COMPUTER SCIENCE

Description
Website: http://cse.unl.edu
email: info@cse.unl.edu

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

The CSE Department offers a challenging baccalaureate degree program in computer science that prepares graduates for professional practice as computer scientists, provides the basis for advanced studies in the field, and establishes a foundation for lifelong learning and achievement. The BS degree in computer science is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

Introductory Courses
Entering students may select from several introductory courses, according to their interests and as indicated by the CSE Placement Examination. The Computer Science I courses (CSCE 155A Computer Science I, CSCE 155H Honors: Computer Science I, CSCE 155E Computer Science I: Systems Engineering Focus, CSCE 155N Computer Science I: Engineering and Science Focus, and CSCE 155T Computer Science I: Informatics Focus) all provide a foundation in designing and programming computing solutions and prepare students for more advanced CSCE courses, including CSCE 156 Computer Science II. These courses are designed to meet different interests. CSCE 155A is designed for students majoring in computer science. CSCE 155H is for honors students. CSCE 155E emphasizes computing for systems engineering, such as control systems, mobile computing, and embedded devices and is designed for students majoring in computer engineering. CSCE 155N focuses on numerical and graphical computation in engineering and science, such as applied physics, working with time-sequence data, and matrix applications. CSCE 155T focuses on data and information processing, such as document or database applications, online commerce, or bioinformatics. CSCE 156 is for students with a background in designing and programming computing solutions, such as is provided by Computer Science I. CSCE 101 Fundamentals of Computer Science is for students seeking a broad introduction to computer science with brief instruction in computer programming.

Program Assessment. In order to assist the department in evaluating the effectiveness of its programs, majors will be required in their senior year to complete a written exit survey. Results of participation in these assessment activities will in no way affect a students GPA or graduation.

College Admission
The entrance requirements for the College of Arts and Sciences (CAS), including any of the majors or minors offered through the college, are the same as the UNL General Admission Requirements. In addition to these requirements, the College of Arts and Sciences strongly recommends a third and fourth year of one foreign language in high school. Four years of high school coursework in the same language will fulfill the College of Arts and Sciences’ language requirement. It will also allow students to continue language study at a more advanced level at UNL and provide more opportunity to study abroad.

ACADEMIC AND CAREER Advising

Academic and Career Advising Center
The Academic and Career Advising Center in 107 Oldfather Hall is the undergraduate hub for CAS students in all majors. Centrally located and easily accessed, students encounter friendly, knowledgeable people who are eager to help. Students visit the Advising Center in 107 Oldfather Hall to:

- Choose or change their major, minor, or degree program.
- Check in on policies, procedures, and deadlines.
- Get a college approval signature from the Dean’s representative, Sr. Director of Advising and Student Success.

While the assigned academic advisor should be the student’s primary contact, there are daily walk-ins from 12-3 where a general academic advisor can answer a quick question. In addition, the CAS Career Coaches are located here. They help students explore majors and minors, gain experience, and develop a plan for life after graduation. Not sure where to go or who to ask? The Advising Center team can help.

Assigned Academic Advisors
Academic advisors are critical resources dedicated to students' academic, personal, and professional success. Every CAS student is assigned an academic advisor based on their primary major. Since most CAS students have more than just a single major, it is important to get to know the advisor for any minors or additional majors. Academic advisors work closely with the faculty to provide the best overall support and the discipline-specific expertise.

Assigned advisors are listed in MyRED (https://its.unl.edu/myunl) and their offices may be located in or near the department of the major for which they advise or in the Academic and Career Advising Center. Students who have declared a pre-health or pre-law area of interest will also work with advisors in the Exploratory and Pre-Professional Advising Center (Explore Center) in 127 Love South, who are specially trained to guide students preparing to enter a professional school.

For complete and current information on advisors for majors, minors, or pre-professional areas, contact the Arts and Sciences Academic and Career Advising Center, 107 Oldfather Hall, 402-472-4190, http://cas.unl.edu/advising.

Career Coaching
The College believes that Academics + Experience = Opportunities and encourages students to complement their academic preparation with real-world experience, including internships, research, education abroad, service, and leadership. Arts and sciences students have access to a powerful network of faculty, staff, and advisors dedicated to providing information and support for their goals of meaningful employment or advanced education. Arts and sciences graduates have unlimited career possibilities and carry with them important career competencies—communication, critical thinking, creativity, context, and collaboration. They have the skills and adaptability that employers universally value. Graduates are not only prepared to effectively contribute professionally in the real world, but they have a solid foundation to excel in an increasingly global, technological, and interdisciplinary world.

Students should contact the career coaches in the Arts and Sciences Academic and Career Advising Center in 107 Oldfather, or their assigned advisor, for more information. The CAS career coaches help students explore career options, identify ways to build experience, and prepare...
to apply for internships, jobs, or graduate school, including help with resumes, applications, and interviewing.

**ACE Requirements**

Students must complete one course for each of the ACE Student Learning Outcomes below. Certified course choices are published in the degree audit, or visit the ACE website (http://ace.unl.edu) for the most current list of certified courses.

**ACE Student Learning Outcomes**

<table>
<thead>
<tr>
<th>ACE 1</th>
<th>Write texts, in various forms, with an identified purpose, that respond to specific audience needs, integrate research or existing knowledge, and use applicable documentation and appropriate conventions of format and structure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE 2</td>
<td>Demonstrate competence in communication skills.</td>
</tr>
<tr>
<td>ACE 3</td>
<td>Use mathematical, computational, statistical, logical, or other formal reasoning to solve problems, draw inferences, justify conclusions, and determine reasonableness.</td>
</tr>
<tr>
<td>ACE 4</td>
<td>Use scientific methods and knowledge to pose questions, frame hypotheses, interpret data, and evaluate whether conclusions about the natural and physical world are reasonable.</td>
</tr>
<tr>
<td>ACE 5</td>
<td>Use knowledge, historical perspectives, analysis, interpretation, critical evaluation, and the standards of evidence appropriate to the humanities to address problems and issues.</td>
</tr>
<tr>
<td>ACE 6</td>
<td>Use knowledge, theories, and research perspectives such as statistical methods or observational accounts appropriate to the social sciences to understand and evaluate social systems or human behaviors.</td>
</tr>
<tr>
<td>ACE 7</td>
<td>Use knowledge, theories, or methods appropriate to the arts to understand their context and significance.</td>
</tr>
<tr>
<td>ACE 8</td>
<td>Use knowledge, theories, and analysis to explain ethical principles and their importance in society.</td>
</tr>
<tr>
<td>ACE 9</td>
<td>Exhibit global awareness or knowledge of human diversity through analysis of an issue.</td>
</tr>
<tr>
<td>ACE 10</td>
<td>Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.</td>
</tr>
</tbody>
</table>

**College Degree Requirements**

**College Distribution Requirements – BA and BS**

The College of Arts and Sciences distribution requirements are common to both the bachelor of arts and bachelor of science degrees and are designed to ensure a range of courses. By engaging in study in several different areas within the College, students develop the ability to learn in a variety of ways and apply their knowledge from a variety of perspectives. All requirements are in addition to University ACE requirements, and no course can be used to fulfill both an ACE outcome and a College Distribution Requirement.

- A student may not use a single course to satisfy more than one College Distribution Requirement, with the exception of CDR Diversity. Courses used to meet CDR Diversity may also meet CDR Writing, CDR Humanities, or CDR Social Science.
- Independent study or reading courses and internships cannot be used to satisfy distribution requirements.
- Courses from interdisciplinary programs will be applied in the same area as courses from the home/cross-listed department.

<table>
<thead>
<tr>
<th>College Distribution Requirements</th>
<th>Credit Hours Subtotal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDR: Written Communication</td>
<td>3</td>
</tr>
<tr>
<td>Select from courses approved for ACE outcome 1.</td>
<td></td>
</tr>
<tr>
<td>CDR: Natural, Physical, and Mathematical Sciences with Lab</td>
<td>4</td>
</tr>
<tr>
<td>Select from biochemistry, biological sciences, chemistry, computer science, geology, meteorology, mathematics, physics, and statistics. Must include one lab in the natural or physical sciences. Lab courses may be selected from biochemistry, biological sciences, chemistry, geology, meteorology, and physics.</td>
<td></td>
</tr>
<tr>
<td>Some courses from geography and anthropology may also be used to satisfy the lab requirement above.</td>
<td></td>
</tr>
<tr>
<td>CDR: Humanities</td>
<td>3</td>
</tr>
<tr>
<td>Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.</td>
<td></td>
</tr>
<tr>
<td>CDR: Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Select from anthropology, communication studies, geography, political science, psychology, or sociology.</td>
<td></td>
</tr>
<tr>
<td>CDR: Human Diversity in U.S. Communities</td>
<td>0-3</td>
</tr>
<tr>
<td>Select from a set of approved courses as listed in the degree audit.</td>
<td></td>
</tr>
<tr>
<td>CDR: Language</td>
<td>0-16</td>
</tr>
</tbody>
</table>

Fulfilled by the completion of the 6-credit-hour second-year sequence in a single foreign language in one of the following departments: Classics and religious studies or modern languages and literatures. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, Russian, and Spanish.

A student who has completed the fourth-year level of one foreign language in high school is exempt from the languages requirement, but encouraged to continue on in their language study.

**Language Requirement**

UNL and the College of Arts and Sciences place great value on academic exposure and proficiency in a second language. The UNL entrance requirement of two years of the same foreign language or the College's language distribution requirement (CDR: Language) will rarely be waived and only with relevant documentation. See the main College of Arts and Sciences page for more details.

**Scientific Base - BS Only**

The bachelor of science degree requires students to complete 60 hours in mathematical, physical, and natural sciences. Approved courses
for scientific base credit come from the following College of Arts and Sciences disciplines: actuarial science, anthropology (selected courses), astronomy, biochemistry (excluding BIOL 101), biological sciences (excluding BIOS 100 or BIOS 203), chemistry (excluding CHEM 101), computer science (excluding CSCE 10), geography (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104), meteorology, microbiology (excluding MBIO 101), and physics.

See your Degree Audit or your assigned academic advisor for a complete list, including individual classes that fall outside of the disciplines listed above. Up to 12 hours of scientific and technical courses offered by other colleges may be accepted toward this requirement with approval of the College of Arts and Sciences. See your assigned academic advisor to start the approval process.

Minimum Hours Required for Graduation
A minimum of 120 semester hours of credit is required for graduation from the College of Arts and Sciences. A cumulative grade point average of at least 2.0 is required.

Grade Rules
Restrictions on C- and D Grades
The College will accept no more than 15 semester hours of C- and D grades from other domestic institutions except for UNO and UNK. All courses taken at UNO and UNK impact the UNL transcript. No transfer of C- and D grades can be applied toward requirements in a major or a minor. No UNL C- and D grades can be applied toward requirements in a major or a minor. International coursework (including education abroad) with a final grade equivalent to a C- or lower will not be validated by College of Arts and Sciences departments to be degree applicable.

Pass/No Pass Privilege
The College of Arts and Sciences adheres to the University regulations for the Pass/No Pass (P/N) privilege with the following additional regulations:

- Pass/No Pass hours can count toward fulfillment of University ACE requirements and college distribution requirements up to the 24-hour maximum.
- Most arts and sciences departments and programs do not allow courses graded Pass/No Pass to apply to the major or minor. Students should refer to the department's or program's section of the catalog for clarification. By college rule, departments can allow up to 6 hours of Pass/No Pass in the major or minor.
- Departments may specify that certain courses of theirs can be taken only on a P/N basis.
- The college will permit no more than a total of 24 semester hours of P/N grades to be applied toward degree requirements. This total includes all Pass grades earned at UNL and other U.S. schools. NOTE: This 24-hour limit is more restrictive than the University regulation.

Grading Appeals
A student who feels that he/she has been unfairly graded must ordinarily take the following sequential steps in a timely manner, usually by initiating the appeal in the semester following the awarding of the grade:

1. Talk with the instructor concerned. Most problems are resolved at this point.
2. Talk to the instructor's department chairperson.
3. Take the case to the Grading Appeal Committee of the department concerned. The Committee should be contacted through the department chairperson.
4. Take the case to the College Grading Appeals Committee by contacting the Dean's Office, 1223 Oldfather Hall.

Course Level Requirements
Courses Numbered at the 300 or 400 Level
Thirty (30) of the 120 semester hours of credit must be in courses numbered at the 300 or 400 level. Of those 30 hours, 15 hours (1/2) must be completed in residence at UNL.

Residency Requirement
Students must complete at least 30 of the 120 total hours for their degree at UNL. Students must complete at least 1/2 of their major coursework, including 6 hours at the 300 or 400 level in their major and 15 of the 30 hours required at the 300 or 400 level, in residence. Credit earned during education abroad may be used toward the residency requirement only if students register through UNL.

Catalog to Use
Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted to and enrolled as a degree-seeking student at UNL. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at UNL in the College of Arts and Sciences. Students must complete all degree requirements from a single catalog year. Beginning in 1990-1991, the catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Learning Outcomes
Graduates of the computer science program will be able to:

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

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

Major Requirements (Non-Raikes)
Core Requirements

Required Computer Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCE 10</td>
<td>Introduction to CSE</td>
<td>0</td>
</tr>
</tbody>
</table>

Select one of the following: 3
CSCE 155A  Computer Science I
CSCE 155E  Computer Science I: Systems Engineering Focus
CSCE 155H  Honors: Computer Science I
CSCE 155N  Computer Science I: Engineering and Science Focus
CSCE 155T  Computer Science I: Informatics Focus
CSCE 156  Computer Science II
CSCE 231  Computer Systems Engineering
CSCE 235  Introduction to Discrete Structures
CSCE 251  Unix Programming Environment
CSCE 310  Data Structures and Algorithms
CSCE 322  Programming Language Concepts
CSCE 361  Software Engineering
Credit Hours Subtotal: 24

**Specific Major Requirements**

**Depth Courses**
- CSCE 351  Operating System Kernels 3
- or CSCE 451  Operating Systems Principles
- CSCE 423  Design and Analysis of Algorithms 3
- or CSCE 428  Automata, Computation, and Formal Languages
Credit Hours Subtotal: 6

**Technical Electives**
Select 9-11 hours of technical courses from any CSCE 300- or 400-level course. 1 2
Credit Hours Subtotal: 9-11

**Senior Design Experience**
Select one of the following sequences. CSCE 486 and CSCE 487 should be taken in consecutive semesters. CSCE 401H and CSCE 402H are by special invitation and permission only.
- CSCE 486 & CSCE 487  Computer Science Professional Development and Computer Science Senior Design Project
- CSCE 401H & CSCE 402H  Honors: RAIK Design Studio I and Honors: RAIK Design Studio II
Credit Hours Subtotal: 6

Total Credit Hours 21-23

1 Select from any CSCE/RAIK 300 or 400 course except CSCE 390, CSCE 490, and RAIK courses lacking CSCE equivalents (except that RAIK 384H, RA01 401H, RA01 402H, RA01 403H, and RA01 404H are acceptable as technical electives).

2 Up to 3 hours of CSCE 491 can be used for technical courses. No more than one of MATH 428, MATH 433, MATH 439, MATH 450, MATH 452 may be used. At least 6 credit hours of technical courses must be other than CSCE 399H, CSCE 491, CSCE 493, CSCE 498, RA01 401H, RA01 402H, RA01 403H, and RA01 404H.

**Ancillary Requirements**

**Mathematics**
- MATH 106  Calculus I 5
- MATH 107  Calculus II 4
- MATH 314  Linear Algebra 3
- STAT 380  Statistics and Applications 3
Credit Hours Subtotal: 15

**Science**
Select 12 credit hours of courses intended for science or engineering majors including at least one laboratory. Acceptable disciplines and courses are:

- **Chemistry**
  - CHEM 109  General Chemistry I
  - CHEM 110  General Chemistry II
  - CHEM 221  Elementary Quantitative Analysis
  - CHEM 113  Fundamental Chemistry I
  - CHEM 114  Fundamental Chemistry II

- **Physics and Astronomy**
  - PHYS 141  Elementary General Physics I
  - PHYS 142  Elementary General Physics II
  - PHYS 211  General Physics I
  - PHYS 221  General Physics Laboratory I
  - PHYS 212  General Physics II
  - PHYS 222  General Physics Laboratory II
  - PHYS 213  General Physics III
  - PHYS 223  General Physics Laboratory III
  - ASTR 204  Introduction to Astronomy and Astrophysics
  - ASTR 224  Astronomy and Astrophysics Laboratory

- **Biological Sciences**
  - BIOS 111  Introduction to Microbiology and Human Health
  - BIOS 205  Genetics, Molecular and Cellular Biology Laboratory
  - BIOS 206  General Genetics
  - BIOS 207  Ecology and Evolution
  - LIFE 120 & LIFE 120L  Fundamentals of Biology I and Fundamentals of Biology I Laboratory
  - LIFE 121 & LIFE 121L  Fundamentals of Biology II and Fundamentals of Biology II Laboratory

- **Earth and Atmospheric Sciences**
  - GEOL 155  Elements of Physical Geography
  - GEOL 101  Dynamic Earth
  - GEOL 103H  Honors: Historical Geology
  - GEOL 210  Geochemistry
  - METR 100  Weather and Climate
  - METR 205  Introduction to Atmospheric Science
  - METR 370  Applied Climatology

- **Anthropology**
  - ANTH 242  Introduction to Biological Anthropology
  - ANTH 242L  Introduction to Biological Anthropology Laboratory

Credit Hours Subtotal: 12

Total Credit Hours 27
Minor Requirement
The Plan A minor is required. By completing MATH 208 Calculus III or one additional advanced MATH course (in addition to the major requirements for MATH) the Plan A minor requirements for mathematics can be met. You must declare a minor through the College of Arts and Sciences Advising Center in 107 Oldfather Hall.

Major Requirements (Raikes)

Core Requirements

Required Computer Science Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIK 183H</td>
<td>Honors: Computer Problem Solving Essentials</td>
<td>4</td>
</tr>
<tr>
<td>RAIK 184H</td>
<td>Honors: Software Development Essentials</td>
<td>4</td>
</tr>
<tr>
<td>RAIK 283H</td>
<td>Honors: Software Engineering III</td>
<td>4</td>
</tr>
<tr>
<td>RAIK 383H</td>
<td>Software Engineering IV</td>
<td>4</td>
</tr>
<tr>
<td>CSCE 231</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CSCE 251</td>
<td>Unix Programming Environment</td>
<td>1</td>
</tr>
<tr>
<td>CSCE 322</td>
<td>Programming Language Concepts</td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 24

Required Raikes School Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIK 10</td>
<td>Raikes School Freshman Seminar</td>
<td>0</td>
</tr>
<tr>
<td>CSCE 163H</td>
<td>Innovation Processes and Software Engineering Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 185H</td>
<td>Honors: Foundations of Leadership I</td>
<td>1</td>
</tr>
<tr>
<td>RAIK 186H</td>
<td>Honors: Foundations of Leadership II</td>
<td>1</td>
</tr>
<tr>
<td>RAIK 188H</td>
<td>Honors: Introductory Communication Seminar II</td>
<td>1</td>
</tr>
<tr>
<td>RAIK 288H</td>
<td>Honors Business Writing</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 40</td>
<td>Professional and Life Skills</td>
<td>0</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 9

Specific Major Requirements

Depth Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCE 351</td>
<td>Operating System Kernels</td>
<td>3</td>
</tr>
<tr>
<td>or CSCE 451</td>
<td>Operating Systems Principles</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 423</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>or CSCE 428</td>
<td>Automata, Computation, and Formal Languages</td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 6

Technical Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIK 370H</td>
<td>Honors: Data and Models II: Data Science Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>RAIK 403H</td>
<td>Honors: RAIK Design Studio III</td>
<td>3</td>
</tr>
</tbody>
</table>

Select an additional CSCE or RAIK 300- or 400-level course. 3-4

Credit Hours Subtotal: 9-10

Senior Design Experience

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIK 401H</td>
<td>Honors: RAIK Design Studio I</td>
<td>6</td>
</tr>
<tr>
<td>&amp; RAIK 402H</td>
<td>and Honors: RAIK Design Studio II</td>
<td>6</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 6

Total Credit Hours 21-22

1 Select from any CSCE or RAIK 300- or 400-level course except CSCE 320, CSCE 390, CSCE 399H, CSCE 490, CSCE 491, CSCE 493, CSCE 493A, CSCE 498, RAIK 404H.

Ancillary Requirements

Mathematics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course 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>RAIK 270H</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>STAT 380</td>
<td>Statistics and Applications</td>
<td>3</td>
</tr>
<tr>
<td>STAT 380H</td>
<td>Statistics and Applications</td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 15

Science

Select 12 credit hours of courses intended for science or engineering majors including at least one laboratory. Acceptable disciplines and courses are:

Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course 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>CHEM 110</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 221</td>
<td>Elementary Quantitative Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Fundamental Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 114</td>
<td>Fundamental Chemistry II</td>
<td>3</td>
</tr>
</tbody>
</table>

Physics and Astronomy

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course 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

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOS 111</td>
<td>Introduction to Microbiology and Human Health</td>
<td>3</td>
</tr>
<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 and Fundamentals of Biology I Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 121</td>
<td>Fundamentals of Biology II and Fundamentals of Biology II Laboratory</td>
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Earth and Atmospheric Sciences

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<tr>
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<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>GEOG 155</td>
<td>Elements of Physical Geography</td>
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<td>GEOG 101</td>
<td>Dynamic Earth</td>
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<tr>
<td>GEOG 103H</td>
<td>Honors: Historical Geology</td>
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<td>GEOG 210</td>
<td>Weather and Climate</td>
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<tr>
<td>METR 100</td>
<td>Introduction to Atmospheric Science</td>
<td>3</td>
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<tr>
<td>METR 370</td>
<td>Applied Climatology</td>
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Anthropology

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>ANTH 242</td>
<td>Introduction to Biological Anthropology</td>
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</tbody>
</table>
ANTH 242L  Introduction to Biological Anthropology Laboratory
Credit Hours Subtotal: 12
Total Credit Hours 27

Minor Requirement
The business minor for Raikes is required for computer science majors in the Raikes School.

Additional Major Requirements

Grade Rules

C- and D Grades
A grade of C or above is required for all courses in the major and minor, excluding ancillary courses.

Pass/No Pass
Up to 6 hours of courses taken Pass/No Pass can be counted toward the major.

Course Level Requirement
Thirteen (13) hours of the CSCE courses must be at the 400 level for students not completing the J. S. Raikes School of Computer Science and Management.

Restriction
Students majoring in computer science may not declare a minor in informatics or software development.

Requirements for Minor Offered by Department

Minor in Computer Science – Non-Raikes Students
Eighteen (18) hours of computer science courses as follows.

Select one of the following: 3

- CSCE 155A  Computer Science I
- CSCE 155H  Honors: Computer Science I
- CSCE 155E  Computer Science I: Systems Engineering Focus
- CSCE 155N  Computer Science I: Engineering and Science Focus
- CSCE 155T  Computer Science I: Informatics Focus

Select at least one of the following: 3-4

- CSCE 156  Computer Science II
- CSCE 311  Data Structures and Algorithms for Informatics
- CSCE 300- or 400-level course 1

Additional CSCE courses 1 8-9

Total Credit Hours 18

1  Excluding CSCE 100, CSCE 120, CSCE 220, or CSCE 320.

Minor in Computer Science – Raikes Students
Eighteen (18) hours of computer science courses, including:

CSCE 183H / RAIK 183H  Honors: Computer Problem Solving Essentials 4
CSCE 283H / RAIK 283H  Honors: Foundations of Computer Science 3
Additional CSCE courses (or RAIK courses cross-listed as CSCE) at the 200 level or above. 2 3

Total Credit Hours 18

2  Except CSCE 235 and courses designated as not counting toward the minor (see CSCE course list in the catalog or the degree audit).
3  No more than 3 hours for RAIK Design Studio courses RAIK 401H, RAIK 402H, RAIK 403H, RAIK 404H.

Grade Rules

C- and D Grades
A grade of C or above is required for all courses in the major and minor, excluding ancillary courses.

Pass/No Pass
No course taken Pass/No Pass will be counted toward the minor.

Restriction
Students minoring in computer science may not declare a minor in informatics or software development. The computer science minor is not available to students majoring in computer engineering or software engineering.

CSCE 100 Introduction to Informatics

Prerequisites: Placement in to MATH 101 or higher

Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering.

Description: Introduction to the use of data-centric and information technologies and issues and challenges in today’s applications in sciences, engineering, the humanities, and the arts. Exposure to computational thinking and programming, statistical thinking and research design, data analysis and database techniques, and visualization and creative thinking.

Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 101 Fundamentals of Computer Science

Prerequisites: Placement in to MATH 101 or higher

Notes: A course in the science of computation and is suitable for non-CSCE majors and prospective CSCE majors.

Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation in a high-level programming environment. Hardware, software, software engineering, networks, and impacts of computing on society.

Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

Prerequisite for: CSCE 101L

ACE: ACE 3 Math/Stat/Reasoning
CSCE 101L Fundamentals of Computing Laboratory
Prerequisites: CSCE 101 or parallel.
Notes: Will not count towards the requirements for a major or minor in computer science and computer engineering.
Description: A variety of computer oriented exercises using many software tools is presented which supplement and are coordinated with the topics taught in CSCE 101. Students are exposed to programming, operating systems, simulation software, spreadsheets, database software, the Internet, etc. Applications software introduced in the context of tools to explore the computer science topics and as alternatives to traditional programming languages. Emphasis on learning by experiment, with a goal of developing problem solving skills. A major component is the study of a programming language—the choice of which may vary by course section.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
CSCE 120 Learning to Code
Prerequisites: Placement in to MATH 101 or higher
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. First course in a sequence for the minor in Software Development.
Description: Introduction to coding in the context of current web development technologies (JavaScript, HTML, CSS). Basic coding skills and an introduction to computing with an emphasis on processing data: data formatting and structure, data manipulation, data presentation and the basics of an interactive program.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 220; CSCE 320
CSCE 155A Computer Science I
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Credit may be earned in only one CSCE 155 course.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 156; CSCE 156H; CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300
ACE: ACE 3 Math/Stat/Reasoning
CSCE 155E Computer Science I: Systems Engineering Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Credit may be earned in only one CSCE 155 course.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 156; CSCE 156H; CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300
ACE: ACE 3 Math/Stat/Reasoning
CSCE 155H Honors: Computer Science I
Prerequisites: Good standing in UNL Honors Program; MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Covers the same topics as CSCE 155A, but in greater depth.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 156; CSCE 156H; CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300
ACE: ACE 3 Math/Stat/Reasoning
CSCE 155N Computer Science I: Engineering and Science Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Recommended for students interested in numerical and graphical applications in engineering and science, such as applied physics, working with time-sequence data, and matrix applications.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CHME 312; CSCE 156; CSCE 156H; CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300; MECH 318; MECH 330; MECH 350; MECH 381
ACE: ACE 3 Math/Stat/Reasoning
CSCE 155T Computer Science I: Informatics Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher.
Notes: Credit may be earned in only one CSCE 155 course.
Description: Introduction to computers and problem-solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 156; CSCE 156H; CSCE 230; CSCE 230H; CSCE 235; CSCE 235H; CSCE 311; ECEN 106; ECEN 224; MECH 300
ACE: ACE 3 Math/Stat/Reasoning

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

CSCE 156H Honors: Computer Science II
Prerequisites: Good standing UNL Honors Program. A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; coreq: MATH 106.
Notes: Covers the same topics as CSCE 156, but in greater depth. Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: BSAD 372H, RAIK 372H; CSCE 231; CSCE 283H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 260H, RAIK 283H

CSCE 163H Innovation Processes and Software Engineering Fundamentals
Crosslisted with: RAIK 163H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to innovation processes for interdisciplinary and team-oriented problem solving of software engineering, business development, and industrial design problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

CSCE 183H Honors: Computer Problem Solving Essentials
Crosslisted with: RAIK 183H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation. JAVA in a Windows platform.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: CSCE 230; CSCE 230H; CSCE 235, CSCE 235H; ECON 215; RAIK 184H, CSCE 184H
ACE: ACE 3 Math/Stat/Reasoning

CSCE 184H Honors: Software Development Essentials
Crosslisted with: RAIK 184H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 183H.
Description: Problem solving with computers. Problem analysis and specification, data structures, relational databases, algorithm development, and program design and implementation. Discrete mathematics topics, propositional and predicate logic, sets, relations, functions, and proof techniques. Software Development Principles.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: BSAD 372H, RAIK 372H; CSCE 231; CSCE 283H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; SOFT 260H, RAIK 283H

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

CSCE 220 Software Development for Smart-Mobile Systems
Prerequisites: CSCE 120
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. Second course in a sequence for the minor in Software Development.
Description: Practical experience on building larger scale applications and familiarity with the tools, environments (e.g., Android or iOS), and requirements to develop software for current smart-mobile devices such as phones and tablets.
Credit Hours: 4
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 320

CSCE 230 Computer Organization
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H, or RAIK 183H.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 236; CSCE 351; ECEN 220; ECEN 370, CSCE 335

CSCE 230H Honors: Computer Organization
Prerequisites: Good standing in the University Honors Program; a grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H.
Notes: Covers the same topics as CSCE 230, but in greater depth. 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
Grading Option: Graded with Option
Prerequisite for: CSCE 236; CSCE 351; ECEN 220; ECEN 370, CSCE 335

CSCE 231 Computer Systems Engineering
Prerequisites: Grade of "P" or "C" or better in CSCE 235, CSCE 235H or RAIK 184H.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: CSCE 236; CSCE 351

CSCE 235 Introduction to Discrete Structures
Crosslisted with: CSCE 235H
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H; and MATH 106.
Notes: Theoretical concepts with programming assignments.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 231; CSCE 310; CSCE 310H; SOFT 260

CSCE 235H Introduction to Discrete Structures
Crosslisted with: CSCE 235
Prerequisites: Good Standing in the University Honors program. A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H, or RAIK 183H; and MATH 106.
Notes: Theoretical concepts with programming assignments.
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
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: CSCE 231; CSCE 310; CSCE 310H; SOFT 260

CSCE 236 Embedded Systems
Prerequisites: A grade of "P" or "C" or better in CSCE 230, CSCE 230H or CSCE 231
Description: Introduction to designing, interfacing, configuring, and programming embedded systems. Configure simple embedded microprocessor systems, control peripherals, write device drivers in a high-level language, set up embedded and real-time operating systems, and develop applications for embedded systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 488
CSCE 251 Unix Programming Environment
Notes: Familiarity with at least one high-level programming language.
Description: Introduction to the Unix operating system. Unix file system.
Unix tools and utilities. Shell programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

CSCE 251H Honors: Unix Programming Environment
Notes: Permission.
Description: Advanced Unix programming with emphasis on shell scripting.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: CSCE 251

CSCE 283H Honors: Foundations of Computer Science
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 184H.
Notes: CSCE/RAIK 283H is the third course in the Jeffrey S. Raikes School of Computer Science and Management core.
Description: Advanced data structures and algorithms that solve common problems and standard approaches to solving new problems. Analysis and comparison of algorithms, asymptotic notation and proofs of correctness. Discrete mathematics. Induction and principles of counting and combinatorics as foundation for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CSCE 251 H, CSCE 361, CSCE 361 H; SOFT 261 H, RAIK 383 H

CSCE 290 Special Topics in Computer Science
Prerequisites: Permission.
Notes: Students may not receive credit for both CSCE 290 and 590.
Description: Topics vary depending on faculty interest.
Credit Hours: 1-3
Max credits per semester: 1
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 290H Special Topics in Computer Science
Prerequisites: Permission.
Description: Topics vary depending on faculty interest.
Credit Hours: 1-3
Max credits per semester: 1
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 296 Special Topics in Computer Science
Prerequisites: Permission.
Description: Topics vary depending on faculty interest.
Credit Hours: 1-3
Max credits per semester: 1
Max credits per degree: 6
Grading Option: Graded with Option

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

CSCE 310H Honors: Data Structures and Algorithms
Prerequisites: Good Standing in UNL Honors Program or by invitation; grades of "P" or "C" better in CSCE 156/156H or SOFT 161 and CSCE 235/235H.
Description: CSCE 310H covers the same topics as CSCE 310, but in greater depth. For course description, see CSCE 310.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CSCE 351; CSCE 493

CSCE 311 Data Structures and Algorithms for Informatics
Prerequisites: Grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160.
Notes: Students may not receive credit for both CSCE 310 and 311.
Description: An introduction to algorithms and data structures for informatics. Foundational coverage of algorithms includes both problems (such as indexing, searching, sorting, and pattern matching) and methods (such as greedy, divide-and-conquer, and dynamic programming). Foundational coverage of data structures includes lists, tables, relational databases, regular expressions, trees, graphs, and multidimensional arrays. The topics will be studied in the context of informatics applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 322; CSCE 322 H; CSCE 351; CSCE 361, CSCE 361 H; CSCE 378, CSCE 378 H; CSCE 493; CSCE 493 A

CSCE 320 Data Analysis
Prerequisites: A grade of "P" or "C" or better in CSCE 120 or CSCE 220.
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. Third course in a sequence for the minor in Software Development.
Description: Practical experience on how to model data through existing techniques including object-oriented and relational models. These models can then be used at the center of systems to promote efficient and effective data processing and analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 493
CSCE 322 Programming Language Concepts  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H.  
**Description:** List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option

CSCE 322H Honors: Programming Language Concepts  
**Prerequisites:** Good Standing in UNL Honors Program or by invitation; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H.  
**Description:** List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option  
**Offered:** FALL/SPR

CSCE 335 Digital Logic Design  
**Crosslisted with:** ECEN 370  
**Prerequisites:** ECEN 103/(UNO) ECEN 1030 or CSCE 230  
**Description:** Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded  
**Prerequisite for:** ECEN 307

CSCE 351 Operating System Kernels  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
**Description:** Design and implementation of operating system kernels. Bootstrapping and system initialzation, process context switching, I/O hardware and software, DMA, I/O polling, interrupt handlers, device drivers, clock management. Substantial programming implementing or extending an instructional operating system kernel.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option

CSCE 361 Software Engineering  
**Crosslisted with:** CSCE 361H  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
**Notes:** Requires participation in a group design and implementation of a software project.  
**Description:** Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option  
**Offered:** FALL/SPR

CSCE 361H Software Engineering  
**Crosslisted with:** CSCE 361  
**Prerequisites:** Good Standing in UNL Honors Program or by invitation; A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
**Notes:** Requires participation in a group design and implementation of a software project.  
**Description:** Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option  
**Prerequisite for:** CSCE 461, CSCE 861, SOFT 461; CSCE 486; CSCE 488

CSCE 370H Honors: Data and Models II: Data Science Fundamentals  
**Crosslisted with:** RAIK 370H  
**Prerequisites:** Good standing in the University Honors Program or by invitation; admission to the Jeffrey S.Raikes School of Computer Science and Management; and RAIK 270H  
**Description:** Introduction to approaches using data for prediction and learning. Exploration of data for linear and nonlinear data modeling, machine learning, and supportive methods from statistics and numerical methods.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option  
**Offered:** FALL/SPR
CSCE 378 Human-Computer Interaction
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: MATH/STAT 380 or ECEN 305 recommended. Meeting ACE1 and ACE2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCl, human information processing characteristics important in HCI, computer system features, such as input and output devices, dialogue techniques, and information presentation, task analysis, prototyping and the iterative design cycle, user interface implementation, interface evaluation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 378H Honors: Human-Computer Interaction
Prerequisites: Good standing in the University Honors Program; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: MATH/STAT 380, ECEN 305 or RAIK 270H recommended. Meeting ACE1 and ACE2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCl, human information processing characteristics important in HCI, computer system features, such as input and output devices, dialogue techniques, and information presentation, task analysis, prototyping and the iterative design cycle, user interface implementation, interface evaluation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

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

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

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

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

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

CSCE 401H Honors: RAIK Design Studio I
Crosslisted with: RAIK 401H, BSAD 401H, SOFT 401H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/RAIK 282H; and CSCE/RAIK 284H.
Notes: First semester in the Jeffrey S. Raikes School of Computer Science and Management design studio
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: RAIK 402H, BSAD 402H, CSCE 402H, SOFT 402H
ACE: ACE 8 Civic/Ethics/Stewardship

CSCE 402H Honors: RAIK Design Studio II
Crosslisted with: RAIK 402H, BSAD 402H, SOFT 402H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; and BSAD/CSCE/SOFT/RAIK 401H.
Notes: Second semester in the Jeffrey S. Raikes School of Computer Science and Management design studio
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: RAIK 403H, BSAD 403H, CSCE 403H, SOFT 403H
ACE: ACE 10 Integrated Product
CSCE 403H Honors: RAIK Design Studio III
Crosslisted with: RAIK 403H, BSAD 403H, SOFT 403H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/CSCE/SOFT/RAIK 402H.
Notes: Third semester of Jeffrey S. Raikes School of Computer Science and Management design studio sequence.
Description: Application of Jeffrey S. Raikes School of Computer Science and Management core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: RAIK 404H, BSAD 404H, CSCE 404H, SOFT 404H

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

CSCE 411 Data Modeling for Systems Development
Crosslisted with: CSCE 811
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Concepts of relational and object-oriented data modeling through the process of data model development including conceptual, logical and physical modeling. Techniques for identifying and creating relationships between discrete data members, reasoning about how data modeling and analysis are incorporated in system design and development, and specification paradigms for data models. Common tools and technologies for engineering systems and frameworks for integrating data. Design and analysis of algorithms and techniques for identification and exploration of data relationships, such as Bayesian probability and statistics, clustering, map-reduce, and web-based visualization.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 913; CSCE 914

CSCE 412 Data Visualization
Crosslisted with: CSCE 812
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; MATH 314.
Description: Fundamentals and implementations of data visualization techniques. Programming skills and practices in interactive visualization applications. Visualization foundations; human perception for information processing, and visualization techniques for different data types, such as scalar-field data, vector-field data, geospatial data, multivariate data, graph/network data, and text/document data. Advanced visualization algorithms and topics as time permits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 413 Database Systems
Crosslisted with: CSCE 813
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Involves practical experience with a working database system.
Description: Data and storage models for database systems; entity/relationship, relational, and constraint models; relational databases; relational algebra and calculus; structured query language; Logical database design: normalization; integrity; distributed data storage; concurrency; security issues. Spatial databases and geographic information systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 913; CSCE 914

CSCE 421 Foundations of Constraint Processing
Crosslisted with: CSCE 821
Prerequisites: A grade of "P" or "C" or better in CSCE 235 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Constraint processing for articulating and solving industrial problems such as design, scheduling, and resource allocation. The foundations of constraint satisfaction, its basic mechanisms (e.g., search, backtracking, and consistency-checking algorithms), and constraint programming languages. New directions in the field, such as strategies for decomposition and for symmetry identification.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 921
CSCE 423 Design and Analysis of Algorithms
Crosslisted with: CSCE 823
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Description: Mathematical preliminaries. Strategies for algorithm design, including divide-and-conquer, greedy, dynamic programming and backtracking. Mathematical analysis of algorithms. Introduction to NP-Completeness theory, including the classes P and NP, polynomial transformations and NP-complete problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 923; CSCE 924

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

CSCE 425 Compiler Construction
Crosslisted with: CSCE 825
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Description: Review of program language structures, translation, loading, execution, and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile-time and run-time symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, object code optimization techniques, and overall design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 428 Automata, Computation, and Formal Languages
Crosslisted with: CSCE 828
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Description: Introduction to the classical theory of computer science. Finite state automata and regular languages, minimization of automata. Context free languages and pushdown automata, Turing machines and other models of computation, undecidable problems, introduction to computational complexity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 430 Computer Architecture
Crosslisted with: CSCE 830
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H; Coreq: MATH/STAT 380, ECEN 305 or RAiK 270H.
Description: Architecture of single-processor (Von Neumann or SISD) computer systems. Evolution, design, implementation, and evaluation of state-of-the-art systems. Memory Systems, including interleaving, hierarchies, virtual memory and cache implementations; Communications and I/O, including bus architectures, arbitration, I/O processors and DMA channels; and Central Processor Architectures, including RISC and Stack machines, high-speed arithmetic, fetch/execute overlap, and parallelism in a single-processor system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 435 Cluster and Grid Computing
Crosslisted with: CSCE 835
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAiK 283H.
Notes: Designed for CSCE and non-CSCE students who have an interest in building or programming clusters to enhance their computationally-intense research.
Description: Build and program clusters. Cluster construction, cluster administration, cluster programming, and grid computing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 436 Advanced Embedded Systems
Crosslisted with: CSCE 836
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 236 or ECEN 220.
Description: Embedded hardware design techniques; transceiver design and low-power communication techniques; sensors and distributed sampling techniques; embedded software design and embedded operating systems; driver development; embedded debugging techniques; hardware and software architectures of embedded systems; and design, development, and implementation of embedded applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 438 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
Grading Option: Graded with Option
CSCE 439 Robotics: Algorithms and Applications
Crosslisted with: CSCE 839
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 236 or ECEN 220 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H
Description: Fundamental theory and algorithms for real world robot systems. Design and build a robot platform and implement algorithms in C++ or other high level languages. Topics include: open and closed loop control, reactive control, localization, navigation, path planning, obstacle avoidance, dynamics, kinematics, manipulation and grasping, sensing, robot vision processing, and data fusion.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 440 Numerical Analysis I
Crosslisted with: CSCE 840, MATH 440, MATH 840
Prerequisites: CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; MATH 107.
Notes: Credit toward the degree may be earned in only one of the following: CSCE/MATH 440/840 and MECH 480/880.
Description: Principles of numerical computing and error analysis covering numerical error, root finding, systems of equations, interpolation, numerical differentiation and integration, and differential equations. Modeling real-world engineering problems on digital computers. Effects of floating point arithmetic.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 942, MATH 942

CSCE 441 Approximation of Functions
Crosslisted with: CSCE 841, MATH 441, MATH 841
Prerequisites: MATH 221/MATH 221H and MATH 314/MATH 314H.
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
Grading Option: Graded with Option
Prerequisite for: CSCE 942, MATH 942
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
Grading Option: Graded with Option
Prerequisite for: CSCE 942, MATH 942
Groups: Advanced Mathematics Courses

CSCE 451 Operating Systems Principles
Crosslisted with: CSCE 851
Prerequisites: A grade of "P" or "C" or better in CSCE 230, CSCE 230H or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 454 Human-Robot Interaction
Crosslisted with: CSCE 854
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: Meeting ACE1 and ACE2 requirements prior to taking this course is recommended. Non-CSCE majors may discuss qualifications with the instructor.
Description: Introduction to the area of human-robot interaction through the reading and discussion of current peer-reviewed articles on topic to include teleoperation, social robotics, and open questions with field-based or aerial robotic systems. Areas covered include: research methods, experimental design, and identification of problems/open questions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 455 Distributed Operating Systems
Crosslisted with: CSCE 855
Prerequisites: CSCE 451/851.
Description: Organization and structure of distributed operating systems. Control, communication and synchronization of concurrent processes in the context of distributed systems. Processor allocation and scheduling. Deadlock avoidance, detection, recovery in distributed systems. Fault tolerance. Distributed file system concepts and structure.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 456 Parallel Programming
Crosslisted with: CSCE 856
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAIK 283H.
Description: Introduction to the 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
Grading Option: Graded with Option
CSCE 457 Systems Administration
Crosslisted with: CSCE 857
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to basic 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
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 458 Molecular and Nanoscale Communication
Crosslisted with: CSCE 858
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Completing CSCE 462/862 and CSCE 465/865 prior to taking this course is recommended. Exceptions can be granted on a per-student basis by the instructor.
Description: Overview of nanoscale communication options. Focus on bio-inspired communication through molecule exchange and biochemical reactions. Different techniques to realize nanomachines will be surveyed in the course, with particular attention to the tools provided by synthetic biology for the programming of biological cooperative systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

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

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

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

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

CSCE 463 Data and Network Security
Crosslisted with: CSCE 863
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Concepts and principles of data and network security. Focuses on practical aspects and application of crypto systems in security protocols for networks such as the Internet. Topics include: applications of cryptography and cryptosystems for digital signatures, authentication, network security protocols for wired and wireless networks, cyberattacks and countermeasures, and security in modern computing platforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
CSCE 464 Internet Systems and Programming  
Crosslisted with: CSCE 864  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 361 or equivalent programming experience.  
**Notes:** A grade of "P" or "C" or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.  
**Description:** Paradigms, systems, and languages for Internet applications. Client-side and server-side programming, object-based and event-based distributed programming, and multi-tier applications. Coverage of specific technologies varies.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option

CSCE 465 Wireless Communication Networks  
Crosslisted with: CSCE 865  
**Prerequisites:** A grade of "P" or "C" or better in STAT 380, ECEN 305 or RAIK 270H  
**Description:** Discussion of theoretical and practical insight to wireless communications and wireless networking, current practices, and future trends. Wireless network architectures, mobility management, radio propagation, modulation, power control, antennas, channel access, pricing, and standards.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option

CSCE 466 Software Design and Architecture  
Crosslisted with: SOFT 466, CSCE 866  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.  
**Notes:** Letter grade only.  
**Description:** Introduction to the concepts, principles, and state-of-the-art methods in software design and architecture. Topics include application of software engineering process models and management approaches for the design and architecture of large-scale software systems, tradeoffs of designing for qualities such as performance, security, and dependability, and techniques and tools for analyzing and evaluating software architectures.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

CSCE 467 Testing, Verification and Analysis  
Crosslisted with: SOFT 467, CSCE 867  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.  
**Notes:** Letter grade only.  
**Description:** In-depth coverage of problems related to software quality, and approaches for addressing them. Topics include testing techniques, dynamic and static program analysis techniques, and other approaches for verifying software qualities. Tool support for performing testing, verification, and analysis will also be studied.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

CSCE 468 Requirements Elicitation, Modeling and Analysis  
Crosslisted with: SOFT 468, CSCE 868  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 383H.  
**Notes:** Letter grade only.  
**Description:** In-depth coverage of processes, methods and techniques for determining, or deciding, what a proposed software system should do. Topics include the requirements engineering process, identification of stakeholders, requirements elicitation techniques, methods for informal and formal requirements documentation, techniques for analyzing requirements models for consistency and completeness, and traceability of requirements across system development and evolution. Tool support for modeling functional and non-functional requirements to support elicitation and analysis will be studied.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

CSCE 470 Computer Graphics  
Crosslisted with: CSCE 870  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; MATH 314  
**Description:** Display and recording devices; incremental plotters; point, vector, and character generation; grey scale displays, digitizers and scanners, digital image storage; interactive and passive graphics; pattern recognition; data structures and graphics software; the mathematics of three dimensions; homogeneous coordinates; projections and the hidden-line problem.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded with Option

CSCE 471 Computational Methods in Bioinformatics  
Crosslisted with: CSCE 871  
**Prerequisites:** A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.  
**Description:** Introduction to computational methods for tackling challenges in biological data analysis and modeling and understanding complex systems at the molecular and cellular level. The main topics include bio-sequence analysis, motif finding, structure prediction, phylogenic inference, regulation network modeling, and high-throughput omics data analysis.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Offered:** SPRING  
**Prerequisite for:** CSCE 971
CSCE 472 Digital Image Processing
Crosslisted with: CSCE 872
Prerequisites: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Description: Digital imaging systems, digital image processing, and low-level computer vision. Data structures, algorithms, and system analysis and modeling. Digital image formation and presentation, image statistics and descriptions, operations and transforms, and system simulation. Applications include system design, restoration and enhancement, reconstruction and geometric manipulation, compression, and low-level analysis for computer vision.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 473 Computer Vision
Crosslisted with: CSCE 873
Prerequisites: CSCE 156, SOFT 161, or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Description: High-level processing for image understanding and high-level vision. Data structures, algorithms, and modeling. Low-level representation, basic pattern-recognition and image-analysis techniques, segmentation, color, texture and motion analysis, and representation of 2-D and 3-D shape. Applications for content-based image retrieval, digital libraries, and interpretation of satellite imagery.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 474 Introduction to Data Mining
Crosslisted with: CSCE 874
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Requires the completion of a project involving the application of data mining techniques to real-world problems.
Description: Data mining and knowledge discovery methods and their application to real-world problems. Algorithmic and systems issues. Statistical foundations, association discovery, classification, prediction, clustering, spatial data mining and advanced techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 475 Multiagent Systems
Crosslisted with: CSCE 875
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Description: Distributed problem solving and planning, search algorithms for agents, distributed rational decision making, learning multiagent systems, computational organization theory, formal methods in Distributed Artificial Intelligence, multiagent negotiations, emergent behaviors (such as ants and swarms), and Robocup technologies and real-time coalition formation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 476 Introduction to Artificial Intelligence
Crosslisted with: CSCE 876
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Description: Introduction to basic principles, techniques, and tools now being used in the area of machine intelligence. Languages for AI programming introduced with emphasis on LISP. Lecture topics include problem solving, search, game playing, knowledge representation, expert systems, and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 976

CSCE 477 Cryptography and Computer Security
Crosslisted with: CSCE 877
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H; MATH 314.
Description: Introductory course on cryptography and computer security. Topics: classical cryptography (substitution, Vigenere, Hill and permutation ciphers, and the one-time pad); Block ciphers and stream ciphers; The Data Encryption Standard; Public-key cryptography, including RSA and El-Gamal systems; Signature schemes, including the Digital Signature Standard; Key exchange, key management and identification protocols.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 478 Introduction to Machine Learning
Crosslisted with: CSCE 878
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Notes: STAT 380, ECEN 305, or RAiK 270H recommended.
Description: Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, date mining, computational biology, and robotics. Theoretical and empirical analyses of decision trees, artificial neural networks, Bayesian classifiers, genetic algorithms, instance-based classifiers and reinforcement learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
CSCE 479 Introduction to Deep Learning
Crosslisted with: CSCE 879
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAiK 283H.
Notes: Completing STAT 380, ECEN 305, or RAiK 270 prior to taking this course is recommended.
Description: Fundamentals and current trends in deep learning.
Backpropagation, activation functions, loss functions, choosing an optimizer, and regularization. Common architectures such as convolutional, autoencoders, and recurrent. Applications such as image analysis, text analysis, sequence analysis, and reinforcement learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

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

CSCE 487 Computer Science Senior Design Project
Prerequisites: CSCE 486
Notes: Should be taken in the immediate next term after CSCE 486.
Description: A substantial computer science project requiring design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and software engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: SOFT 403
ACE: ACE 10 Integrated Product

CSCE 488 Computer Engineering Professional Development
Prerequisites: CSCE 236; A grade of "Pass" or "C" or better in CSCE 361 or CSCE 361H; formal admission to the College of Engineering; prerequisite or corequisite: JGEN 300.
Notes: Must be taken exactly one semester before CSCE 489.
Description: Preparation for the senior design project. Professional practice through familiarity and practice with current tools, resources, and technologies; professional standards, practices, and ethics; and oral and written report styles used in the computer engineering field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 489
ACE: ACE 8 Civic/Ethics/Stewardship

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

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

CSCE 491 Internship in Computing Practice
Prerequisites: Instructor permission.
Notes: Requires a detailed project proposal and final report.
Description: Experiential learning in conjunction with an approved industrial or government agency under the joint supervision of an outside sponsor and a faculty advisor.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 493 Innovation Lab Project
Prerequisites: CSCE 310, CSCE 310H, CSCE 311, or CSCE 320
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Students will work in teams and collaborate with CSE research faculty, supervising MS students, and sponsors that include private sectors and UNL faculty to design and develop real-world systems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option
CSCE 493A Interdisciplinary Capstone
Prerequisites: CSCE 311
Notes: Does not apply toward any requirements for the Computer Science or Computer Engineering degree. Required for the Informatics minor.
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Work in teams and collaboration with CSE research faculty and sponsors that include private sectors and UNL faculty to design and develop real-world systems to solve interdisciplinary problems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded

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

CSCE 496H Honors: Special Topics in Computer Science
Prerequisites: Good standing in the University Honors Program or by invitation.
Notes: Specific course prerequisites will vary depending on the topic.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

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

Career Information
The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Transferable Skills
- Implement appropriate technological interventions to help solve problems
- Collaborate with a team to develop solutions
- Simplify complex information and present it to others
- Use quantitative analysis techniques
- Document and replicate processes and procedures
- Apply mathematical and scientific skills to solve real-world problems
- Make decisions carefully, using appropriate theoretical frameworks
- Make predictions using mathematical, statistical, and scientific modeling methods

Jobs of Recent Graduates
- Mobile App Developer, Sandhills Publishing - Lincoln NE
- Software Consultant, Self Employed - Austin TX
- Programmer, Nebraska Heart Hospital - Lincoln NE
- Business Technology Support Technician, Department of Roads - Lincoln NE
- GIS Web Developer/Analyst, The North Jackson Company - Marquette MI
- Officer, United States Air Force - Cheyenne WY
- Software Developer, Experian - Lincoln NE
- Systems Application Specialist, Sandhills Publishing - Lincoln NE
- Data Engineer, Hudl - Lincoln NE
- Technology Specialist, TD Ameritrade - Omaha NE
- Software Engineer, Union Pacific - Omaha NE
- Software Engineer, Lockheed Martin - Littleton CO
- Implementation Consultant, Fast Enterprises, LLC - Atlanta GA
- IT Officer, United States Air Force - Cheyenne WY
- Jr. Application Developer, Builder Trend - Omaha NE
- Developer, Microsoft - Redmond WA

Internships
- System Application Developer Intern, Gallup - Lincoln NE
- Sandhills Systems Intern, Sandhills Publishing - Lincoln NE
- Data Science Intern, Hudl - Lincoln NE
- Junior Developer, NeSis - Lincoln NE
- Student Web Developer, Internet and Interactive Media (University Comm.) - Lincoln NE
- Year Round PC Build Intern, Union Pacific - Council Bluffs IA
- Software Development Intern, Nelnet - Lincoln NE
- IOS Intern, OSG Corporation - Irving TX
- Programmer, GIS Workshop - Lincoln NE
- Research Intern, ABB Corporate Research Center - Raleigh NC
- Web Develop Intern, Lincoln Stars - Lincoln NE
- Functional Assurance Intern, FISERV - Lincoln NE
- Software Engineer Intern, Bosch Security System - Lincoln NE
- Application Development Intern, BuilderTREND - Omaha NE
- Software Developer Engineer Intern, Zillow - Lincoln NE
Graduate & Professional Schools

- Master's Degree, Data Science, University of Minnesota-Twin Cities - Twin Cities MN
- Master's Degree, Computer Science, University of Nebraska-Lincoln - Lincoln NE
- Ph.D., Computer Science, University of Nebraska-Lincoln - Lincoln NE
- Master's Degree, Mathematical Science, Purdue University - West Lafayette IN
- Juris Doctorate, University of Nebraska-Lincoln - Lincoln NE
- Ph.D., Physics, University of Nebraska-Lincoln - Lincoln NE
- Ph.D., Computer Science, University of Texas at Austin - Austin TX
- Master's Degree, Computer Science, Arizona State University - Tempe AZ
- Medical Doctor, University of Nebraska Medical Center - Omaha NE
- Ph.D., Computer Science, Ohio State University - Columbus OH