SOFTWARE ENGINEERING

Description

The UNL 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 formulate software solutions and 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 and within realistic constraints.
• Identify, formulate and solve engineering problems using computational resources.
• Contribute their expertise to the solution of problems 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 life-long 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 between 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 (SOFT 160, SOFT 161 Software Engineering II, SOFT 260 Software Engineering III, SOFT 261 Software Engineering IV). This course provides 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 Bulletin 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 160 Software Engineering I, SOFT 161 Software Engineering II, SOFT 260 Software Engineering III, SOFT 261 Software Engineering IV, CSCE 235 Introduction to Discrete Structures, MATH 106 Calculus I, and MATH 107 Calculus II 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. 4 units of mathematics: 2 of algebra, 1 of geometry, 1 of precalculus and trigonometry.
2. 4 units of English.
3. 3 units of natural science that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management).
4. 2 units of a single foreign language.
5. 3 units of social studies.
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 College of Engineering.

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 UNL 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 UNL.

Students should consult their advisor, their department chair, or the Office of the Dean 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 for Nebraska residents or 3.0 for non-residents. Students not meeting either of these requirements must enroll in the Explore Center or another UNL college until they meet COE admission requirements.

The COE accepts courses for transfer for which a C or better grade was received. Although UNL 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 bulletin current at the time of transfer to the COE—not that in use when they entered UNL. Upon admission to UNL, students wishing to pursue degree programs in the COE will be classified and subject to the policies defined in the subsequent section.

**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.

**Bulletin Rule**

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

**Learning Outcomes**

Majors in software engineering will be able to:

1. Apply rigorous software engineering practices and principles to the design, development and maintenance of complex software systems in order to produce software in a systematic, controlled and efficient manner for a wide range of applications and contexts. Studies include mathematical foundations, software development, application of theory, experimentation, and software engineering processes, technologies and tools.

2. Contribute their expertise to the solution of problems by effectively collaborating and communicating with other stakeholders in multidisciplinary teams. Studies include natural sciences, software development, written and oral communications, teamwork, and software engineering technologies and practices.

3. Quickly adapt to new work environments, assimilate new information, and solve new problems. Studies develop skills in the application of theory, experimentation, software engineering technologies and practices, and technical communications.

4. Develop a background and perspective for post-graduate education. Studies develop skills in the application of theory, experimentation, and life-long learning/professional development.

5. Work in conformance with societal needs and expectations. Studies include liberal arts and ethical/social issues.

6. Understand the world of practicing professionals for collaborations, mutual support, and representing the profession to government and society. Studies include teamwork and life-long learning/professional development, and students are provided multiple opportunities for involvement in undergraduate research, service to the department and community, and in organizations such as ACM, UPE, and IEEE.

**Major Requirements**

The software engineering degree requires 124 hours of course work, including a set of required core courses and technical elective courses in computer science and software engineering and a 2-year capstone (79 credit hours), and courses in mathematics (18 credit hours), science (12 credit hours), and other supporting courses (15 credit hours) as described below.

**Computer Science and Software Engineering Core**

**Computer Science**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCE 10</td>
<td>Introduction to CSE</td>
<td>0</td>
</tr>
<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>
<tr>
<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>CSCE 491</td>
<td>Internship in Computing Practice</td>
<td>1</td>
</tr>
</tbody>
</table>

**Software Engineering**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFT 160</td>
<td>Software Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>SOFT 161</td>
<td>Software Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>SOFT 260</td>
<td>Software Engineering III</td>
<td>4</td>
</tr>
<tr>
<td>SOFT 261</td>
<td>Software Engineering IV</td>
<td>4</td>
</tr>
<tr>
<td>SOFT 360</td>
<td>Software Engineering Mentoring and Leadership</td>
<td>1</td>
</tr>
<tr>
<td>SOFT 461</td>
<td>Advanced Topics in Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>SOFT 466</td>
<td>Software Design and Architecture</td>
<td>3</td>
</tr>
<tr>
<td>SOFT 467</td>
<td>Testing, Verification and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>SOFT 468</td>
<td>Requirements Elicitation, Modeling and Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credit Hours**

52

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

**Computer Science**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCE 10</td>
<td>Introduction to CSE</td>
<td>0</td>
</tr>
<tr>
<td>CSCE 196</td>
<td>Special Topics in Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 231</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>
CSCE 322 Programming Language Concepts 3
CSCE 378 Human-Computer Interaction 3
CSCE 411 Data Modeling for Systems Development 3
CSCE 423 Design and Analysis of Algorithms 3
CSCE 451 Operating Systems Principles 3
CSCE 491 Internship in Computing Practice 1

**Mathematics (minimum 18 hrs)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 106</td>
<td>Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>MATH 107</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 314</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 380</td>
<td>Statistics and Applications</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credit Hours 15

**Software Engineering**

RAIK 183H Honors: Computer Problem Solving Essentials 4
RAIK 184H Honors: Software Development Essentials 4
RAIK 283H Honors: Foundations of Computer Science 3
RAIK 383H Honors: Fundamentals of Software Engineering 3
SOFT 360 Software Engineering Mentoring and Leadership 1
SOFT 461 Advanced Topics in Software Engineering 3
SOFT 466 Software Design and Architecture 3
SOFT 467 Testing, Verification and Analysis 3
SOFT 468 Requirements Elicitation, Modeling and Analysis 3

Total Credit Hours 50

**Technical Electives**

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

Total Credit Hours 15

**Capstone Experience**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCE 493</td>
<td>Innovation Lab Project (two semesters, 3 hrs ea)</td>
<td>6</td>
</tr>
<tr>
<td>CSCE 486</td>
<td>Computer Science Professional Development</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 487</td>
<td>Computer Science Senior Design Project</td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 12

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIK 401H</td>
<td>Honors: RAIK Design Studio I</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 402H</td>
<td>Honors: RAIK Design Studio II</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 403H</td>
<td>Honors: RAIK Design Studio III</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 404H</td>
<td>Honors: RAIK Design Studio IV</td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 12

**Mathematics (minimum 18 hrs)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 208</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 208H</td>
<td>Honors: Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 238</td>
<td>Mathematical Methods for Biology and Medicine</td>
<td>5</td>
</tr>
<tr>
<td>MATH 428</td>
<td>Principles of Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>MATH 439</td>
<td>Mathematical Models in Biology</td>
<td>3</td>
</tr>
<tr>
<td>MATH 465</td>
<td>Introduction to Mathematical Logic</td>
<td>3</td>
</tr>
<tr>
<td>STAT 412</td>
<td>Introduction to Experimental Design</td>
<td>3</td>
</tr>
<tr>
<td>STAT 414</td>
<td>Introduction to Survey Sampling</td>
<td>3</td>
</tr>
<tr>
<td>STAT 442</td>
<td>Computational Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following:

- MATH 208 Calculus III 4
- MATH 208H Honors: Calculus III 4
- MATH 238 Mathematical Methods for Biology and Medicine 5
- MATH 428 Principles of Operations Research 3
- MATH 439 Mathematical Models in Biology 3
- MATH 465 Introduction to Mathematical Logic 3
- STAT 412 Introduction to Experimental Design 3
- STAT 414 Introduction to Survey Sampling 3
- STAT 442 Computational Biology 3

**Statistics (minimum 18 hrs)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 465</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>MATH 439</td>
<td>Mathematical Models in Biology</td>
<td>3</td>
</tr>
<tr>
<td>MATH 428</td>
<td>Principles of Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>STAT 412</td>
<td>Introduction to Experimental Design</td>
<td>3</td>
</tr>
<tr>
<td>STAT 414</td>
<td>Introduction to Survey Sampling</td>
<td>3</td>
</tr>
<tr>
<td>STAT 442</td>
<td>Computational Biology</td>
<td>3</td>
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Select one of the following:

- MATH 208 Calculus III 4
- MATH 208H Honors: Calculus III 4
- MATH 238 Mathematical Methods for Biology and Medicine 5
- MATH 428 Principles of Operations Research 3
- MATH 439 Mathematical Models in Biology 3
- MATH 465 Introduction to Mathematical Logic 3
- STAT 412 Introduction to Experimental Design 3
- STAT 414 Introduction to Survey Sampling 3
- STAT 442 Computational Biology 3

**Science**

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</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>&amp; CHEM 110</td>
<td>and General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Fundamental Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>&amp; CHEM 114</td>
<td>and Fundamental Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 261</td>
<td>Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 262</td>
<td>Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 263</td>
<td>Organic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 264</td>
<td>Organic Chemistry Laboratory</td>
<td>3</td>
</tr>
</tbody>
</table>

**Physics and Astronomy**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 141</td>
<td>Elementary General Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 142</td>
<td>Elementary General Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>General Physics Laboratory I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 222</td>
<td>General Physics Laboratory II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 213</td>
<td>General Physics III</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 223</td>
<td>General Physics Laboratory III</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 204</td>
<td>Introduction to Astronomy and Astrophysics</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 224</td>
<td>Astronomy and Astrophysics Laboratory</td>
<td>3</td>
</tr>
</tbody>
</table>

**Biological Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 205</td>
<td>Genetics, Molecular and Cellular Biology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 206</td>
<td>General Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 207</td>
<td>Ecology and Evolution</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 120</td>
<td>Fundamentals of Biology I</td>
<td>3</td>
</tr>
<tr>
<td>&amp; LIFE 120L</td>
<td>and Fundamentals of Biology I laboratory</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 121</td>
<td>Fundamentals of Biology II</td>
<td>3</td>
</tr>
<tr>
<td>&amp; LIFE 121L</td>
<td>and Fundamentals of Biology II Laboratory</td>
<td>3</td>
</tr>
</tbody>
</table>

**Earth and Atmospheric Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOL 101</td>
<td>Dynamic Earth</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 103</td>
<td>Evolution of the Earth</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 210</td>
<td>Earth Materials: Rocks and Minerals</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 211</td>
<td>Sedimentology and Stratigraphy</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 310</td>
<td>Depositional Environments</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 400</td>
<td>Structural Geology</td>
<td>3</td>
</tr>
<tr>
<td>METR 100</td>
<td>Weather and Climate</td>
<td>3</td>
</tr>
<tr>
<td>METR 205</td>
<td>Introduction to Atmospheric Science</td>
<td>3</td>
</tr>
<tr>
<td>METR 223</td>
<td>Atmospheric Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>METR 311</td>
<td>Dynamic Meteorology I</td>
<td>3</td>
</tr>
<tr>
<td>METR 312</td>
<td>Dynamic Meteorology II</td>
<td>3</td>
</tr>
<tr>
<td>METR 323</td>
<td>Physical Meteorology</td>
<td>3</td>
</tr>
<tr>
<td>METR 341</td>
<td>Synoptic Meteorology</td>
<td>3</td>
</tr>
</tbody>
</table>
Students must take at least 15 credit hours of SOFT or CSCE technical electives. At least 9 hours must be taken at the 400 level except SOFT and CSCE courses required by the software engineering major and except courses that have been designated as courses that will not count toward a major or minor in computer science or software engineering by the Department of Computer Science and Engineering.

Included courses at the 200-level are: CSCE 236 Embedded Systems, CSCE 351 Operating System Kernels, CSCE 396 Special Topics in Computer Science, CSCE 399H Honors Thesis.

In addition to the courses mentioned above, excluded CSCE designated courses are: CSCE 401H Honors: RAIK Design Studio I, CSCE 402H Honors: RAIK Design Studio II, CSCE 488 Computer Engineering Professional Development, CSCE 489 Computer Engineering Senior Design Project, CSCE 490 Special Topics in Computer Science, CSCE 493 Innovation Lab Project. Honors versions of these courses are also not allowed to count towards technical elective credits.

Students must take Capstone Experience courses in strict sequence.

Indicates a lab course or that a lab is included with the course.

CSCE 101 Fundamentals of Computer Science
Crosslisted with: CSCE 101H
Prerequisites: High School algebra and use of computing applications
Description: Introduction to problem solving with computers. Problem analysis and specifications, algorithm development, program design, and implementation in a high-level programming environment. Hardware, software, software engineering, networks, and impacts of computing on society. CSCE 101 is intended for non-CSCE majors who desire a deeper understanding of computers and the work of computer scientists.

CSCE 101 is a course in the science of computation and is suitable for non-CSCE majors and prospective CSCE majors.

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

ACE: ACE 3 Math/Stat/Reasoning

CSCE 101H Fundamentals of Computer Science
Crosslisted with: CSCE 101
Prerequisites: High School algebra and use of computing applications
Description: Introduction to problem solving with computers. Problem analysis and specifications, algorithm development, program design, and implementation in a high-level programming environment. Hardware, software, software engineering, networks, and impacts of computing on society. CSCE 101 is intended for non-CSCE majors who desire a deeper understanding of computers and the work of computer scientists.

CSCE 101 is a course in the science of computation and is suitable for non-CSCE majors and prospective CSCE majors.

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

ACE: ACE 3 Math/Stat/Reasoning

CSCE 101L Fundamentals of Computing Laboratory
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. Will not count towards the requirements for a major or minor in computer science and computer engineering.

Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
CSCE 120 Learning to Code
Prerequisites: Placement in to MATH 101 or higher
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. First course in a sequence for the minor in Software Development. This course should not be taken by majors in Computer Science or Computer Engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

CSCE 155E Computer Science I: Systems Engineering Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society. Recommended for students interested in systems engineering, such as operating systems, mobile computing, and embedded devices. Credit may be earned in only one CSCE 155 course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224, ECEN 220H; ECEN 224; MECH 300; MECH 350, MECH 350H
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155N Computer Science I: Engineering and Science Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society. 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHME 223, CHME 223H; CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350, MECH 350H; MECH 381; METR 223; METR 312; METR 323
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155T Computer Science I: Informatics Focus
Prerequisites: Appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Description: Introduction to computers and problem-solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society. Recommended for students interested in data and information processing, such as library and database applications, online commerce, and bioinformatics. Credit may be earned in only one CSCE 155 course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350, MECH 350H
ACE: ACE 3 Math/Stat/Reasoning

CSCE 156 Computer Science II
Prerequisites: Appropriate score on the CSE Placement Exam or a grade of "P" or "C" or better in CSCE 155A, CSCE155E, CSCE 155H, CSCE 155N, or CSCE 155T; Math 106 or parallel
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. Laboratories supplement the lecture material and give an opportunity to practice concepts.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; CSCE 322; CSCE 378; SOFT 162
ACE: ACE 3 Math/Stat/Reasoning

CSCE 155H Honors: Computer Science I
Prerequisites: Good standing in the University Honors Program or by invitation; appropriate score on the CSE Placement Exam or CSCE101; MATH 103 or equivalent
Description: For course description, see CSCE 155A. CSCE 155H covers the same topics as CSCE 155A, but in greater depth.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 224; MECH 300; MECH 350, MECH 350H
ACE: ACE 3 Math/Stat/Reasoning
CSCE 156H Honors: Computer Science II
Prerequisites: Good standing in the University Honors Program or by invitation; appropriate score on CSE Placement Exam or a grade of "P" or "C" or better in CSCE 155 or 155H; MATH 106 or parallel
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; CSCE 322; CSCE 378; SOFT 162

CSCE 183H Honors: Computer Problem Solving Essentials
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation. JAVA in a Windows platform.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
ACE: ACE 3 Math/Stat/Reasoning

CSCE 184H Honors: Software Development Essentials
Description: Problem solving with computers. Problem analysis and specification, data structures, relational databases, algorithm development, and program design and implementation. Discrete mathematics topics, propositional and predicate logic, sets, relations, functions, and proof techniques. Software Development Principles.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
ACE: ACE 8 Civic/Ethics/Stewardship

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

CSCE 196 Special Topics in Computer Science
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

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

CSCE 230 Computer Organization
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T or equivalent knowledge of a high-level programming language
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Introduction to organization and structure of computer systems. Boolean logic, digital arithmetic, processor organization, machine language programming, input/output, memory organization, system support software, communication, and ethics.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
ACE: ACE 8 Civic/Ethics/Stewardship

CSCE 230H Honors: Computer Organization
Prerequisites: Good standing in the University Honors Program or by invitation; a grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T or equivalent knowledge of a high-level programming language.
Notes: CSCE 230H covers the same topics as CSCE 230, but in greater depth. Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: For course description, see CSCE 230.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 322; CSCE 438, CSCE 838; ECEN 220, ECEN 220H
ACE: ACE 8 Civic/Ethics/Stewardship

CSCE 231 Computer Systems Engineering
Prerequisites: Grade of "Pass" or "C" or better in CSCE 235 or CSCE 235H.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
CSCE 235 Introduction to Discrete Structures
Crosslisted with: CSCE 235H
Prerequisites: A grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; Math 106.
Description: 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
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; SOFT 260

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

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

CSCE 251 Unix Programming Environment
Description: Introduction to the Unix operating system. Unix file system. Unix tools and utilities. Shell programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CSCE 251H C Programming
Crosslisted with: CSCE 251K
Description: Introduction to the C programming language.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

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

CSCE 252A FORTRAN Programming
Description: Principles and practice of FORTRAN programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CSCE 283H Honors: Foundations of Computer Science
Description: Advanced data structures and algorithms that solve common problems and standard approaches to solving new problems. Analysis and comparison of algorithms, asymptotic notation and proofs of correctness. Discrete mathematics. Induction and principles of counting and combinatorics as foundation for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 378H; CSCE 411H, RAIK 411H; CSCE 476H

CSCE 284H Honors: Foundations of Computer Systems
Description: Introduction to fundamental organization and structure of computer systems. Boolean logic, data representation, processor organization, input/output, memory organization, system support software and communication.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: RAIK 401H

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

CSCE 296 Special Topics in Computer Science
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC
CSCE 310 Data Structures and Algorithms
Crosslisted with: CSCE 310H
Prerequisites: Grades of "Pass" or "C" or better in CSCE 156/156H or SOFT 161 and 235/235H.
Description: 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
Format: LEC
Prerequisite for: CSCE 361, CSCE 361H; CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 310H Data Structures and Algorithms
Crosslisted with: CSCE 310
Prerequisites: Good Standing in UNL Honors Program or by invitation; grades of "P" or "C" or better in CSCE 156/156H or SOFT 161 and 235/235H.
Description: 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
Format: LEC
Prerequisite for: CSCE 361, CSCE 361H; CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 311 Data Structures and Algorithms for Informatics
Prerequisites: Grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160.
Notes: CSE majors must take CSCE 310. Students may not receive credit for both CSCE310 and 311.
Description: An introduction to algorithms and data structures for informatics. Foundational coverage of algorithms includes both problems (such as indexing, searching, sorting, and pattern matching) and methods (such as greedy, divide-and-conquer, and dynamic programming). Foundational coverage of data structures includes lists, tables, relational databases, regular expressions, trees, graphs, and multidimensional arrays. The topics will be studied in the context of informatics applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CSCE 322; CSCE 361, CSCE 361H; CSCE 378; CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491

CSCE 320 Data Analysis
Prerequisites: CSCE 220
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. This course should not be taken by majors in Computer Science or Computer Engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 322 Programming Language Concepts
Prerequisites: CSCE 156, SOFT 161 or CSCE 311; CSCE 230.
Description: List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

CSCE 335 Digital Logic Design
Crosslisted with: CSCE 335H
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 335H Digital Logic Design
Crosslisted with: CSCE 335
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 351 Operating System Kernels
Prerequisites: CSCE 230, CSCE 310 or CSCE 311
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. Lab content reinforces concepts through practice.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

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

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

CSCE 378 Human-Computer Interaction
Prerequisites: CSCE 156, SOFT 161, or CSCE 311.
Notes: MATH/STAT 380 or ELEC 305 recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of 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
Format: LEC

CSCE 378H Honors: Human-Computer Interaction
Prerequisites: CSCE 310, CSCE 311, SOFT 260, or CSCE 283H; Good standing in the University Honors Program or by instructor permission.
Notes: CSCE 378H covers the same topics as CSCE 378, but in greater depth.
Description: 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
Format: LEC

CSCE 383H Honors: Fundamentals of Software Engineering
Description: Proper principles and methods of engineering software. Requirements, design, implementation, management and software evolution.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 384H Honors: Applied Numerical Analysis
Description: Application of established numerical analysis techniques to selected business and finance problems, finite difference applied to standard options or stochastic processes in modeling financial markets.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 390 Special Topics in Computer Science
Description: Aspects of computers and computing for non-computer science and computer engineering majors and/or minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC
CSCE 396 Special Topics in Computer Science
Crosslisted with: CSCE 396H
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

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

CSCE 399H Honors Thesis
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: IND

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

Prerequisite for: RAIK 402H

ACE: ACE 8 Civic/Ethics/Stewardship

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

Prerequisite for: RAIK 403H

CSCE 403H RAIK Design Studio III
Crosslisted with: SOFT 403H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/CSCE/RAIK 402H.
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. Third semester of Jeffrey S. Raikes School of Computer Science and Management design studio sequence.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

Prerequisite for: RAIK 404H

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

CSCE 410 Information Retrieval Systems
Crosslisted with: SOFT 810
Prerequisites: CSCE 310, SOFT 260, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 411 Data Modeling for Systems Development
Crosslisted with: CSCE 811
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Concepts of relational and object-oriented data modeling through the process of data model development including conceptual, logical and physical modeling. Techniques for identifying and creating relationships between discrete data members, reasoning about how data modeling and analysis are incorporated in system design and development, and specification paradigms for data models. Common tools and technologies for engineering systems and frameworks for integrating data. Design and analysis of algorithms and techniques for identification and exploration of data relationships, such as Bayesian probability and statistics, clustering, map-reduce, and web-based visualization.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

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

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

CSCE 421 Foundations of Constraint Processing
Crosslisted with: CSCE 821
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Constraint processing for articulating and solving industrial problems such as design, scheduling, and resource allocation. The foundations of constraint satisfaction, its basic mechanisms (e.g., search, backtracking, and consistency-checking algorithms), and constraint programming languages. New directions in the field, such as strategies for decomposition and for symmetry identification.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 423 Design and Analysis of Algorithms
Crosslisted with: CSCE 823
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Mathematical preliminaries. Strategies for algorithm design, including divide-and-conquer, greedy, dynamic programming and backtracking. Mathematical analysis of algorithms. Introduction to NP-Completeness theory, including the classes P and NP, polynomial transformations and NP-complete problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 424 Computational Complexity Theory
Crosslisted with: CSCE 824
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 425 Compiler Construction
Crosslisted with: CSCE 825
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Review of program language structures, translation, loading, execution, and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile-time and runtime symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, object code optimization techniques, and overall design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

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

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

CSCE 432 High-Performance Processor Architectures
Crosslisted with: CSCE 832
Prerequisites: CSCE 430; MATH 314; MATH/STAT 380 or ELEC 305
Description: High performance computing at the processor level. The underlying principles and micro-architectures of contemporary high-performance processors and systems. State-of-the-art architectural approaches to exploiting instruction level parallelism for performance enhancements. Case studies of actual systems highlight real-world trade-offs and theories. CSCE 432 assumes knowledge of computer architecture, pipelining, memory hierarchy, instruction level parallelism, and compiler principles.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

CSCE 435 Cluster and Grid Computing
Crosslisted with: CSCE 835
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311 or equivalent programming experience.
Description: Build and program clusters. Cluster construction, cluster administration, cluster programming, and grid computing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 436 Advanced Embedded Systems
Crosslisted with: CSCE 836
Prerequisites: CSCE 236; SOFT 260, CSCE 310, CSCE 310H, CSCE 311, or equivalent; senior/graduate standing.
Description: Techniques in embedded hardware and software design. Transceiver design and low-power communication, sensors, and distributed sampling techniques. Operating systems, driver development, and debugging. Architectures of embedded systems such as wireless sensors and design. Development and implementation of these applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 437 File and Storage Systems
Crosslisted with: CSCE 837
Description: System-level and device-level topics in the design, implementation, and use of file and storage systems. Components and organization of storage systems, disk drive hardware and firmware, multi-disk systems, RAID's, local distributed and P2P file systems, and low-power design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 438 Sensor Networks
Crosslisted with: CSCE 838
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent; senior or graduate standing or instructor permission.
Description: Basics of sensor networks; theoretical and practical insight into wireless sensor networks, including low-power hardware and wireless communication principles; networking in wireless sensor networks; and applications of sensor networks, such as multimedia, underwater, and underground. A group project that provides hands-on interaction with a wireless sensor network testbed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

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

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

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

CSCE 451 Operating Systems Principles
Crosslisted with: CSCE 451H, CSCE 851
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 451H Operating Systems Principles
Crosslisted with: CSCE 451, CSCE 851
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 455 Distributed Operating Systems
Crosslisted with: CSCE 855
Description: Organization and structure of distributed operating systems. Control, communication and synchronization of concurrent processes in the context of distributed systems. Processor allocation and scheduling. Deadlock avoidance, detection, recovery in distributed systems. Fault tolerance. Distributed file system concepts and structure.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

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

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

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

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

CSCE 463 Data and Network Security
Crosslisted with: CSCE 863
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Concepts and principles of data and network security. Focuses on practical aspects and application of crypto systems in security protocols for networks such as the Internet. Topics include: applications of cryptography and cryptosystems for digital signatures, authentication, network security protocols for wired and wireless networks, cyberattacks and countermeasures, and security in modern computing platforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 464 Internet Systems and Programming
Crosslisted with: CSCE 864
Prerequisites: CSCE 156, SOFT 161, CSCE 311, or CSCE 320 or equivalent programming experience.
Description: Paradigms, systems, and languages for Internet applications. Client-side and server-side programming, object-based and event-based distributed programming, and multi-tier applications. Coverage of specific technologies varies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 465 Wireless Communication Networks
Crosslisted with: CSCE 865
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380 or ELEC 305; or instructor permission
Description: Discussion of theoretical and practical insight to wireless communications and wireless networking, current practices, and future trends. Wireless network architectures, mobility management, radio propagation, modulation, power control, antennas, channel access, pricing, and standards.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 466 Software Design and Architecture
Crosslisted with: SOFT 466, CSCE 866
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 467 Testing, Verification and Analysis
Crosslisted with: SOFT 467, CSCE 867
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: SOFT 468, CSCE 868
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 470 Computer Graphics
Crosslisted with: CSCE 470H, CSCE 870
Prerequisites: CSCE 230, CSCE 310, CSCE 310H, or CSCE 311; 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
Format: LEC

CSCE 470H Computer Graphics
Crosslisted with: CSCE 470, CSCE 870
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; 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
Format: LEC

CSCE 471 Introduction to Bioinformatics
Crosslisted with: CSCE 871
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380
Description: Fundamentals and trends in bioinformatics. Scoring matrices and pairwise sequence alignments via dynamic programming, BLAST, and other heuristics. Multiple sequence alignments. Applications of machine learning methods such as hidden Markov models and support vector machines to biological problems such as family modeling and phylogeny.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 472 Digital Image Processing
Crosslisted with: CSCE 872
Prerequisites: CSCE 156, SOFT 161, or CSCE 311 or equivalent programming experience.
Description: Digital imaging systems, digital image processing, and low-level computer vision. Data structures, algorithms, and system analysis and modeling. Digital image formation and presentation, image statistics and descriptions, operations and transforms, and system simulation. Applications include system design, restoration and enhancement, reconstruction and geometric manipulation, compression, and low-level analysis for computer vision.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

CSCE 474 Introduction to Data Mining
Crosslisted with: CSCE 874
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380
Description: Data mining and knowledge discovery methods and their application to real-world problems. Algorithmic and systems issues. Statistical foundations, association discovery, classification, prediction, clustering, spatial data mining and advanced techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 475 Multiagent Systems
Crosslisted with: CSCE 875
Prerequisites: CSCE 156, SOFT 161, or CSCE 311
Description: Distributed problem solving and planning, search algorithms for agents, distributed rational decision making, learning multiagent systems, computational organization theory, formal methods in Distributed Artificial Intelligence, multiagent negotiations, emergent behaviors (such as ants and swarms), and Robocup technologies and real-time coalition formation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 476 Introduction to Artificial Intelligence
Crosslisted with: CSCE 876
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311
Description: Introduction to basic principles, techniques, and tools now being used in the area of machine intelligence. Languages for AI programming introduced with emphasis on LISP. Lecture topics include problem solving, search, game playing, knowledge representation, expert systems, and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 476H Honors: Introduction to Artificial Intelligence
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311, or CSCE 283H; Good standing in the University Honors Program or by instructor permission.
Notes: CSCE 476H covers the same topics as CSCE 476, but in greater depth.
Description: Introduction to basic principles, techniques, and tools now being used in the area of machine intelligence. Languages for AI programming introduced with emphasis on LISP. Lecture topics include problem solving, search, game playing, knowledge representation, expert systems, and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 477 Cryptography and Computer Security
Crosslisted with: CSCE 477H, CSCE 877
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH 314.
Description: Introductory course on cryptography and computer security. Topics: classical cryptography (substitution, Vigenere, Hill and permutation ciphers, and the one-time pad); Block ciphers and stream ciphers; The Data Encryption Standard; Public-key cryptography, including RSA and El-Gamal systems; Signature schemes, including the Digital Signature Standard; Key exchange, key management and identification protocols.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 477H Cryptography and Computer Security
Crosslisted with: CSCE 477, CSCE 877
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH 314.
Description: Introductory course on cryptography and computer security. Topics: classical cryptography (substitution, Vigenere, Hill and permutation ciphers, and the one-time pad); Block ciphers and stream ciphers; The Data Encryption Standard; Public-key cryptography, including RSA and El-Gamal systems; Signature schemes, including the Digital Signature Standard; Key exchange, key management and identification protocols.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 478 Introduction to Machine Learning
Crosslisted with: CSCE 878
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, 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
Format: LEC

CSCE 479 Introduction to Neural Networks
Crosslisted with: CSCE 879
Prerequisites: CSCE 310 or CSCE 311
Description: Introduction to the concepts, design, and application of connection-based computing begins with simulating neural networks, focusing on competing alternative network architectures, including sparse distributed memories, Hopfield networks, and the multilayered feed-forward systems. Construction and improvement of algorithms used for training of neural networks addressed to reduce training time and improve generalization. Algorithms for training and synthesizing effective networks implemented in high level language programs running on conventional computers. Emphasis on methods for synthesizing and simplifying network architectures for improved generalization. Application areas include: pattern recognition, computer vision, robotics medical diagnosis, weather and economic forecasting.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 486 Computer Science Professional Development
Prerequisites: A grade of "Pass" or "C" or better in SOFT 261, CSCE 361 or CSCE 361H
Notes: CSCE 486 must be taken exactly one semester before CSCE 487.
Description: Preparation for the senior design project. Professional practice through familiarity with current tools, resources, and technologies; professional standards, practices, and ethics; and oral and written report styles used in the computer science field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 8 Civic/Ethics/Stewardship

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

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

CSCE 489H Computer Engineering Senior Design Project
Crosslisted with: CSCE 489
Prerequisites: CSCE 488 (taken exactly one semester previous).
Description: A substantial computer engineering project requiring hardware-software co-design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and computer engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product
CSCE 490 Special Topics in Computer Science
Crosslisted with: CSCE 890
Description: Prereq: Permission. CSCE 490/890 will not count toward a major or minor in Computer Science and Computer Engineering. Aspects of computers and computing for non-computer science and computer engineering majors and/or minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

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

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

CSCE 493A Interdisciplinary Capstone
Prerequisites: CSCE 311
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. Does not apply toward any requirements for the Computer Science or Computer Engineering degree. Required for the Informatics minor.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: LEC

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

CSCE 496H Honors: Special Topics in Computer Science
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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

SOFT 160 Software Engineering I
Prerequisites: MATH 103 or equivalent.
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. Letter grade only.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235; CSCE 235H; CSCE 311; MECH 300; MECH 350; MECH 350H; SOFT 161; SOFT 260; SOFT 360

SOFT 161 Software Engineering II
Prerequisites: A grade of C+ or higher in SOFT 160 or equivalent
Description: Design and modeling of complex software systems. Techniques and tools based on disciplined software engineering principles and practices for designing and modeling software-intensive systems from technical, organizational and management perspectives. Techniques for building and analyzing event-driven applications and multi-layer applications with an SQL database backend. Data structures and operations for lists, stacks, queues, and other data structures. Algorithms and data structures for searching and sorting. Concepts and practice of object-oriented programming, including encapsulation, composition, inheritance, and polymorphism. Letter grade only.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CSCE 310, CSCE 310H; CSCE 322; CSCE 378; SOFT 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  
**Format:** LEC  
**Offered:** SUMMER

SOFT 260 Software Engineering III  
**Prerequisites:** A grade of C+ or higher in SOFT 161 or equivalent; CSCE 235 or parallel.  
**Description:** Specification and analysis of complex software systems. Techniques and tools based on disciplined software engineering principles and practices for systematically establishing, defining, analyzing, refining, and managing requirements for software-intensive systems from technical, organizational and management perspectives. Advanced data structures and algorithms. Techniques for conflict resolution, negotiating and managing change, and working effectively in teams. Letter grade only.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Prerequisite for:** CSCE 361, CSCE 361H; CSCE 378H; CSCE 410, CSCE 810; CSCE 411H, RAIK 411H; CSCE 413, CSCE 813; CSCE 438, CSCE 838; CSCE 476H; CSCE 491; SOFT 360

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:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Offered:** FALL/SPR  
**ACE:** ACE 2 Communication Competence

SOFT 261H Software Engineering IV  
**Prerequisites:** Good Standing in UNL Honors Program or by invitation; 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:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**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.  
**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. Letter grade only.  
**Credit Hours:** 1  
**Max credits per semester:** 1  
**Max credits per degree:** 1  
**Format:** LEC  
**Prerequisite for:** RAIK 404H

SOFT 401H Honors: RAIK Design Studio I  
**Crosslisted with:** 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; BSAD/RAIK 282H; and CSCE/RAIK 284H.  
**Description:** Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients. First semester in the Jeffrey S. Raikes School of Computer Science and Management design studio sequence.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** RAIK 402H  
**ACE:** ACE 8 Civic/Ethics/Stewardship

SOFT 402H Honors: RAIK Design Studio II  
**Crosslisted with:** 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/RAIK 282H; and CSCE/RAIK 284H.  
**Description:** Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients. Second semester in the Jeffrey S. Raikes School of Computer Science and Management design studio sequence.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** RAIK 403H

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

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

SOFT 466 Software Design and Architecture
Crosslisted with: CSCE 466, CSCE 866
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

SOFT 467 Testing, Verification and Analysis
Crosslisted with: CSCE 467, CSCE 867
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

SOFT 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: CSCE 468, CSCE 868
Prerequisites: SOFT 261 or CSCE 361 or equivalent
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. Letter grade only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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.