a group project culminating in a presentation to the Computer Science faculty. Prerequisite: CS 498. Credit Hours: 3

**CS499B - Senior Thesis in Computer Science** A continuation of CS 498, carrying out the approved research under the supervision of a Computer Science faculty culminating in a written thesis and presentation to the Computer Science faculty, evaluated by a committee consisting of the Undergraduate Curriculum Committee, the advisor, and the instructor of the course. Prerequisite: CS 498. Credit Hours: 3

## Computer Science Faculty

**Ahmed, Khaled**, Assistant Professor, Computer Science, Ph.D., Tokyo Institute of Technology, 2004; 2019. Deep learning, big data, computer vision, parallel and distributed computing.

**Aydeger, Abdullah**, Assistant Professor, Computer Science, Ph.D., Florida International University, 2020; 2020. Network security, software defined networking, network function virtualization.

**Carver, Norman F., III**, Associate Professor, Computer Science, Ph.D., University of Massachusetts, 1990; 1995. Machine learning and data sciences, artificial intelligence approaches to optimization and control problems, multi-agent systems.

**Che, Dunren**, Professor, Computer Science, Ph.D., Beijing University of Aeronautics and Astronautics, 1994; 2001. Database and data mining, big data management and analysis, machine learning and recommendation, cloud and fog/edge computing, crowdsourcing, scientific workflow, personalized learning and education.

**Gupta, Bidyut**, Professor, Computer Science, Ph.D., University of Calcutta, 1986; 1988. Fault-tolerant computing, routing algorithms in computer networks, architecture design of P2P networks, P4P networks, Fog P2P networks.

**Hexmoor, Henry**, Associate Professor, Computer Science, Ph.D., University at Buffalo, 1996; 2006. Artificial intelligence, multi-agent systems, cognitive science, knowledge representation and reasoning, cybersecurity, blockchain.

**Huang, Chun-Hsi**, Professor and Director School of Computing, Computer Science, Ph.D., State University of New York at Buffalo, 2001; 2019. Extreme-scale computing and data analytics, computational biology, security and applied algorithmics.

**Huang, Xiaolan**, Assistant Professor, Computer Science, Ph.D., Southern Illinois University, 2017; 2019. Bioinformatics, big data analytics, machine learning, high performance computing.

**Liu, Xiaoqing**, Professor and Dean College of Engineering, Computer Science, Ph.D., Texas A & M University, 1995; 2020. Cyber argumentation based social media and networking, data analytics based recommendation systems, service computing, cyber physical systems, software engineering, applied artificial intelligence, advanced computing and data applications.

**Rekabdar, Banafsheh**, Assistant Professor, Computer Science, Ph.D., University of Nevada, 2017; 2017. Artificial intelligence, machine learning, deep learning, data mining, robotics.

**Shu, Tong**, Assistant Professor, Computer Science, Ph.D., New Jersey Institute of Technology, 2017; 2020. Parallel and distributed systems, machine learning, big data, scientific workflow, wireless networks, cloud computing, energy efficiency.

**Sinha, Koushik**, Assistant Professor, Computer Science, Ph.D., Jadavpur University, 2007; 2015. Mobile computing, wireless ad hoc and sensor networks, complex networks, social computing, crowdsourcing systems.

## **Emeriti Faculty**

**Danhof, Kenneth J.**, Professor, Emeritus, Ph.D., Purdue University, 1969.

**Hou, Wen-Chi**, Professor, Emeritus, Ph.D., Case Western Reserve University, 1989.

**Mark, Abraham M.**, Professor, Emeritus, Ph.D., Cornell University, 1947.

**McGlenn, Robert**, Associate Professor, Emeritus, Ph.D., Southern Illinois University Carbondale, 1976.

**Mogharreban, Namdar**, Associate Professor, Emeritus, Ph.D., Southern Illinois University Carbondale, 1989.

**Phillips, Nicholas C. K.**, Associate Professor, Emeritus, Ph.D., University of Natal, 1967.

**Wainer, Michael S.**, Associate Professor, Emeritus, Ph.D., University of Alabama-Birmingham, 1987.

**Wright, William E.**, Professor, Emeritus, D.Sc., Washington University, 1972.

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