### COMPUTER SCIENCE AND ENGINEERING

#### Courses

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**Notes:**
- The Unix programming environment: I/O programming, Unix processes, fork, exec, pipes and signals, and tools.
- Course content varies and will be announced in the schedule of classes by title.
- Students may not apply both CSCE 210 and CSCE 212 to any minor or major program of study.
- UNIX System Administration: UNIX system, user-level system commands, and programming tools.
- UNIX/Linux Fundamentals: UNIX operating system, user-level system commands, and programming tools.
- Advanced object-oriented concepts and techniques; multiple inheritance; memory management; operator overloading; polymorphism; performance issues.
- Fundamentals of software design and development; software implementation strategies; object-oriented design techniques; functional design techniques; design patterns; design process; source control; testing.
- Design and control of robots. Interactions between robots, sensing, actuation, and computation.
CSCE 304 - Applied Problem Solving and Programming (3 Credits)
Systematic problem definition, solution formulation, and computer implementation for business and related areas. Internet and database applications. Programming exercises in a high-level programming language.
Prerequisites: CSCE 204 or MGSC 298.

Cross-listed course: MGSC 398

CSCE 311 - Operating Systems (3 Credits)
Operating system structure and function; process implementation, scheduling, and synchronization; memory management; security; naming protection; resource allocation; network file systems.
Prerequisites: CSCE 240; CSCE 210 or CSCE 212.

CSCE 313 - Embedded Systems (3 Credits)
Fundamentals of embedded systems: hardware components, software components, hardware/software interface design, and hardware/software co-design.
Prerequisites: CSCE 211, CSCE 212.

CSCE 317 - Computer Systems Engineering (3 Credits)
System-level modeling and evaluation of computer systems: requirements elicitation and specification, architectural design, reliability and performance evaluation, Markov modeling, life-cycle cost analysis, project management.
Prerequisites: CSCE 212, MATH 242, STAT 509.

CSCE 330 - Programming Language Structures (3 Credits)
Formal specification of syntax and semantics; structure of algorithms; list processing and string manipulation languages; statement types, control structures, and interfacing procedures.
Prerequisites: CSCE 240; MATH 174 or MATH 374 or MATH 574.

CSCE 350 - Data Structures and Algorithms (3 Credits)
Techniques for representing and processing information, including the use of lists, trees, and graphs; analysis of algorithms; sorting, searching, and hashing techniques.
Prerequisites: CSCE 240; MATH 174 or MATH 374 or MATH 574.

CSCE 355 - Foundations of Computation (3 Credits)
Basic theoretical principles of computing as modeled by formal languages, grammars, automata, and Turing machines; fundamental limits of computation.
Prerequisites: CSCE 211, CSCE 212, CSCE 350.

CSCE 390 - Professional Issues in Computer Science and Engineering (1 Credit)
Professional issues in the information technology professions; history and social context of computing; professional responsibilities; privacy; intellectual property; risks and liabilities of computer-based systems.
Carolina Core: VSR

CSCE 415 - Mainframe Systems (3 Credits)
Introduction to the large scale computer systems used by businesses to support thousands of simultaneous users and process millions of transactions.
Prerequisites: ITEC 352 or CSCE 240.

Cross-listed course: ITEC 475

CSCE 416 - Introduction to Computer Networks (3 Credits)
Concepts and components of computer networks and the Internet; network applications; network protocol stack.
Prerequisites: CSCE 146.

CSCE 490 - Capstone Computing Project I (3 Credits)
Major team-based software design project to be undertaken in a student's final year of study; project planning, software requirements analysis, design, and specification. Written reports and oral presentations in a technical setting.
Prerequisites: D or better in CSCE 240.

Prerequisite or Corequisite: D or better in CSCE 350.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

CSCE 491 - Capstone Computer Engineering Project (3 Credits)
Advanced computer systems engineering. Team projects. Written reports and oral presentations in a technical setting.
Prerequisites: D or better in CSCE 240, CSCE 313, CSCE 611.

Graduation with Leadership Distinction: GLD: Research

CSCE 492 - Capstone Computing Project II (3 Credits)
Continuation of CSCE 490. Computer system implementation, testing, verification and validation of results. Written reports and oral presentations in a technical setting.
Prerequisites: CSCE 490.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

CSCE 498 - Independent Study (1-3 Credits)
Individual investigation or study of special topics. At most three credits may be applied toward a degree. Approval of project proposal by instructor and department advisor.
Graduation with Leadership Distinction: GLD: Research

CSCE 500 - Computer Programming and Applications (3 Credits)
Concepts and properties of algorithms; programming exercises with emphasis on good programming habits. Credit may not be received for both CSCE 500 and CSCE 145. Open to all majors. May not be used for major credit by computer science and engineering majors.

CSCE 510 - System Programming (3 Credits)
System software such as command language interpreters, client-server applications, debuggers; mail systems, browsers, macroprocessors, and revision control systems; file systems, processes, threads, and interprocess communication.
Prerequisites: CSCE 215, CSCE 240.

CSCE 512 - System Performance Evaluation (3 Credits)
Measuring, modeling, analyzing, and predicting performance of computer systems and networks; bottleneck analysis; Markovian queuing systems and networks; use of operational and probabilistic models.
Prerequisites: CSCE 311, STAT 509 or STAT 515.

CSCE 513 - Computer Architecture (3 Credits)
Design methodology; processor design; computer arithmetic: algorithms for addition, multiplication, floating point arithmetic; microprogrammed control; memory organization; introduction to parallel architectures.
Prerequisites: CSCE 211, CSCE 212.

CSCE 515 - Computer Network Programming (3 Credits)
Computer networks and communication protocols; socket programming; interprocess communication; development of network software; case studies.
Prerequisites: CSCE 311.
CSCE 516 - Computer Networks (3 Credits)
Structure, design, and analysis of computer networks; ISO/OSI network architecture.
Prerequisites: STAT 509 or STAT 515.

CSCE 517 - Computer Crime and Forensics (3 Credits)
Structure, design, and analysis of computer networks; ISO/OSI network architecture.
Prerequisites: CSCE 215.

CSCE 518 - Ethical Hacking (3 Credits)
Fundamental principles and techniques of ethical hacking, including penetration testing life cycle, planning and scoping, identifying targets and goals, active and passive reconnaissance, enumeration and scanning, exploitation, post-exploitation, and results reporting.
Prerequisites: CSCE 215 or previous Linux/UNIX experience.

CSCE 520 - Database System Design (3 Credits)
Database management systems; database design and implementation; security, integrity, and privacy.
Prerequisites: CSCE 240 or GEOG 563.

CSCE 522 - Information Security Principles (3 Credits)
Threats to information resources and appropriate countermeasures. Cryptography, identification and authentication, access control models and mechanisms, multilevel database security, steganography, Internet security, and intrusion detection and prevention.
Prerequisites: CSCE 146; MATH 374 or MATH 174.

CSCE 526 - Service Oriented Computing (3 Credits)
Cooperative information systems and service-oriented computing. Techniques for achieving coordinated behavior among a decentralized group of information system components. Distributed databases, multiagent systems, conceptual modeling, Web services, and applications.
Prerequisites: CSCE 311.

CSCE 531 - Compiler Construction (3 Credits)
Techniques for design and implementation of compilers, including lexical analysis, parsing, syntax-directed translation, and symbol table management.
Prerequisites: CSCE 240.

CSCE 546 - Mobile Application Development (3 Credits)
Development of mobile applications, including user interface design for mobile, local and cloud data storage techniques, and application architectures.
Prerequisites: CSCE 240 or previous programming experience with one of the following programming languages (C/C++, Java, Swift, Python, Matlab, Javascript).

CSCE 547 - Windows Programming (3 Credits)
Object-oriented methods and tools for application programming with graphically interactive operating systems.
Prerequisites: CSCE 240.

CSCE 548 - Building Secure Software (3 Credits)
Prerequisites: CSCE 240.

CSCE 551 - Theory of Computation (3 Credits)
Basic theoretical principles of computing as modeled by formal languages and automata; computability and computational complexity.
Prerequisites: C or better in CSCE 350 or MATH 300.

CSCE 552 - Computer Game Development (3 Credits)
Design and development of computer games, with emphasis on the technologies used. Hands-on development of computer games.
Prerequisites: CSCE 240, CSCE 350.

CSCE 555 - Algorithms in Bioinformatics (3 Credits)
Concepts, algorithms and tools for important problems in Bioinformatics, including nucleotide and amino acid sequence alignment, DNA fragment assembly, phylogenetic reconstruction, and protein structure visualization and assessment.
Prerequisites: CSCE 350.

CSCE 557 - Introduction to Cryptography (3 Credits)
Design of secret codes for secure communication, including encryption and integrity verification: ciphers, cryptographic hashing, and public key cryptosystems such as RSA. Mathematical principles underlying encryption. Code-breaking techniques. Cryptographic protocols.
Prerequisites: C or better in CSCE 145 or MATH 241, and at least one of CSCE 355, MATH 300 or MATH 374.

CSCE 561 - Numerical Analysis (3 Credits)
Interpolation and approximation of functions; solution of algebraic equations; numerical differentiation and integration; numerical solutions of ordinary differential equations and boundary value problems; computer implementation of algorithms.
Prerequisites: C or better MATH 520 or in both MATH 242 and MATH 344.

CSCE 563 - Systems Simulation (3 Credits)
Computer simulation of real systems; principles of system organization; random number generation; programming exercises in a simulation language.
Prerequisites: CSCE 240, STAT 509 or STAT 515.

CSCE 564 - Computational Science (3 Credits)
Parallel algorithms; scientific visualization; techniques for solving scientific problems.
Prerequisites: MATH 526, CSCE 146 or CSCE 207 or CSCE 500.

CSCE 565 - Introduction to Computer Graphics (3 Credits)
Graphics hardware; graphics primitives; two-dimensional and three-dimensional viewing; basic modeling.
Prerequisites: CSCE 240, MATH 526 or MATH 544.

CSCE 567 - Visualization Tools (3 Credits)
Scientific visualization tools as applied to sampled and generated data; methods for data manipulation and representation; investigation of visualization techniques.
Prerequisites: CSCE 145 or CSCE 206 or CSCE 207.
CSCE 569 - Parallel Computing (3 Credits)
Architecture and interconnection of parallel computers; parallel programming models and applications; issues in high-performance computing; programming of parallel computers.
**Prerequisites:** knowledge of programming in a high-level language; MATH 526 or MATH 544.

CSCE 571 - Critical Interactives (3 Credits)
Foundational techniques in multidisciplinary software development, specifically of applications designed to present sensitive, sometimes controversial, materials in ways to engender empathic awareness of the interactor.
**Cross-listed course:** FAMS 581

CSCE 572 - Human-Computer Interaction (3 Credits)
Interdisciplinary approach to interaction design, user-centered design, human abilities, survey development, experimental study methodology, heuristic evaluations, usability testing, universal design, and accessibility.
**Prerequisites:** Undergraduate or graduate standing in CSE or permission of the instructor.

CSCE 574 - Robotics (3 Credits)
Design and application of robotic systems; emphasis on mobile robots and intelligent machines.
**Prerequisites:** CSCE 211, CSCE 212, CSCE 240.

CSCE 578 - Text Processing (3 Credits)
Text and natural language processing; formal models and data structures appropriate for text processing; selected topics in computational linguistics, stylistics, and content analysis.
**Prerequisites:** CSCE 330, CSCE 355.

CSCE 580 - Artificial Intelligence (3 Credits)
Heuristic problem solving, theorem proving, and knowledge representation, including the use of appropriate programming languages and tools.
**Prerequisites:** CSCE 350.

CSCE 582 - Bayesian Networks and Decision Graphs (3 Credits)
Normative approaches to uncertainty in artificial intelligence. Probabilistic and causal modeling with Bayesian networks and influence diagrams. Applications in decision analysis and support. Algorithms for probability update in graphical models.
**Prerequisites:** CSCE 350, STAT 509 or STAT 515.

**Cross-listed course:** STAT 582

CSCE 585 - Machine Learning Systems (3 Credits)
Design and implementation of machine learning systems, Deep learning systems stack, machine learning platforms, scalable and distributed machine learning.
**Prerequisites:** C or better in CSCE 240 or CSCE 206.

CSCE 587 - Big Data Analytics (3 Credits)
Foundational techniques and tools required for data science and big data analytics. Concepts, principles, and techniques applicable to any technology and industry for establishing a baseline that can be enhanced by future study.
**Prerequisites:** STAT 509, STAT 513, or STAT 515.

**Cross-listed course:** STAT 587