COMPUTER SCIENCE AND ENGINEERING (CSCE)

CSCE 100 Introduction to Informatics
Prerequisites: Placement in to MATH 101 or higher
Notes: This course should not be taken by majors in Computer Science or Computer Engineering.
Description: Introduction to programming in the context of current web development technologies (JavaScript, HTML, CSS). Basic coding skills and an introduction to computing with an emphasis on problem-solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 101 Fundamentals of Computer Science
Prerequisites: High School algebra and use of computing applications
Notes: CSCE 101 is intended for non-CSCE majors who desire a deeper understanding of computers and the work of computer scientists. CSCE 101 is a course in the science of computation and is suitable for non-CSCE majors and prospective CSCE majors.
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation in a high-level programming environment. Hardware, software, software engineering, networks, and impacts of computing on society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 101L Fundamentals of Computing Laboratory
Prerequisites: CSCE 101 or parallel.
Notes: Will not count towards the requirements for a major or minor in computer science and computer engineering.
Description: A variety of computer oriented exercises using many software tools is presented which supplement and are coordinated with the topics taught in CSCE 101. Students are exposed to programming, operating systems, simulation software, spreadsheets, database software, the Internet, etc. Applications software introduced in the context of tools to explore the computer science topics and as alternatives to traditional programming languages. Emphasis on learning by experiment, with a goal of developing problem solving skills. A major component is the study of a programming language-the choice of which may vary by course section.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CSCE 120 Learning to Code
Prerequisites: Placement in to MATH 101 or higher
Notes: This course should not be taken by majors in Computer Science or Computer Engineering. First course in a sequence for the minor in Software Development.
Description: Introduction to coding in the context of current web development technologies (JavaScript, HTML, CSS). Basic coding skills and an introduction to computing with an emphasis on problem-solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 155A Computer Science I
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Notes: Credit may be earned in only one CSCE 155 course. Recommended for students majoring in computer science or computer engineering.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155E Computer Science I: Systems Engineering Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE 101; MATH 103 or equivalent
Notes: Credit may be earned in only one CSCE 155 course. Recommended for students interested in systems engineering, such as operating systems, mobile computing, and embedded devices.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155H Honors: Computer Science I
Prerequisites: Good standing in the University Honors Program or by invitation; appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Notes: CSCE 155H covers the same topics as CSCE 155A, but in greater depth.
Description: For course description, see CSCE 155A.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350
ACE: ACE 3 Math/Stat/Reasoning
CSCE 155N Computer Science I: Engineering and Science Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE 101; MATH 103 or equivalent
Notes: Recommended for students interested in numerical and graphical applications in engineering and science, such as applied physics, working with time-sequence data, and matrix applications.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHME 223; CSCE 230; CSCE 230H; CSCE 235; CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350; MECH 381; METR 223; METR 312; METR 323
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155T Computer Science I: Informatics Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE 101; MATH 103 or equivalent
Notes: Recommended for students interested in data and information processing, such as library and database applications, online commerce, and bioinformatics. Credit may be earned in only one CSCE 155 course.
Description: Introduction to computers and problem-solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235; CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350
ACE: ACE 3 Math/Stat/Reasoning

CSCE 156 Computer Science II
Prerequisites: Appropriate score on the CSE Placement Exam or a grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; MATH 106 or parallel
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; CSCE 322; CSCE 378; SOFT 162

CSCE 156H Honors: Computer Science II
Prerequisites: Good standing in the University Honors Program or by invitation; appropriate score on CSE Placement Exam or a grade of "P" or "C" or better in CSCE 155 or 155H; MATH 106 or parallel
Notes: CSCE 156H covers the same topics as CSCE 156, but in greater depth. Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: For course description, see CSCE 156.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; CSCE 322; CSCE 378; SOFT 162

CSCE 183H Honors: Computer Problem Solving Essentials
Crosslisted with: RAIK 183H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation. JAVA in a Windows platform.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ECON 215; MATH 380, MATH 380H, STAT 380, STAT 380H, RAIK 270H; MRKT 350; SCMA 250
ACE: ACE 3 Math/Stat/Reasoning

CSCE 184H Honors: Software Development Essentials
Crosslisted with: RAIK 184H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 183H.
Description: Problem solving with computers. Problem analysis and specification, data structures, relational databases, algorithm development, and program design and implementation. Discrete mathematics topics, propositional and predicate logic, sets, relations, functions, and proof techniques. Software Development Principles.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 190 Special Topics in Computer Science

CSCE 190 Special Topics in Computer Science
Prerequisites: Permission.
Notes: CSCE 190 will not count towards a major or minor in computer science and computer engineering. Topics will vary.
Description: Aspects of computers and computing at the freshman level for non-computer science and computer engineering majors and/or minors.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC
CSCE 196 Special Topics in Computer Science  
Prerequisites: Permission.  
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.  
Credit Hours: 1-3  
Min credits per semester: 1  
Max credits per semester: 3  
Max credits per degree: 6  
Format: LEC

CSCE 220 Software Development for Smart-Mobile Systems  
Prerequisites: CSCE 120  
Notes: Second course in a sequence for the minor in Software Development. This course should not be taken by majors in Computer Science or Computer Engineering.  
Description: Practical experience on building larger scale applications and familiarity with the tools, environments (e.g., Android or iOS), and requirements to develop software for current smart-mobile devices such as phones and tablets.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 230 Computer Organization  
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160 or equivalent knowledge of a high-level programming language.  
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.  
Description: Introduction to organization and structure of computer systems. Boolean logic, digital arithmetic, processor organization, machine language programming, input/output, memory organization, system support software, communication, and ethics.  
Credit Hours: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Format: LEC  
Prerequisite for: CSCE 322; CSCE 438, CSCE 838; ECEN 220

CSCE 230H Honors: Computer Organization  
Prerequisites: Good standing in the University Honors Program or by invitation; a grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160 or equivalent knowledge of a high-level programming language.  
Notes: CSCE 230H covers the same topics as CSCE 230, but in greater depth. Laboratories supplement the lecture material and give an opportunity to practice concepts.  
Description: For course description, see CSCE 230.  
Credit Hours: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Format: LEC  
Prerequisite for: CSCE 322; CSCE 438, CSCE 838; ECEN 220

CSCE 231 Computer Systems Engineering  
Prerequisites: Grade of "Pass" or "C" or better in CSCE 235 or CSCE 235H.  
Credit Hours: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Format: LEC

CSCE 235 Introduction to Discrete Structures  
Crosslisted with: CSCE 235H  
Prerequisites: A grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; Math 106.  
Description: For course description, see CSCE235.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: CSCE 310, CSCE 310H; SOFT 260

CSCE 235H Introduction to Discrete Structures  
Crosslisted with: CSCE 235  
Prerequisites: A grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; Math 106.  
Description: For course description, see CSCE235.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: CSCE 310, CSCE 310H; SOFT 260

CSCE 236 Embedded Systems  
Prerequisites: CSCE 230  
Description: Introduction to designing, interfacing, configuring, and programming embedded systems. Configure simple embedded microprocessor systems, control peripherals, write device drivers in a high-level language, set up embedded and real-time operating systems, and develop applications for embedded systems.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 251 Unix Programming Environment  
Prerequisites: Familiarity with at least one high-level programming language.  
Description: Introduction to the Unix operating system. Unix file system. Unix tools and utilities. Shell programming.  
Credit Hours: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Format: LEC

CSCE 251K C Programming  
Prerequisites: Familiarity with one high-level programming language.  
Description: Introduction to the C programming language.  
Credit Hours: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Format: LAB
CSCE 252A FORTRAN Programming

Prerequisites: Familiarity with one high-level programming language.
Notes: Credit towards the degree may be earned in only one of: CSCE 155E or CSCE 155N or CSCE 155T or CSCE 252A.
Description: Principles and practice of FORTRAN programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CSCE 283H Honors: Foundations of Computer Science

Crosslisted with: RAIK 283H

Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 184H.
Description: Advanced data structures and algorithms that solve common problems and standard approaches to solving new problems. Analysis and comparison of algorithms, asymptotic notation and proofs of correctness. Discrete mathematics. Induction and principles of counting and combinatorics as foundation for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 284H Honors: Foundations of Computer Systems

Crosslisted with: RAIK 284H

Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 283H.
Description: Introduction to fundamental organization and structure of computer systems. Boolean logic, data representation, processor organization, input/output, memory organization, system support software and communication.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

CSCE 290 Special Topics in Computer Science

Prerequisites: Permission.
Notes: Topics vary. CSCE 290 will not count towards a major or minor in computer science and computer engineering.
Description: Aspects of computers and computing for non-computer science and computer engineering majors and/or minors.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 296 Special Topics in Computer Science

Prerequisites: Permission.
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 310 Data Structures and Algorithms

Crosslisted with: CSCE 310H
Prerequisites: Grades of "Pass" or "C" or better in CSCE 156/156H or SOFT 161 and 235/235H.
Description: For course description, see CSCE310.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 310H Data Structures and Algorithms

Crosslisted with: CSCE 310
Prerequisites: Good Standing in UNL Honors Program or by invitation; grades of "P" or "C" or better in CSCE 156/156H or SOFT 161 and 235/235H.
Description: For course description, see CSCE310.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 311 Data Structures and Algorithms for Informatics

Prerequisites: Grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160.
Notes: CSE majors must take CSCE 310. Students may not receive credit for both CSCE310 and 311.
Description: An introduction to algorithms and data structures for informatics. Foundational coverage of algorithms includes both problems (such as indexing, searching, sorting, and pattern matching) and methods (such as greedy, divide-and-conquer, and dynamic programming). Foundational coverage of data structures includes lists, tables, relational databases, regular expressions, trees, graphs, and multidimensional arrays. The topics will be studied in the context of informatics applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 322; CSCE 378; CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 320 Data Analysis

Prerequisites: CSCE 220
Notes: This course should not be taken by majors in Computer Science or Computer Engineering. Third course in a sequence for the minor in Software Development.
Description: Practical experience on how to model data through existing techniques including object-oriented and relational models. These models can then be used at the center of systems to promote efficient and effective data processing and analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 322 Programming Language Concepts
Prerequisites: CSCE 156, SOFT 161 or CSCE 311; CSCE 230.
Description: List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 322H Honors: Programming Language Concepts
Prerequisites: Good Standing in UNL Honors Program or by invitation; CSCE156/CSCE156H or CSCE311, CSCE230/CSCE230H
Description: List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 335 Digital Logic Design
Crosslisted with: ECEN 370
Prerequisites: ECEN 121/(UNO) ECEN 1210 or CSCE 230.
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 307

CSCE 351 Operating System Kernels
Prerequisites: CSCE 230; CSCE 310 or CSCE 311
Notes: Lab content reinforces concepts through practice.
Description: Design and implementation of operating system kernels. Bootstrapping and system initialization, process context switching, I/O hardware and software, DMA, I/O polling, interrupt handlers, device drivers, clock management. Substantial programming implementing or extending an instructional operating system kernel.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 361 Software Engineering
Crosslisted with: CSCE 361H
Prerequisites: A grade of "Pass" or "C" or better in CSCE 310, CSCE 310H, CSCE 311 or SOFT 260.
Description: Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 486

CSCE 361H Software Engineering
Crosslisted with: CSCE 361
Prerequisites: Good Standing in UNL Honors Program or by invitation; A grade of "Pass" or "C" or better in CSCE 310, CSCE 310H, CSCE 311 or SOFT 260.
Description: Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 486

CSCE 370H Data and Models II: Data Science Fundamentals
Crosslisted with: RAIK 370H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S.Raikes School of Computer Science and Management; and RAIK 270H
Description: Introduction to approaches using data for prediction and learning. Exploration of data for linear and nonlinear data modeling, machine learning, and supportive methods from statistics and numerical methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL/SPR

CSCE 378 Human-Computer Interaction
Prerequisites: CSCE 156, SOFT 161, or CSCE 311.
Notes: MATH/STAT 380 or ELEC 305 recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCl, human information processing characteristics important in HCl, computer system features, such as input and output devices, dialogue techniques, and information presentation, task analysis, prototyping and the iterative design cycle, user interface implementation, interface evaluation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 378H Honors: Human-Computer Interaction  
**Prerequisites:** CSCE 310, CSCE 311, SOFT 260, or CSCE 283H; Good standing in the University Honors Program or by instructor permission.  
**Notes:** CSCE 378H covers the same topics as CSCE 378, but in greater depth.  
**Description:** For course description, see CSCE 378.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 383H Honors: Fundamentals of Software Engineering  
**Crosslisted with:** RAIK 383H  
**Prerequisites:** Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; CSCE/RAIK 284H.  
**Description:** Proper principles and methods of engineering software. Requirements, design, implementation, management and software evolution.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 384H Honors: Applied Numerical Analysis  
**Crosslisted with:** RAIK 384H  
**Prerequisites:** Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 284H; parallel BSAD/RAIK 382H.  
**Description:** Application of established numerical analysis techniques to selected business and finance problems, finite difference applied to standard options or stochastic processes in modeling financial markets.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 390 Special Topics in Computer Science  
**Prerequisites:** Permission.  
**Description:** Aspects of computers and computing for non-computer science and computer engineering majors and/or minors. Topics vary.  
**Credit Hours:** 1-3  
**Min credits per semester:** 1  
**Max credits per semester:** 3  
**Max credits per degree:** 6  
**Format:** LEC

CSCE 396 Special Topics in Computer Science  
**Prerequisites:** Permission.  
**Description:** Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.  
**Credit Hours:** 1-3  
**Min credits per semester:** 1  
**Max credits per semester:** 3  
**Max credits per degree:** 6  
**Format:** LEC

CSCE 399H Honors Thesis  
**Prerequisites:** Open to students in the honors program and to candidates for degrees with distinction, with high distinction, and with highest distinction.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** IND

CSCE 401H Honors: RAIK Design Studio I  
**Crosslisted with:** SOFT 401H  
**Prerequisites:** Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/RAIK 282H; and CSCE/RAIK 284H.  
**Notes:** First semester in the Jeffrey S. Raikes School of Computer Science and Management design studio  
**Description:** Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**ACE:** ACE 8 Civic/Ethics/Stewardship

CSCE 402H Honors: RAIK Design Studio II  
**Crosslisted with:** SOFT 402H  
**Prerequisites:** Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; and BSAD/CSCE/SOFT/RAIK 401H.  
**Notes:** Second semester in the Jeffrey S. Raikes School of Computer Science and Management design studio sequence.  
**Description:** Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**ACE:** ACE 10 Integrated Product

CSCE 403H Honors: RAIK Design Studio III  
**Crosslisted with:** RAIK 403H, BSAD 403H, SOFT 403H  
**Prerequisites:** Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/CSCE/SOFT/RAIK 402H.  
**Notes:** Third semester of Jeffrey S. Raikes School of Computer Science and Management design studio sequence. Third semester of Jeffrey S. Raikes School of Computer Science and Management design studio sequence.  
**Description:** Application of Jeffrey S. Raikes School of Computer Science and Management core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC
CSCE 404H Honors: RAIK Design Studio IV  
Crosslisted with: RAIK 404H, BSAD 404H, SOFT 404H  
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; and BSAD/CSCE/SOFT/RAIK 403H.  
Notes: Fourth semester in the Jeffrey S. Raikes School of Computer Science and Management design studio sequence.  
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 410 Information Retrieval Systems  
Crosslisted with: CSCE 810  
Prerequisites: CSCE 310, SOFT 260, or CSCE 311.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 411 Data Modeling for Systems Development  
Crosslisted with: CSCE 811  
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.  
Description: Concepts of relational and object-oriented data modeling through the process of data model development including conceptual, logical and physical modeling. Techniques for identifying and creating relationships between discrete data members, reasoning about how data modeling and analysis are incorporated in system design and development, and specification paradigms for data models. Common tools and technologies for engineering systems and frameworks for integrating data. Design and analysis of algorithms and techniques for identification and exploration of data relationships, such as Bayesian probability and statistics, clustering, map-reduce, and web-based visualization.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 411H Honors: Data Modeling for Systems Development  
Crosslisted with: RAIK 411H  
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311, or CSCE 283H. Good standing in the University Honors Program.  
Description: Concepts of relational and object-oriented data modeling through the process of data model development including conceptual, logical and physical modeling. Techniques for identifying and creating relationships between discrete data members, reasoning about how data modeling and analysis are incorporated in system design and development, and specification paradigms for data models. Common tools and technologies for engineering systems and frameworks for integrating data. Design and analysis of algorithms and techniques for identification and exploration of data relationships, such as Bayesian probability and statistics, clustering, map-reduce, and web-based visualization.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 412 Data Visualization  
Crosslisted with: CSCE 812  
Prerequisites: CSCE 310, CSCE 310H or CSCE 311; MATH 314  
Description: Fundamentals and implementations of data visualization techniques. Programming skills and practices in interactive visualization applications. Visualization foundations, human perception for information processing, and visualization techniques for different data types, such as scalar-field data, vector-field data, geospatial data, multivariate data, graph/network data, and text/document data. Advanced visualization algorithms and topics as time permits.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 413 Database Systems  
Crosslisted with: CSCE 813  
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311  
Description: Data and storage models for database systems; entity/relationship, relational, and constraint models; relational databases; relational algebra and calculus; structured query language; Logical database design; normalization; integrity; distributed data storage; concurrency; security issues. Spatial databases and geographic information systems.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

CSCE 421 Foundations of Constraint Processing  
Crosslisted with: CSCE 821  
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.  
Description: Constraint processing for articulating and solving industrial problems such as design, scheduling, and resource allocation. The foundations of constraint satisfaction, its basic mechanisms (e.g., search, backtracking, and consistency-checking algorithms), and constraint programming languages. New directions in the field, such as strategies for decomposition and for symmetry identification.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC
CSCE 423 Design and Analysis of Algorithms
Crosslisted with: CSCE 823
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Mathematical preliminaries. Strategies for algorithm design, including divide-and-conquer, greedy, dynamic programming and backtracking. Mathematical analysis of algorithms. Introduction to NP-Completeness theory, including the classes P and NP, polynomial transformations and NP-complete problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 424 Computational Complexity Theory
Crosslisted with: CSCE 824
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 425 Compiler Construction
Crosslisted with: CSCE 825
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Review of program language structures, translation, loading, execution, and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile-time and runtime symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, object code optimization techniques, and overall design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 428 Automata, Computation, and Formal Languages
Crosslisted with: CSCE 828
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Introduction to the classical theory of computer science. Finite state automata and regular languages, minimization of automata. Context free languages and pushdown automata, Turing machines and other models of computation, undecidable problems, introduction to computational complexity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 430 Computer Architecture
Crosslisted with: CSCE 830
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; Prereq or Coreq: MATH/STAT 380 or ELEC 305.
Description: Architecture of single-processor (Von Neumann or SISD) computer systems. Evolution, design, implementation, and evaluation of state-of-the-art systems. Memory Systems, including interleaving, hierarchies, virtual memory and cache implementations; Communications and I/O, including bus architectures, arbitration, I/O processors and DMA channels; and Central Processor Architectures, including RISC and Stack machines, high-speed arithmetic, fetch/execute overlap, and parallelism in a single-processor system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 432 High-Performance Processor Architectures
Crosslisted with: CSCE 832
Prerequisites: CSCE 430; MATH 314; MATH/STAT 380 or ELEC 305
Notes: CSCE 432 assumes knowledge of computer architecture, pipelining, memory hierarchy, instruction level parallelism, and compiler principles.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 434 VLSI Design
Crosslisted with: CSCE 834
Prerequisites: CSCE 335 or permission.
Description: Introduction to VLSI design using metal-oxide semiconductor (MOS) devices primarily aimed at computer science majors with little or no background in the physics or circuitry of such devices. Includes design of nMOS and CMOS logic, data-path, control unit, and highly concurrent systems as well as topics in design automation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 435 Cluster and Grid Computing
Crosslisted with: CSCE 835
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311 or equivalent programming experience.
Description: Build and program clusters. Cluster construction, cluster administration, cluster programming, and grid computing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 436 Advanced Embedded Systems
Crosslisted with: CSCE 836
Prerequisites: CSCE 230, CS260, CSCE 310H, CSCE 311.
Description: Embedded hardware design techniques; transceiver design and low-power communication techniques; sensors and distributed systems; embedded operating systems; driver development; embedded debugging techniques; hardware and software architectures of embedded systems; and design, development, and implementation of embedded applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 437 File and Storage Systems
Crosslisted with: CSCE 837
Prerequisites: CSCE 311, or equivalent; senior/graduate standing.
Description: System-level and device-level topics in the design, implementation, and use of file and storage systems. Components and organization of storage systems, disk drive hardware and firmware, multi-disk systems, RAID's, local distributed and P2P file systems, and low-power design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 438 Sensor Networks
Crosslisted with: CSCE 838
Prerequisites: CSCE 230, CS260, CSCE 310H, CSCE 311.
Description: Basics of sensor networks; theoretical and practical insight into wireless sensor networks, including low-power hardware and wireless communication principles; networking in wireless sensor networks; and applications of sensor networks, such as multimedia, underwater, and underground. A group project that provides hands-on interaction with a wireless sensor network testbed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 439 Robotics: Algorithms and Applications
Crosslisted with: CSCE 839
Prerequisites: CSCE 236, or ELEC 222; SOFT 260, CSCE 310H, CSCE 310H, CSCE 311, or equivalent programming experience; MATH 314; senior/graduate standing or instructor permission.
Description: Fundamental theory and algorithms for real-world robot systems. Design and build a robot platform and implement algorithms in C++ or other high-level languages. Topics include: open and closed loop control, reactive control, localization, navigation, path planning, obstacle avoidance, dynamics, kinematics, manipulation and grasping, sensing, robot vision processing, and data fusion.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 440 Numerical Analysis I
Crosslisted with: CSCE 840, MATH 440, MATH 840
Prerequisites: CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; Math 107.
Notes: Credit toward the degree may be earned only in one of the following: CSCE/MATH 440/840 and MECH 480/880.
Description: Principles of numerical computing and error analysis covering numerical error, root finding, systems of equations, interpolation, numerical differentiation and integration, and differential equations. Modeling real-world engineering problems on digital computers. Effects of floating point arithmetic.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 441 Approximation of Functions
Crosslisted with: CSCE 841, MATH 441, MATH 841
Prerequisites: A programming language, MATH 221 and 314.
Description: Polynomial interpolation, uniform approximation, orthogonal polynomials, least-first-power approximation, polynomial and spline interpolation, approximation and interpolation by rational functions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Advanced Mathematics Courses

CSCE 447 Numerical Linear Algebra
Crosslisted with: CSCE 847, MATH 447, MATH 847
Prerequisites: MATH 314
Description: Mathematics and algorithms for numerically stable matrix and linear algebra computations, including solution of linear systems, computation of eigenvalues and eigenvectors, singular value decomposition, and QR decomposition.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Advanced Mathematics Courses

CSCE 451 Operating Systems Principles
Crosslisted with: CSCE 851
Prerequisites: CSCE 230, SOFT 260, CSCE 310H, or equivalent programming experience; MATH 314; senior/graduate standing or instructor permission.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 455 Distributed Operating Systems
Crosslisted with: CSCE 855
Prerequisites: CSCE 451/851.
Description: Organization and structure of distributed operating systems. Control, communication and synchronization of concurrent processes in the context of distributed systems. Processor allocation and scheduling. Deadlock avoidance, detection, recovery in distributed systems. Fault tolerance. Distributed file system concepts and structure.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 456 Parallel Programming
Crosslisted with: CSCE 856
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent programming experience.
Description: Introduction to the fundamentals of parallel computation and applied algorithm design. Methods and models of modern parallel computation; general techniques for designing efficient parallel algorithms for distributed and shared memory multiprocessor machines; principles and practice in programming an existing parallel machine.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 457 Systems Administration
Crosslisted with: CSCE 857
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent programming experience.
Description: Introduction to basic concepts of system administration. Operating systems and networking overview. User and resource management. Networking, systems and internet related security. System services and common applications, web services, database services, and mail servers. Basic scripting in shell, Perl, and Expect. Systems administration on UNIX® platform.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 461 Advanced Topics in Software Engineering
Crosslisted with: CSCE 861, SOFT 461
Prerequisites: CSCE 361, CSCE 361H or SOFT 261
Description: Advanced or emerging techniques in software engineering. Topics include but not limited to design methodology, software dependability, and advanced software development environments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 462 Communication Networks
Crosslisted with: CSCE 862
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380 or ELEC 305.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 463 Data and Network Security
Crosslisted with: CSCE 863
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Concepts and principles of data and network security. Focuses on practical aspects and application of crypto systems in security protocols for networks such as the Internet. Topics include: applications of cryptography and cryptosystems for digital signatures, authentication, network security protocols for wired and wireless networks, cyberattacks and countermeasures, and security in modern computing platforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 464 Internet Systems and Programming
Crosslisted with: CSCE 864
Prerequisites: CSCE 156, SOFT 161, CSCE 311, or CSCE 320 or equivalent programming experience.
Description: Paradigms, systems, and languages for Internet applications. Client-side and server-side programming, object-based and event-based distributed programming, and multi-tier applications. Coverage of specific technologies varies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 465 Wireless Communication Networks
Crosslisted with: CSCE 865
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380 or ELEC 305; or instructor permission
Description: Discussion of theoretical and practical insight to wireless communications and wireless networking, current practices, and future trends. Wireless network architectures, mobility management, radio propagation, modulation, power control, antennas, channel access, pricing, and standards.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 466 Software Design and Architecture
Crosslisted with: SOFT 466, CSCE 866
Prerequisites: SOFT 261 or CSCE 361 or equivalent
Notes: Letter grade only.
Description: Introduction to the concepts, principles, and state-of-the-art methods in software design and architecture. Topics include application of software engineering process models and management approaches for the design and architecture of large-scale software systems, trade-offs of designing for qualities such as performance, security, and dependability, and techniques and tools for analyzing and evaluating software architectures.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 467 Testing, Verification and Analysis
Crosslisted with: SOFT 467, CSCE 867
Prerequisites: SOFT 261 or CSCE 361 or equivalent
Notes: Letter grade only.
Description: In-depth coverage of problems related to software quality, and approaches for addressing them. Topics include testing techniques, dynamic and static program analysis techniques, and other approaches for verifying software qualities. Tool support for performing testing, verification, and analysis will also be studied.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: SOFT 468, CSCE 868
Prerequisites: SOFT 261 or CSCE 361 or equivalent
Notes: Letter grade only.
Description: In-depth coverage of processes, methods and techniques for determining, or deciding, what a proposed software system should do. Topics include the requirements engineering process, identification of stakeholders, requirements elicitation techniques, methods for informal and formal requirements documentation, techniques for analyzing requirements models for consistency and completeness, and traceability of requirements across system development and evolution. Tool support for modeling functional and non-functional requirements to support elicitation and analysis will be studied.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 470 Computer Graphics
Crosslisted with: CSCE 870
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380
Description: Display and recording devices; incremental plotters; point, vector, and character generation; grey scale displays, digitizers and scanners, digital image storage; interactive and passive graphics; pattern recognition; data structures and graphics software; the mathematics of three dimensions; homogeneous coordinates; projections and the hidden-line problem.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 471 Introduction to Bioinformatics
Crosslisted with: CSCE 871
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380
Description: Fundamentals and trends in bioinformatics. Scoring matrices and pairwise sequence alignments via dynamic programming, BLAST, and other heuristics. Multiple sequence alignments. Applications of machine learning methods such as hidden Markov models and support vector machines to biological problems such as family modeling and phylogeny.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 472 Digital Image Processing
Crosslisted with: CSCE 872
Prerequisites: SOFT 161, or CSCE 311 or equivalent programming experience.
Description: Digital imaging systems, digital image processing, and low-level computer vision. Data structures, algorithms, and system analysis and modeling. Digital image formation and presentation, image statistics and descriptions, operations and transforms, and system simulation. Applications include system design, restoration and enhancement, reconstruction and geometric manipulation, compression, and low-level analysis for computer vision.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 473 Computer Vision
Crosslisted with: CSCE 873
Prerequisites: CSCE 156, SOFT 161, or CSCE 311 or equivalent programming experience.
Description: High-level processing for image understanding and high-level vision. Data structures, algorithms, and modeling. Low-level representation, basic pattern-recognition and image-analysis techniques, segmentation, color, texture and motion analysis, and representation of 2-D and 3-D shape. Applications for content-based image retrieval, digital libraries, and interpretation of satellite imagery.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 474 Introduction to Data Mining
Crosslisted with: CSCE 874
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380
Description: Data mining and knowledge discovery methods and their application to real-world problems. Algorithmic and systems issues. Statistical foundations, association discovery, classification, prediction, clustering, spatial data mining and advanced techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
### CSCE 475 Multiagent Systems
**Crosslisted with:** CSCE 875
**Prerequisites:** CSCE 156, SOFT 161, or CSCE 311
**Description:** Distributed problem solving and planning, search algorithms for agents, distributed rational decision making, learning multiagent systems, computational organization theory, formal methods in Distributed Artificial Intelligence, multiagent negotiations, emergent behaviors (such as ants and swarms), and Robocup technologies and real-time coalition formation.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 476 Introduction to Artificial Intelligence
**Crosslisted with:** CSCE 876
**Prerequisites:** SOFT 260, CSCE 310, CSCE 310H, or CSCE 311
**Description:** Introduction to basic principles, techniques, and tools now being used in the area of machine intelligence. Languages for AI programming introduced with emphasis on LISP. Lecture topics include problem solving, search, game playing, knowledge representation, expert systems, and applications.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 476H Honors: Introduction to Artificial Intelligence
**Crosslisted with:** CSCE 876
**Prerequisites:** SOFT 260, CSCE 310, CSCE 310H, CSCE 311, or CSCE 283H; Good standing in the University Honors Program or by instructor permission.
**Notes:** CSCE 476H covers the same topics as CSCE 476, but in greater depth.
**Description:** For course description, see CSCE 476.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 477 Cryptography and Computer Security
**Crosslisted with:** CSCE 877
**Prerequisites:** SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH 314.
**Description:** Introductory course on cryptography and computer security. Topics: classical cryptography (substitution, Vigenere, Hill and permutation ciphers, and the one-time pad); Block ciphers and stream ciphers; The Data Encryption Standard; Public-key cryptography, including RSA and El-Gamal systems; Signature schemes, including the Digital Signature Standard; Key exchange, key management and identification protocols.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 478 Introduction to Machine Learning
**Crosslisted with:** CSCE 878
**Prerequisites:** SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
**Description:** Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, date mining, computational biology, and robotics. Theoretical and empirical analyses of decision trees, artificial neural networks, Bayesian classifiers, genetic algorithms, instance-based classifiers and reinforcement learning.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 479 Introduction to Neural Networks
**Crosslisted with:** CSCE 879
**Prerequisites:** CSCE 310 or CSCE 311.
**Description:** Introduction to the concepts, design and application of connection-based computing begins by simulating neural networks, focusing on competing alternative network architectures, including sparse distributed memories, Hopfield networks, and the multilayered feed-forward systems. Construction and improvement of algorithms used for training of neural networks addressed to reduce training time and improve generalization. Algorithms for training and synthesizing effective networks implemented in high level language programs running on conventional computers. Emphasis on methods for synthesizing and simplifying network architectures for improved generalization. Application areas include: pattern recognition, computer vision, robotics medical diagnosis, weather and economic forecasting.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

### CSCE 486 Computer Science Professional Development
**Prerequisites:** A grade of "Pass" or "C" or better in SOFT 261, CSCE 361 or CSCE 361H.
**Notes:** CSCE 486 must be taken exactly one semester before CSCE 487.
**Description:** Preparation for the senior design project. Professional practice through familiarity with current tools, resources, and technologies. Professional standards, practices and ethics, and the oral and written report styles used specifically in the field of computer science.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

**ACE:** ACE 8 Civic/Ethics/Stewardship

### CSCE 487 Computer Science Senior Design Project
**Prerequisites:** CSCE 486 (taken exactly one semester previous).
**Description:** A substantial computer science project requiring design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and software engineering.

**Credit Hours:** 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Format:** LEC

**ACE:** ACE 10 Integrated Product
CSCE 488 Computer Engineering Professional Development
Prerequisites: CSCE 236; A grade of "Pass" or "C" or better in CSCE 361 or CSCE 361H; formal admission to the College of Engineering; prereq or coreq: JGEN 300.
Description: Preparation for the senior design project. Professional practice through familiarity and practice with current tools, resources, and technologies; professional standards, practices, and ethics; and oral and written report styles used in the computer engineering field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 8 Civic/Ethics/Stewardship

CSCE 489 Computer Engineering Senior Design Project
Prerequisites: CSCE 488 (taken exactly one semester previous).
Description: A substantial computer engineering project requiring hardware-software co-design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and computer engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

CSCE 490 Special Topics in Computer Science
Crosslisted with: CSCE 890
Prerequisites: Permission.
Notes: CSCE 490/890 will not count toward a major or minor in Computer Science and Computer Engineering. Topics vary.
Description: Aspects of computers and computing for non-Computer Science and Computer Engineering majors and/or minors.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 491 Internship in Computing Practice
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311
Notes: CSCE 491 requires a detailed project proposal and final report.
Description: Experiential learning in conjunction with an approved industrial or government agency under the joint supervision of an outside sponsor and a faculty advisor.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: FLD

CSCE 493 Innovation Lab Project
Prerequisites: CSCE310, CSCE310H, CSCE311, or CSCE320
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Students will work in teams and collaborate with CSE research faculty, supervising MS students, and sponsors that include private sectors and UNL faculty to design and develop real-world systems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 493A Interdisciplinary Capstone
Prerequisites: CSCE 311
Notes: Does not apply toward any requirements for the Computer Science or Computer Engineering degree. Required for the Informatics minor.
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Work in teams and collaboration with CSE research faculty and sponsors that include private sectors and UNL faculty to design and develop real-world systems to solve interdisciplinary problems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 496 Special Topics in Computer Science
Crosslisted with: CSCE 896
Prerequisites: Senior or graduate standing.
Description: Aspects of computers and computing not covered elsewhere in the curriculum presented as the need arises.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

CSCE 496H Honors: Special Topics in Computer Science
Prerequisites: Good standing in the University Honors Program or by invitation; specific course prerequisites will vary depending on the topic.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 498 Computer Problems
Crosslisted with: CSCE 898
Prerequisites: Senior or graduate standing.
Description: Independent project executed under the guidance of a member of the faculty of the Department of Computer Science. Solution and documentation of a computer problem demanding a thorough knowledge of either the numerical or nonnumerical aspects of computer science.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: IND