SOFTWARE ENGINEERING

Description
The University of Nebraska–Lincoln Department of Computer Science and Engineering (CSE) offers Nebraska’s only comprehensive program of higher education, research, and service outreach in computer science, computer engineering, and software engineering.

The CSE department offers a unique and challenging baccalaureate degree program in software engineering, incorporating hands-on learning and an integrated computer science and software engineering core curriculum to prepare graduates for professional practice in a wide range of industries and for post-graduate education.

Software engineers work on multidisciplinary teams to identify and develop software solutions and to maintain software intensive systems of all sizes. The focus of this program is on the rigorous engineering practices necessary to build, maintain, and protect modern software intensive systems. Consistent with this focus, the software engineering baccalaureate program consists of a rigorous curriculum of science, math, computer science, and software engineering courses.

Students completing the major will have the ability to:

• Apply disciplined software engineering practices and principles to the design, architecture, development, analysis, testing, and maintenance of complex software systems to meet the desired needs of the stakeholders within realistic constraints.
• Identify, formulate, and solve engineering problems using computational resources.
• Contribute their expertise by effectively collaborating and communicating with other stakeholders in multidisciplinary teams.
• Adapt to rapid advances in computing and software engineering tools, technologies, principles, and practices.

Students will also have:

• The background and perspective for post-graduate education. Studies develop skills in the application of theory, experimentation, and lifelong learning/professional development.
• Insight into the world of practicing professionals for collaborations, mutual support, and representing the profession to government and society. Studies include teamwork, communication, and hands-on experience, plus students are provided with multiple opportunities for involvement in organizations such as ACM, UPE, and IEEE.

The CSE department also offers a degree of bachelor of science in computer engineering through the College of Engineering and a bachelor of science in computer science through the College of Arts and Sciences. All students majoring in the CSE department should see their advisors during the first semester to ensure they understand the differences in the requirements among the three majors. Majors should consult with their advisors each semester for registration advising.

Introductory Courses. Entering students take SOFT 160 Software Engineering I, the first course in the software engineering core series. The software engineering core courses (SOFT 160, SOFT 161 Software Engineering II, SOFT 260 Software Engineering III, SOFT 261 Software Engineering IV) provide an introduction to fundamental software engineering concepts and foundational computer science topics to prepare students for more advanced software engineering and computer science courses.

Graduate Programs. The CSE department offers several graduate degree programs: master of science in computer science, master of science in computer science with a computer engineering specialization, master of science in computer science with a bioinformatics specialization, doctor of philosophy in computer science, doctor of philosophy in engineering with computer engineering specialization, doctor of philosophy in computer science with bioinformatics specialization, and joint doctor of philosophy in computer science and mathematics. See the Graduate Studies Catalog for details.

Major Department Admission
Students are expected to meet minimum college entrance requirements. After being admitted to the college, students desiring to pursue a degree in software engineering must go through the Professional Admission process, which is automatically performed for qualifying students at the end of the sophomore year. In order to be considered for Professional Admission to the software engineering program, students must receive at least a C+ in SOFT 260 Software Engineering III (RAIK 283H Honors: Software Engineering III), SOFT 261 Software Engineering IV (RAIK 284H Software Engineering IV), and CSCE 235 Introduction to Discrete Structures (RAIK 184H Honors: Software Development Essentials) and a GPA of at least 2.5 (semester and cumulative). If a student’s cumulative GPA drops below 2.4, the student may be placed on restricted status, may be removed from the College, and may not be able to graduate.

College Requirements

College Admission

College Entrance Requirements
Students must have high school credit for (one unit is equal to one high school year):

1. Mathematics – 4 units: 2 of algebra, 1 of geometry, and 1 of precalculus and trigonometry
2. English – 4 units
3. Natural sciences – 3 units that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management)
4. Foreign language – 2 units of a single foreign language
5. Social studies – 3 units
6. Students having a composite ACT score of 28 or greater (or equivalent SAT score) will be admitted to the College of Engineering even if they lack any one of the following: trigonometry, chemistry, or physics.
7. Students having an ACT score of 19 or less in English (or equivalent SAT score) must take ENGL 150 Writing and Inquiry or ENGL 151 Writing and Argument.

A total of 16 units is required for admission.

Students must have an ACT (enhanced) score of 24 or greater (or equivalent SAT). Students who lack entrance requirements may be admitted based on ACT scores, high school rank and credits, or may be admitted to pre-engineering status in the Exploratory and Pre-Professional Advising Center. Pre-engineering students are advised within the Exploratory and Pre-Professional Advising Center.
Students for whom English is not their language of nurture must meet the minimum English proficiency requirements of the University.

Students who lack entrance units may complete precollege training by Independent Study through the University of Nebraska–Lincoln Office of On-line and Distance Education, in summer courses, or as a part of their first or second semester course loads while in the Exploratory and Pre-Professional Advising Center or other Colleges at Nebraska.

Students should consult their advisor, their department chair, or Engineering Student Services if they have questions on current policies.

**Other Admission Requirements**

Students who transfer to the University of Nebraska–Lincoln from other accredited colleges or universities and wish to be admitted to the College of Engineering (COE) must meet COE freshman entrance requirements and have a minimum cumulative GPA of 2.5 and be calculus-ready. Students not meeting either of these requirements must enroll in the Explore Center or another University college until they meet COE admission requirements. Students transferring from UNO, UNL, or UNK to the College of Engineering must be in good academic standing with their institution.

The COE accepts courses for transfer for which a C or better grade was received. Although the University of Nebraska–Lincoln accepts D grades from the University of Nebraska at Kearney and at Omaha, not all majors in the COE accept such low grades. Students must conform to the requirements of their intended major and, in any case, are strongly encouraged to repeat courses with a grade of C- or less.

All transfer students must adopt the curricular requirements of the undergraduate catalog current at the time of transfer to the COE—not that in use when they entered the University of Nebraska–Lincoln. Upon admission to Nebraska, students wishing to pursue degree programs in the COE will be classified and subject to the policies defined in the subsequent section.

Students who were previously admitted to COE and are returning to the College of Engineering must demonstrate a cumulative GPA of 2.5 in order to be readmitted to COE.

**College Degree Requirements**

**Grade Rules**

**Grade Appeals**

In the event of a dispute involving any college policies or grades, the student should appeal to his/her instructor and appropriate department chair or school director (in that order). If a satisfactory solution is not achieved, the student may appeal his/her case through the College Academic Appeals Committee on his/her campus.

**Catalog Rule**

Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted at the University of Nebraska–Lincoln. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at Nebraska in the College of Engineering. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

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**Learning Outcomes**

Graduates of the software engineering program will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The above student outcomes have been approved by the ABET Engineering Area Delegation for use beginning with the 2019-20 academic year, and have been adopted by the faculty of the Department of Computer Science and Engineering.

**Major Requirements**

The software engineering degree requires 123 hours of coursework, including a set of required core courses and technical elective courses in computer science and software engineering and a 2-year capstone (78 credit hours), and courses in mathematics (18 credit hours), science (12 credit hours), as well as other supporting courses (15 credit hours) as described below.

**Computer Science and Software Engineering Core**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CSCE 10</td>
<td>Introduction to CSE</td>
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<tr>
<td>CSCE 231</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CSCE 235</td>
<td>Introduction to Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 322</td>
<td>Programming Language Concepts</td>
<td>3</td>
</tr>
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<td>CSCE 378</td>
<td>Human-Computer Interaction</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 411</td>
<td>Data Modeling for Systems Development</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 423</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 451</td>
<td>Operating Systems Principles</td>
<td>3</td>
</tr>
<tr>
<td>or CSCE 351</td>
<td>Operating System Kernels</td>
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**Software Engineering**

<table>
<thead>
<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>CSCE 495</td>
<td>Internship in Computing Practice</td>
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<tr>
<td>SOFT 160</td>
<td>Software Engineering I</td>
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<td>SOFT 161</td>
<td>Software Engineering II</td>
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<td>SOFT 260</td>
<td>Software Engineering III</td>
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<td>SOFT 261</td>
<td>Software Engineering IV</td>
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<td>SOFT 360</td>
<td>Software Engineering Mentoring and Leadership</td>
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### Software Engineering

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<tr>
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<td>Advanced Topics in Software Engineering</td>
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<td>CSCE 461</td>
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<tr>
<td>SOFT 466</td>
<td>Software Design and Architecture</td>
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<td>CSCE 466</td>
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<td>SOFT 467</td>
<td>Testing, Verification and Analysis</td>
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<td>CSCE 467</td>
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<tr>
<td>SOFT 468</td>
<td>Requirements Elicitation, Modeling and Analysis</td>
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<tr>
<td>CSCE 468</td>
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**Total Credit Hours:** 51

**Or, for students in the J.S. Raikes School of Computer Science and Management:**

#### Computer Science

<table>
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<tr>
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<td>CSCE 231</td>
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<td>CSCE 322</td>
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<td>CSCE 378</td>
<td>Human-Computer Interaction</td>
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<tr>
<td>CSCE 411</td>
<td>Data Modeling for Systems Development</td>
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<tr>
<td>CSCE 423</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 451</td>
<td>Operating Systems Principles</td>
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<tr>
<td>or CSCE 351</td>
<td>Operating System Kernels</td>
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**Software Engineering**

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<tr>
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<tr>
<td>CSCE 495</td>
<td>Internship in Computing Practice</td>
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<tr>
<td>RAIK 183H</td>
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<td>CSCE 183H</td>
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<td>RAIK 184H</td>
<td>Honors: Software Development Essentials</td>
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<tr>
<td>RAIK 186H</td>
<td>Honors: Foundations of Leadership II</td>
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<td>RAIK 283H</td>
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<td>SOFT 260H</td>
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<td>RAIK 284H</td>
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<td>CSCE 468</td>
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**Total Credit Hours:** 48

### Technical Electives

Students must take at least 15 credit hours of SOFT or CSCE technical electives.

**Total Credit Hours:** 15

### Capstone Experience

<table>
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<th>Credit Hours</th>
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<td>CSCE 486</td>
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<td>CSCE 487</td>
<td>Computer Science Senior Design Project</td>
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<tr>
<td>SOFT 403</td>
<td>Software Engineering Capstone I</td>
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**SOFT 404 | Software Engineering Capstone II | 3**

**Credit Hours Subtotal:** 12

**Or, for students in the J.S. Raikes School of Computer Science and Management:**

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<tbody>
<tr>
<td>RAIK 401H</td>
<td>Honors: RAIK Design Studio I</td>
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<td>CSCE 401H</td>
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<tr>
<td>RAIK 402H</td>
<td>Honors: RAIK Design Studio II</td>
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<td>CSCE 402H</td>
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<tr>
<td>RAIK 403H</td>
<td>Honors: RAIK Design Studio III</td>
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<td>BSAD 403H</td>
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<td>CSCE 403H</td>
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<tr>
<td>or RAIK 405H</td>
<td>Honors: RAIK Research Studio I</td>
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<tr>
<td>or RAIK 406H</td>
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<tr>
<td>CSCE 406H</td>
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**Credit Hours Subtotal:** 12

### Mathematics (minimum 18 hrs)

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<tr>
<td>MATH 106</td>
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<tr>
<td>MATH 107</td>
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<tr>
<td>MATH 314</td>
<td>Linear Algebra</td>
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<tr>
<td>STAT 380</td>
<td>Statistics and Applications</td>
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Select one of the following: 3-4

<table>
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<tr>
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<th>Course Name</th>
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<tbody>
<tr>
<td>MATH 208</td>
<td>Calculus III</td>
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<td>MATH 208H</td>
<td>Honors: Calculus III</td>
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<tr>
<td>MATH 428</td>
<td>Principles of Operations Research</td>
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<tr>
<td>MATH 439</td>
<td>Mathematical Biology</td>
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<td>STAT 412</td>
<td>Advanced Statistical Design</td>
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<tr>
<td>STAT 414</td>
<td>Introduction to Survey Sampling</td>
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<td>STAT 442</td>
<td>Computational Biology</td>
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<tr>
<td>STAT 450</td>
<td>Introduction to Regression Analysis</td>
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**Total Credit Hours:** 18-19

### Science (minimum 12 hrs)

Must take at least 12 credit hours of science courses intended for science/engineering majors and must include at least one laboratory. The CSE department has identified the following five disciplines with their acceptable courses.

#### Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CHEM 109A</td>
<td>General Chemistry I &amp; &amp;CHEM 109L</td>
<td>and General Chemistry I Laboratory</td>
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<td>&amp; CHEM 110A</td>
<td>and General Chemistry I Laboratory</td>
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<tr>
<td>&amp; CHEM 110L</td>
<td>and General Chemistry II Laboratory</td>
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<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
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<tr>
<td>CHEM 113A</td>
<td>Fundamental Chemistry I &amp; &amp;CHEM 113L</td>
<td>and Fundamental Chemistry I Laboratory</td>
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<tr>
<td>&amp; CHEM 114</td>
<td>and Fundamental Chemistry II</td>
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<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
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<tr>
<td>CHEM 261</td>
<td>Organic Chemistry</td>
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**Total Credit Hours:** 12
Other Supporting Courses (minimum 15 hrs)

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<td>CHEM 263</td>
<td>Organic Chemistry Laboratory 3</td>
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<tr>
<td>CHEM 264</td>
<td>Organic Chemistry Laboratory 3</td>
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<tr>
<td>ASTR 204</td>
<td>Introduction to Astronomy and</td>
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<td></td>
<td>Astrophysics</td>
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<td>ASTR 224</td>
<td>Astronomy and Astrophysics Laboratory 3</td>
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<td>PHYS 141</td>
<td>Elementary General Physics I</td>
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<td>PHYS 142</td>
<td>Elementary General Physics II 3</td>
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<td>PHYS 211</td>
<td>General Physics I</td>
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<td>PHYS 212</td>
<td>General Physics II</td>
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<td>PHYS 223</td>
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<td>BIOS 205</td>
<td>Genetics, Molecular and Cellular</td>
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<td>BIOS 206</td>
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<td>GEOG 155</td>
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<td>METR 100</td>
<td>Weather and Climate 3</td>
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<tr>
<td>METR 205</td>
<td>Introduction to Atmospheric Science</td>
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<td>METR 223</td>
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<td>METR 311</td>
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<td>ANTH 242</td>
<td>Introduction to Biological</td>
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<td>ANTH 242L</td>
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**Other Supporting Courses (minimum 15 hrs)**

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<td>ENGR 20</td>
<td>Sophomore Engineering Seminar</td>
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<tr>
<td>JGEN 200</td>
<td>Technical Communication I</td>
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<tr>
<td>RAIK 288H</td>
<td>Honors Business Writing</td>
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<td>BSAD 220H</td>
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CSCE 101L Fundamentals of Computing Laboratory  
**Prerequisites:** CSCE 101 or parallel.  
**Notes:** This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software 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  
**Grading Option:** Graded with Option

CSCE 120 Learning to Code  
**Prerequisites:** Placement in to MATH 101 or higher  
**Notes:** This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software 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 processing data: data formatting and structure, data manipulation, data presentation and the basics of an interactive program.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option  
**Prerequisite for:** CSCE 220; CSCE 320

CSCE 155A Computer Science I  
**Prerequisites:** MATH 102 or a Math Placement Test score for MATH 103 or higher.  
**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  
**Grading Option:** Graded with Option  
**Prerequisite for:** CSCE 156; CSCE 156H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300  
**ACE:** ACE 3 Math/Stat/Reasoning

CSCE 155E Computer Science I: Systems Engineering Focus  
**Prerequisites:** MATH 102 or a Math Placement Test score for MATH 103 or higher.  
**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  
**Grading Option:** Graded with Option  
**Prerequisite for:** CSCE 156; CSCE 156H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300  
**ACE:** ACE 3 Math/Stat/Reasoning

CSCE 155H Honors: Computer Science I  
**Prerequisites:** Good standing in UNL Honors Program; MATH 102 or a Math Placement Test score for MATH 103 or higher.  
**Notes:** Covers the same topics as CSCE 155A, but in greater depth.  
**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  
**Grading Option:** Graded with Option  
**Prerequisite for:** CSCE 156; CSCE 156H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300  
**ACE:** ACE 3 Math/Stat/Reasoning

CSCE 155N Computer Science I: Engineering and Science Focus  
**Prerequisites:** MATH 102 or a Math Placement Test score for MATH 103 or higher.  
**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  
**Grading Option:** Graded with Option  
**Prerequisite for:** BSEN 311; CHME 312; CSCE 156; CSCE 156H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300; MECH 318; MECH 330; MECH 350; MECH 381  
**ACE:** ACE 3 Math/Stat/Reasoning
CSCE 155T Computer Science I: Informatics Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Credit may be earned in only one CSCE 155 course. Recommended for students interested in data and information processing, such as library and database applications, online commerce, and bioinformatics.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300
ACE: ACE 3 Math/Stat/Reasoning
CSCE 156 Computer Science II
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; coreq: MATH 106.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 162
CSCE 156H Honors: Computer Science II
Prerequisites: Good standing UNL Honors Program. A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; Coreq: MATH 106.
Notes: Covers the same topics as CSCE 156, but in greater depth. 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
Grading Option: Graded
Prerequisite for: CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 162
CSCE 163H Honors: Innovation Processes and Software Engineering Fundamentals
Crosslisted with: RAIK 163H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to innovation processes for interdisciplinary and team-oriented problem solving of software engineering, business development, and industrial design problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL
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
Grading Option: Graded
Prerequisite for: CSCE 235; CSCE 235H; ECON 215; RAIK 184H, CSCE 184H
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
Grading Option: Graded
Prerequisite for: BSAD 372H, RAIK 372H; CSCE 230; CSCE 231; CSCE 283H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 260H, RAIK 283H
CSCE 191 Special Topics in Computer Science
Prerequisites: Permission.
Notes: 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
Grading Option: Graded with Option
CSCE 192 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  
Grading Option: Graded with Option  

CSCE 194 Independent Study in Computing  
Prerequisites: Freshmen standing; permission of the instructor.  
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.  
Credit Hours: 1-3  
Min credits per semester: 1  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded with Option  

CSCE 220 Software Development for Smart-Mobile Systems  
Prerequisites: CSCE 120  
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. Second course in a sequence for the minor in Software Development.  
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  
Min credits per semester: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded with Option  
Prerequisite for: CSCE 320  

CSCE 230 Computer Organization  
Prerequisites: A grade of "P" or "C" or better in CSCE 235, CSCE 235H, or RAIK 184H.  
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  
Min credits per semester: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Grading Option: Graded with Option  
Prerequisite for: CSCE 336; CSCE 351; ECEN 220; ECEN 370, CSCE 335  

CSCE 231 Computer Systems Engineering  
Prerequisites: Grade of "P" or "C" or better in CSCE 235, CSCE 235H or RAIK 184H.  
Credit Hours: 4  
Min credits per semester: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Grading Option: Graded with Option  
Prerequisite for: CSCE 336; CSCE 351  

CSCE 235 Introduction to Discrete Structures  
Crosslisted with: CSCE 235H  
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H; and MATH 106.  
Notes: Theoretical concepts with programming assignments. CSCE235H covers the same topics as CSCE235, but in greater depth.  
Description: Survey of elementary discrete mathematics. Elementary graph and tree theories, set theory, relations and functions, propositional and predicate logic, methods of proof, induction, recurrence relations, principles of counting, elementary combinatorics, and asymptotic notations.  
Credit Hours: 3  
Min credits per semester: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded with Option  
Prerequisite for: CSCE 230; CSCE 231; CSCE 310; CSCE 310H; SOFT 260  

CSCE 235H Introduction to Discrete Structures  
Crosslisted with: CSCE 235  
Prerequisites: Good standing in the University of Honors Program. A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H; and MATH 106.  
Notes: Theoretical concepts with programming assignments. CSCE235H covers the same topics as CSCE235, but in greater depth.  
Description: Survey of elementary discrete mathematics. Elementary graph and tree theories, set theory, relations and functions, propositional and predicate logic, methods of proof, induction, recurrence relations, principles of counting, elementary combinatorics, and asymptotic notations.  
Credit Hours: 3  
Min credits per semester: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded with Option  
Prerequisite for: CSCE 230; CSCE 231; CSCE 310; CSCE 310H; SOFT 260  

CSCE 251 Unix Programming Environment  
Notes: 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  
Min credits per semester: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Grading Option: Graded with Option
CSCE 283H Honors: Foundations of Computer Science
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 184H.
Notes: CSCE/RAIK 283H is the third course in the Jeffrey S. Raikes School of Computer Science and Management core.
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
Grading Option: Graded
Prerequisite for: CSCE 351; CSCE 361, CSCE 361H

CSCE 291 Special Topics in Computer Science
Prerequisites: Permission.
Notes: Will not count towards 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
Grading Option: Graded with Option

CSCE 292 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
Grading Option: Graded with Option

CSCE 294 Independent Study in Computing
Prerequisites: Sophomore standing; permission of the instructor.
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 310 Data Structures and Algorithms
Prerequisites: Grades of "Pass" or "C" or better in CSCE 156/156H or SOFT 161 and CSCE 235/235H.
Notes: Theoretical concepts with programming assignments.
Description: A review of algorithm analysis, asymptotic notation, and solving recurrence relations. Advanced data structures and their associated algorithms, heaps, priority queues, hash tables, trees, binary search trees, and graphs. Algorithmic techniques, divide and conquer, transform and conquer, space-time trade-offs, greedy algorithms, dynamic programming, randomization, and distributed algorithms. Introduction to computability and NP-completeness.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 351; CSCE 361, CSCE 361H; CSCE 493

CSCE 310H Honors: Data Structures and Algorithms
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 CSCE 235/235H.
Description: CSCE 310H covers the same topics as CSCE 310, but in greater depth. For course description, see CSCE 310.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CSCE 351; CSCE 493

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, CSCE 320, or SOFT 160.
Notes: CSE majors must take CSCE 310. Students may not receive credit for both CSCE 310 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
Grading Option: Graded with Option
Prerequisite for: CSCE 322; CSCE 322H; CSCE 351; CSCE 361, CSCE 361H; CSCE 378; CSCE 378H; CSCE 493; CSCE 493A
CSCE 320 Data Analysis  
Prerequisites: A grade of "P" or "C" or better in CSCE 120 or CSCE 220.  
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software 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  
Grading Option: Graded with Option  
Prerequisite for: CSCE 311; CSCE 493

CSCE 322 Programming Language Concepts  
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H.  
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  
Grading Option: Graded with Option  
Prerequisite for: CSCE 311; CSCE 493

CSCE 322H Honors: Programming Language Concepts  
Prerequisites: Good Standing in UNL Honors Program or by invitation; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H.  
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  
Grading Option: Graded with Option  
Offered: FALL/SPR  
Crosslisted with: ECEN 370

CSCE 335 Digital Logic Design  
Prerequisites: ECEN 103/(UNO) ECEN 1030 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  
Grading Option: Graded  
Prerequisite for: ECEN 307; ECEN 494

CSCE 336 Embedded Systems  
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231.  
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  
Grading Option: Graded with Option  
Prerequisite for: CSCE 488

CSCE 351 Operating System Kernels  
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
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  
Grading Option: Graded with Option  
Crosslisted with: CSCE 361

CSCE 361 Software Engineering  
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
Notes: Requires participation in a group design and implementation of a software project.  
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  
Grading Option: Graded with Option  
Prerequisite for: CSCE 461, CSCE 861, SOFT 461; CSCE 486; CSCE 488

CSCE 361H Software Engineering  
Prerequisites: Good standing in the University Honors Program. A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
Notes: Requires participation in a group design and implementation of a software project.  
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  
Grading Option: Graded with Option  
Prerequisite for: CSCE 461, CSCE 861, SOFT 461; CSCE 486; CSCE 488
CSCE 370H Honors: 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
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 378 Human-Computer Interaction
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: MATH/STAT 380 or ECEN 305 recommended. Meeting ACE1 and ACE2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCI, human information processing characteristics important in HCI, 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
Grading Option: Graded with Option

CSCE 378H Honors: Human-Computer Interaction
Prerequisites: Good standing in the University Honors Program; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAiK 184H or CSCE 311.
Notes: MATH/STAT 380, ECEN 305 or RAIK 270H recommended. Meeting ACE1 and ACE2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCI, human information processing characteristics important in HCI, 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
Grading Option: Graded with Option

CSCE 383H Honors: Fundamentals of Software Engineering
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; CSCE/RAiK 284H.
Notes: Fifth course in the Jeffrey S. Raikes School of Computer Science and Management core.
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
Grading Option: Graded

CSCE 391 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
Grading Option: Graded with Option

CSCE 392 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
Grading Option: Graded with Option

CSCE 394 Independent Study in Computing
Prerequisites: Junior standing; permission of the instructor.
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 399 Undergraduate Thesis
Prerequisites: Permission.
Description: Independent practice and research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded

CSCE 399H Honors Undergraduate Thesis
Prerequisites: Permission.
Description: Independent practice and research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded
CSCE 401H Honors: RAIK Design Studio I  
Crosslisted with: RAIK 401H, BSAD 401H, 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; RAIK 383H or equivalent.  
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  
Grading Option: Graded  
Offered: FALL  
Prerequisite for: RAIK 402H, BSAD 402H, CSCE 402H, SOFT 402H  
ACE: ACE 8 Civic/Ethics/Stewardship  

CSCE 402H Honors: RAIK Design Studio II  
Crosslisted with: RAIK 402H, BSAD 402H, 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; BSAD/CSCE/SOFT/RAIK 401H.  
Notes: Second 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  
Grading Option: Graded  
Offered: SPRING  
Prerequisite for: RAIK 403H, BSAD 403H, CSCE 403H  
ACE: ACE 10 Integrated Product  

CSCE 403H Honors: RAIK Design Studio III  
Crosslisted with: RAIK 403H, BSAD 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 401H or RAIK 402H.  
Notes: 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  
Grading Option: Graded  

CSCE 404H Honors: RAIK Design Studio IV  
Crosslisted with: RAIK 404H, BSAD 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  
Grading Option: Graded  

CSCE 405H Honors: RAIK Research Studio I  
Crosslisted with: RAIK 405H  
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; RAIK 383H or equivalent.  
Notes: First semester of Jeffrey S. Raikes School of Computer Science and Management research studio experience. Students work individually with a sponsoring faculty member from the area of their research and Raikes School faculty.  
Description: Application of research principles to solve complex problems through the delivery of innovative, cutting-edge solutions and to gain an understanding of the roles involved.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded  
Offered: FALL  
Prerequisite for: CSCE 406H, RAIK 406H  

CSCE 406H Honors: RAIK Research Studio II  
Crosslisted with: RAIK 406H  
Prerequisites: RAIK 405H  
Notes: Second semester of Jeffrey S. Raikes School of Computer Science and Management research studio experience. Students work individually with a sponsoring faculty member from the area of their research and Raikes School faculty.  
Description: Application of research principles to solve complex problems through the delivery of innovative, cutting-edge solutions and to gain an understanding of the roles involved.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded  
Offered: SPRING
CSCE 410 Information Retrieval Systems
Crosslisted with: CSCE 810
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 411 Data Modeling for Systems Development
Crosslisted with: CSCE 811
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 412 Data Visualization
Crosslisted with: CSCE 812
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; 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
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 413 Database Systems
Crosslisted with: CSCE 813
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Involves practical experience with a working database system.
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
Grading Option: Graded with Option

CSCE 421 Foundations of Constraint Processing
Crosslisted with: CSCE 821
Prerequisites: A grade of "P" or "C" or better in CSCE 235 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 423 Design and Analysis of Algorithms
Crosslisted with: CSCE 823
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 424 Computational Complexity Theory
Crosslisted with: CSCE 824
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
CSCE 425 Compiler Construction
Crosslisted with: CSCE 825
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 428 Automata, Computation, and Formal Languages
Crosslisted with: CSCE 828
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 430 Computer Architecture
Crosslisted with: CSCE 830
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; Coreq: MATH/STAT 380, ECEN 305 or RAIK 270H.
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
Grading Option: Graded with Option

CSCE 435 Cluster and Grid Computing
Crosslisted with: CSCE 835
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAIK 283H.
Notes: Designed for CSCE and non-CSCE students who have an interest in building or programming clusters to enhance their computationally-intense research.
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
Grading Option: Graded with Option

CSCE 436 Advanced Embedded Systems
Crosslisted with: CSCE 836
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 236 or ECEN 220.
Description: Embedded hardware design techniques; transceiver design and low-power communication techniques; sensors and distributed sampling techniques; embedded software design and 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
Grading Option: Graded with Option

CSCE 438 Internet of Things
Crosslisted with: CSCE 838
Prerequisites: CSCE 230 or CSCE 231; SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent; senior or graduate standing or instructor permission.
Description: Theoretical and practical insight into the Internet of Things (IoT). Basics of IoT, including devices and sensors, connectivity, cloud processing and storage, analytics and machine learning, security, business models as well as advanced topics such as localization, synchronization, connected vehicles, and applications of IoT. Includes a group project that provides hands-on interaction with IoT.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 439 Robotics: Algorithms and Applications
Crosslisted with: CSCE 839
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 236 or ECEN 220 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H
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
Grading Option: Graded with Option
Offered: FALL/SPR
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Grading Option</th>
<th>Notes</th>
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<tbody>
<tr>
<td>CSCE 440</td>
<td>Numerical Analysis I</td>
<td></td>
<td>CSCE 440, MATH 440, MATH 840</td>
<td>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.</td>
<td>3</td>
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<td>Graded with Option</td>
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<tr>
<td>CSCE 441</td>
<td>Approximation of Functions</td>
<td></td>
<td>MATH 441, MATH 841</td>
<td>Polynomial interpolation, uniform approximation, orthogonal polynomials, least-first-power approximation, polynomial and spline interpolation, approximation and interpolation by rational functions.</td>
<td>3</td>
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<td>Graded with Option</td>
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<tr>
<td>CSCE 447</td>
<td>Numerical Linear Algebra</td>
<td></td>
<td>MATH 447, MATH 847</td>
<td>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.</td>
<td>3</td>
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<td>Graded with Option</td>
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<tr>
<td>CSCE 451</td>
<td>Operating Systems Principles</td>
<td></td>
<td>MATH 851</td>
<td>Organization and structure of operating systems. Control, communication, and synchronization of concurrent processes. Processor and job scheduling. Memory organization and management including paging, segmentation, and virtual memory. Resource management. Deadlock avoidance, detection, recovery. File system concepts and structure. Protection and security. Substantial programming.</td>
<td>3</td>
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<td>Graded with Option</td>
<td>-</td>
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<tr>
<td>CSCE 454</td>
<td>Human-Robot Interaction</td>
<td></td>
<td>CSCE 854</td>
<td>A grade of &quot;P&quot; or &quot;C&quot; or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.</td>
<td>3</td>
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<td>Graded with Option</td>
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<tr>
<td>CSCE 455</td>
<td>Distributed Operating Systems</td>
<td></td>
<td>CSCE 855</td>
<td>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.</td>
<td>3</td>
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<td>Graded with Option</td>
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<tr>
<td>CSCE 456</td>
<td>Parallel Programming</td>
<td></td>
<td>MATH 847</td>
<td>A grade of &quot;P&quot; or &quot;C&quot; or better in CSCE 230, CSCE 230H or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.</td>
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<td>CSCE 457</td>
<td>Systems Administration</td>
<td></td>
<td>CSCE 857</td>
<td>Basic scripting in shell, Perl, and Expect. Systems administration on UNIX® platform.</td>
<td>3</td>
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<td>3</td>
<td>Graded with Option</td>
<td>-</td>
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CSCE 458 Molecular and Nanoscale Communication
Crosslisted with: CSCE 858
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Completing CSCE 462/862 and CSCE 465/865 prior to taking this course is recommended. Exceptions can be granted on a per-student basis by the instructor.
Description: Overview of nanoscale communication options. Focus on bio-inspired communication through molecule exchange and biochemical reactions. Different techniques to realize nanomachines will be surveyed in the course, with particular attention to the tools provided by synthetic biology for the programming of biological cooperative systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 459 Genetically Engineered Systems
Crosslisted with: CSCE 859
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Completing CSCE/MATH 440/840, MATH 432/832, MATH 439/839, and CSCE 471/871 prior to taking this course is recommended. Exceptions can be granted on a per-student basis by the instructor.
Description: Introduction to the field of synthetic biology, and its interdisciplinary foundational concepts. Presents the technologies at the basis of synthetic biology, together with the engineering concepts that underlie the design, modeling, and realization of genetically engineered systems. Surveys examples of cutting edge applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 460 Software Engineering for Robotics
Crosslisted with: SOFT 460, CSCE 860
Prerequisites: SOFT 261 or RAIK 383H or CSCE 361
Description: Application of software engineering practices and principles to autonomous robotic systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

CSCE 461 Advanced Topics in Software Engineering
Crosslisted with: CSCE 861, SOFT 461
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
Description: Advanced or emerging techniques in software engineering. Topics include but not limited to computer algorithms, software dependability, and advanced software development environments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 462 Communication Networks
Crosslisted with: CSCE 862
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 952; CSCE 953

CSCE 463 Data and Network Security
Crosslisted with: CSCE 863
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
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
Grading Option: Graded with Option

CSCE 464 Internet Systems and Programming
Crosslisted with: CSCE 864
Prerequisites: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 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
Grading Option: Graded

CSCE 465 Wireless Communication Networks
Crosslisted with: CSCE 865
Prerequisites: A grade of "P" or "C" or better in STAT 380, ECEN 305 or RAIK 270H
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
Grading Option: Graded with Option

Software Engineering
CSCE 466 Software Design and Architecture
Crosslisted with: SOFT 466, CSCE 866
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

CSCE 467 Testing, Verification and Analysis
Crosslisted with: SOFT 467, CSCE 867
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

CSCE 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: SOFT 468, CSCE 868
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

CSCE 470 Computer Graphics
Crosslisted with: CSCE 870
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; MATH 314
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
Grading Option: Graded with Option

CSCE 471 Computational Methods in Bioinformatics
Crosslisted with: CSCE 871
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to computational methods for tackling challenges in biological data analysis and modeling and understanding complex systems at the molecular and cellular level. The main topics include bio-sequence analysis, motif finding, structure prediction, phylogenetic inference, regulation network modeling, and high-throughput omics data analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: CSCE 971

CSCE 472 Digital Image Processing
Crosslisted with: CSCE 872
Prerequisites: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H 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
Grading Option: Graded with Option
CSCE 473 Computer Vision
Crosslisted with: CSCE 873
Prerequisites: CSCE 156, SOFT 161, or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAiK 184H 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
Grading Option: Graded with Option

CSCE 474 Introduction to Data Mining
Crosslisted with: CSCE 874
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H; STAT 380, ECEN 305 or RAiK 270H.
Notes: Requires the completion of a project involving the application of data mining techniques to real-world problems.
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
Grading Option: Graded with Option

CSCE 475 Multiagent Systems
Crosslisted with: CSCE 875
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
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
Grading Option: Graded with Option

CSCE 476 Introduction to Artificial Intelligence
Crosslisted with: CSCE 876
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 976

CSCE 477 Cryptography and Computer Security
Crosslisted with: CSCE 877
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H; 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
Grading Option: Graded with Option

CSCE 478 Introduction to Machine Learning
Crosslisted with: CSCE 878
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Notes: STAT 380, ECEN 305, or RAiK 270H recommended.
Description: Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, data 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
Grading Option: Graded with Option

CSCE 479 Introduction to Deep Learning
Crosslisted with: CSCE 879
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Notes: Completing STAT 380, ECEN 305, or RAiK 270 prior to taking this course is recommended.
Description: Fundamentals and current trends in deep learning. Backpropagation, activation functions, loss functions, choosing an optimizer, and regularization. Common architectures such as convolutional, autoencoders, and recurrent. Applications such as image analysis, text analysis, sequence analysis, and reinforcement learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
CSCE 486 Computer Science Professional Development
Prerequisites: A grade of "Pass" or "C" or better in SOFT 261, CSCE 361 or CSCE 361H
Notes: 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
Grading Option: Graded with Option
Prerequisite for: CSCE 487; CSCE 487H
ACE: ACE 8 Civic/Ethics/Stewardship

CSCE 487 Computer Science Senior Design Project
Prerequisites: CSCE 486
Notes: Should be taken in the immediate next term after CSCE 486.
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
Grading Option: Graded with Option
Prerequisite for: SOFT 403; SOFT 403H
ACE: ACE 10 Integrated Product

CSCE 487H Honors Computer Science Senior Design Project
Prerequisites: CSCE 486 or CSCE 486H.
Notes: Should be taken in the immediate next term after CSCE 486 or CSCE 486H.
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
Grading Option: Graded with Option
Prerequisite for: SOFT 403H

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; prerequisite or corequisite: JGEN 300.
Notes: Must be taken exactly one semester before CSCE 489.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 489; CSCE 489H
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
Grading Option: Graded with Option

CSCE 489H Honors Computer Engineering Senior Design Project
Prerequisites: CSCE 488 or CSCE 488H (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
Grading Option: Graded with Option

CSCE 492 Special Topics in Computer Science
Crosslisted with: CSCE 892
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
Grading Option: Graded with Option

CSCE 492H Honors Special Topics in Computer Science
Prerequisites: Permission.
Description: Topics vary
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 493 Innovation Lab Project
Prerequisites: CSCE 310, CSCE 310H, CSCE 311, or CSCE 320
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
Grading Option: Graded with Option
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
Grading Option: Graded

CSCE 495 Internship in Computing Practice
Prerequisites: Permission.
Notes: 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
Grading Option: Graded with Option

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
Grading Option: Graded with Option

SOFT 160 Software Engineering I
Prerequisites: MATH 103 or equivalent
Notes: Letter grade only.
Description: Introduction to software engineering and to problem solving with computers. Topics include problem solving methods, the use of computational resources to solve problems, and techniques for collaborative software development. Techniques based on disciplined software engineering principles and practices for engineering, building, analyzing and managing software-related artifacts. Common tools and techniques for developing, analyzing, testing, debugging, and managing software and software-related artifacts.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Offered: FALL
Prerequisite for: CSCE 235, CSCE 235H; SOFT 161; SOFT 161H

SOFT 161 Software Engineering II
Prerequisites: A grade of C+ or higher in either SOFT 160 or SOFT 160H.
Notes: Letter grade only.
Description: Software engineering techniques and tools for designing, modeling, and building event-driven and multi-layer applications. Topics include advanced data structure, persistent data storage, object-oriented programming, and techniques for testing complex software systems.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Offered: SPRING
Prerequisite for: CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 260; SOFT 360

SOFT 161H Honors: Software Engineering II
Prerequisites: A grade of C+ or higher in either SOFT 160 or SOFT 160H.
Description: Software engineering techniques and tools for designing, modeling, and building event-driven and multi-layer applications. Topics include advanced data structure, persistent data storage, object-oriented programming, and techniques for testing complex software systems.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Offered: SPRING
Prerequisite for: CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 260; SOFT 360

SOFT 160H Software Engineering I
Prerequisites: MATH 103 or equivalent
Notes: Letter grade only.
Description: Introduction to software engineering and to problem solving with computers. Topics include problem solving methods, the use of computational resources to solve problems, and techniques for collaborative software development. Techniques based on disciplined software engineering principles and practices for engineering, building, analyzing and managing software-related artifacts. Common tools and techniques for developing, analyzing, testing, debugging, and managing software and software-related artifacts.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Offered: FALL
Prerequisite for: CSCE 235, CSCE 235H; CSCE 311; MECH 300; MECH 350; SOFT 161; SOFT 161H; SOFT 360

SOFT 162 Software Engineering Fundamentals
Prerequisites: CSCE 156, CSCE 156H or equivalent
Notes: Students must earn a grade of C+ or higher in this course to be admitted to the Software Engineering program.
Description: Introduction to software engineering and problem solving with computers.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Offered: SUMMER
Prerequisite for: SOFT 260
SOFTWARE ENGINEERING III

**Prerequisites:** A grade of C+ or higher in either SOFT 161, SOFT 161H or SOFT 162; CSCE 235.

**Notes:** Letter grade only.

**Description:** Advanced data structures and their associated algorithms for solving computational problems. Techniques for systematically specifying, managing, and analyzing software requirements, and for managing software change and working effectively in teams.

**Credit Hours:** 4

**Max credits per semester:** 4

**Max credits per degree:** 4

**Grading Option:** Graded

**Prerequisites:**
- CSCE 351; CSCE 361, CSCE 361H; SOFT 261; SOFT 261H; RAIK 284H; SOFT 360

**SOFT 260H Honors: Software Engineering III**

**Crosslisted with:** RAIK 283H

**Prerequisites:** A grade of C+ or higher in either SOFT 161 or SOFT 161H or SOFT 162 or RAIK 184H or equivalent; CSCE 235.

**Description:** Advanced data structures and their associated algorithms for solving computational problems. Techniques for systematically specifying, managing, and analyzing software requirements, and for managing software change and working effectively in teams.

**Credit Hours:** 4

**Max credits per semester:** 4

**Max credits per degree:** 4

**Grading Option:** Graded

**Offered:** FALL

**Prerequisites for:**
- CSCE 351; CSCE 361, CSCE 361H; SOFT 261; SOFT 261H; RAIK 284H

**SOFT 261 Software Engineering IV**

**Prerequisites:** A grade of C+ or higher in SOFT 260 or equivalent.

**Description:** Techniques and tools based on disciplined software engineering principles for producing, interpreting, and communicating visual artifacts related to software architecture and construction.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** FALL/SPR

**ACE:** ACE 2 Communication Competence

**SOFT 261H Software Engineering IV**

**Crosslisted with:** RAIK 284H

**Prerequisites:** Good Standing in UNL Honors Program or by invitation; a grade of C+ or higher in SOFT 260, SOFT 260H, or RAIK 283H.

**Description:** Techniques and tools based on disciplined software engineering principles for producing, interpreting, and communicating visual artifacts related to software architecture and construction.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** FALL/SPR

**ACE:** ACE 2 Communication Competence

**SOFT 360 Software Engineering Mentoring and Leadership**

**Prerequisites:** A grade of C or higher in SOFT 160, SOFT 161, SOFT 260 or SOFT 261

**Notes:** Letter grade only.

**Description:** Mentoring and leading software engineering teams. Topics include roles and responsibilities of a leader, roles and responsibilities of a mentor, and traits of effective leaders and mentors. Techniques for effectively mentoring and leading software engineering teams.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Graded

**SOFT 401H Honors: RAIK Design Studio I**

**Crosslisted with:** RAIK 401H, BSAD 401H, CSCE 401H

**Prerequisites:** Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; RAIK 383H or equivalent.

**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

**Grading Option:** Graded

**Offered:** FALL

**Prerequisite for:** RAIK 402H, BSAD 402H, CSCE 402H, SOFT 402H

**SOFT 402H Honors: RAIK Design Studio II**

**Crosslisted with:** RAIK 402H, BSAD 402H, CSCE 402H

**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 401H.

**Notes:** Second 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

**Grading Option:** Graded

**Offered:** SPRING

**Prerequisite for:** RAIK 403H, BSAD 403H, CSCE 403H

**SOFT 403 Software Engineering Capstone I**

**Prerequisites:** CSCE 487 or equivalent

**Notes:** Must be taken exactly one semester before SOFT 404.

**Description:** A substantial software engineering 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 in consultation with private and public sector clients.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** FALL

**Prerequisite for:** SOFT 404; SOFT 404H
SOFT 403H Honors: Software Engineering Capstone I
Prerequisites: CSCE 487 or CSCE 487H or equivalent.
Notes: Must be taken exactly one semester before SOFT 404 or SOFT 404H.
Description: A substantial software engineering 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 in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL
Prerequisite for: SOFT 404H

SOFT 404 Software Engineering Capstone II
Prerequisites: SOFT 403 (taken exactly one semester previous).
Description: A substantial software engineering 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 in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

SOFT 404H Software Engineering Capstone II
Prerequisites: SOFT 403 or SOFT 403H.
Notes: Must be taken exactly one semester after SOFT 403 or SOFT 403H.
Description: A substantial software engineering 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
Grading Option: Graded
Offered: SPRING

SOFT 460 Software Engineering for Robotics
Crosslisted with: CSCE 460, CSCE 860
Prerequisites: SOFT 261 or RAIK 383H or CSCE 361
Description: Application of software engineering practices and principles to autonomous robotic systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

SOFT 461 Advanced Topics in Software Engineering
Crosslisted with: CSCE 461, CSCE 861
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

SOFT 466 Software Design and Architecture
Crosslisted with: CSCE 466, CSCE 866
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

SOFT 467 Testing, Verification and Analysis
Crosslisted with: CSCE 467, CSCE 867
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

SOFT 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: CSCE 468, CSCE 868
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.
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
Grading Option: Graded

PLEASE NOTE
This document represents a sample 4-year plan for degree completion with this major. Actual course selection and sequence may vary and should be discussed individually with your college or department academic advisor. Advisors also can help you plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.