Department of Computer Science

Computer science is a multifaceted discipline that encompasses a broad range of topics. At one end of the spectrum, computer science focuses on the theoretical capabilities of computers and on the properties of various general problems and algorithms. At the other applications-oriented end of the spectrum, computer science deals with techniques for the design and construction of machines and with advanced applications of computers in all aspects of our society. Graduates of the program will be prepared for admission to graduate study or for immediate employment in business, industry or government positions involving computer systems and techniques.

Program Objectives

The mission of the Department of Computer Science is to provide a broad-based, high-quality education in computer science. Our program will provide its graduates with a body of knowledge and an attitude toward learning that allows them to contribute positively to the profession and, ultimately, to society. In order to accomplish this, we must provide an academic experience sufficiently rich in both theory and practice to ensure the development of fundamentally sound, skilled graduates.

For our B.S. degree program in computer science, the following set of educational objectives describes what graduates are expected to attain within a few years following graduation:

- successfully engage in professional practice in the computing sciences or apply computer science tools to another field of interest
- pursue advanced study in the computing sciences
- behave in a professional and ethical manner
- communicate effectively both orally and in writing
- work successfully in both independent and team environments

In addition, the following set of student outcomes describes what students are expected to know and do by graduation:

- apply knowledge of computing and mathematics appropriate to the discipline
- analyze a problem and identify and define the computing requirements appropriate to its solution
- design, implement and evaluate a computer-based system, process, component or program to meet desired needs
- function effectively in teams to accomplish a common goal
- understand professional, ethical, legal, security and social issues and responsibilities
- communicate effectively with a range of audiences
- analyze the local and global impact of computing on individuals, organizations and society
- recognize the need for and engage in continuing professional development
- use current techniques, skills and tools necessary for computing practice
- apply mathematical foundations, algorithmic principles and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices
- apply design and development principles in the construction of software systems of varying complexity

Concentration in Software Engineering

In addition to the standard Bachelor of Science in Computer Science degree, the department offers a Concentration in Software Engineering. This concentration will give students a deeper understanding of software engineering, a sub-discipline of Computer Science. This concentration requires 12 hours of CS 400 level software engineering courses, chosen from an approved list. Students who successfully complete this concentration will have the designation indicated in their transcripts.

To complete this concentration, a student must complete the following courses within the Computer Science portion of their B.S. curriculum:

**Software Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 100</td>
<td>CS I for Majors</td>
<td>4</td>
</tr>
<tr>
<td>CS 101</td>
<td>CS II for Majors</td>
<td>4</td>
</tr>
<tr>
<td>CS 200</td>
<td>Software Design and Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CS 201</td>
<td>Data Structures and Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CS 403</td>
<td>Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>CS 426</td>
<td>Intro Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>CS 457</td>
<td>Database Management Systems</td>
<td>3</td>
</tr>
<tr>
<td>CS 475</td>
<td>Formal Languages &amp; Machines</td>
<td>3</td>
</tr>
<tr>
<td>CS 495</td>
<td>Capstone Computing</td>
<td>3</td>
</tr>
</tbody>
</table>

12 Hours of restricted software engineering elective courses from an approved list

The current list of approved Software Engineering electives can be found on the Department of Computer Science’s website.

This concentration does not require the student to take more than the 120 hours required for the B.S. degree, since six of these course hours replace six hours of CS electives, and the other six hours can be taken from the free electives in the B.S in CS curriculum.

Minors for Computer Science Majors

A minor is not required for students majoring in computer science. However, we strongly encourage all students to combine their individual interests with the free electives in the program to complete a minor in an area of interest to them. For example, computer science majors may earn a minor in mathematics by completing the mathematics courses required by the computer science curriculum plus Calculus III (MATH 227) and one additional math course numbered 300 or above, such as Theory Of Probability (MATH 355).

Computer Science Curriculum

**Freshman**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>EN 101</td>
<td>CS 100 (Computer Science I)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CS 121</td>
<td>ENGR 111 or CS 121</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>MATH 125</td>
<td>CS 121</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>HI/HS elective</td>
<td>HI/HS elective</td>
<td>3</td>
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<td>15</td>
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</tbody>
</table>

**Sophomore**

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<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>CS 200 (Software Design and Engineering)</td>
<td>4 CS 201 (Data Structures &amp; Algorithms)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ECE 381</td>
<td>ECE 381</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 301</td>
<td>MATH 302</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HI/HS elective</td>
<td>HI/HS elective</td>
<td>3</td>
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<td>14</td>
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</table>

**Junior**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>CS 403</td>
<td>CS 403</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CS 475</td>
<td>CS 475</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>GES 255 or ST 450</td>
<td>GES 255 or ST 450</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HI/HS Elective</td>
<td>HI/HS Elective</td>
<td>3</td>
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<tr>
<td></td>
<td>Free elective</td>
<td>Free elective</td>
<td>3</td>
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<td>15</td>
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</tbody>
</table>

**Senior**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Computer Science elective, 400 level</td>
<td>3 CS 495</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Computer Science elective, 400 level</td>
<td>CS 495</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Computer Science elective, 400 level</td>
<td>CS 495</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Approved Natural Science (N) elective</td>
<td>3 Approved natural science (N) elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HI/HS/F or HI/SS elective to complete 3rd course in each category.</td>
<td>3 HI/HS/F or HI/SS elective to complete 3rd course in each category.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Free elective</td>
<td>Free elective</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Hours: 120**

*Approved Natural Science (N) electives must be chosen from majors courses. Potential courses include:

- AY 101 Intro To Astronomy (Must take AY 102 to complete the N credit) | 3 |
- AY 102 Intro Astronomy Lab (Must take AY 101 to complete the N credit) | 3 |
- AY 203 Observational Astronomy (Must take AY 204 to complete the N credit) | 3 |
- AY 204 Solar System Astronomy (Must take AY 204 to complete the N credit) | 3 |
- BSC 114 Principles Of Biology I (Must take BSC 115) | 3 |
- BSC 115 Laboratory Biology I | 3 |
Computing Technology and Applications Minor

Admission into the Minor

Students are expected to formally declare a minor. With the assistance of an adviser in the major department, students should complete the Declaration of Minor form before or during the third year of full-time enrollment.

Grade Point Average

A 2.0 grade point average in the minor is required. The minor GPA is calculated based on all courses applicable to the minor that the student has attempted at UA.

Minor Courses

The minor in computing technology and applications (offered by the Department of Computer Science) is primarily designed for students who are seeking to become computer literate in today's rapidly advancing technology. This minor requires 18 hours of CS courses that are specifically designed for non-majors.

Requirements

Course Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 102</td>
<td>Microcomputer Applications</td>
<td>3</td>
</tr>
<tr>
<td>CS 202</td>
<td>Intro to the Internet</td>
<td>6</td>
</tr>
<tr>
<td>CS 205</td>
<td>Web Site Design</td>
<td></td>
</tr>
<tr>
<td>CS 285</td>
<td>Microcomputer Appl II</td>
<td></td>
</tr>
<tr>
<td>CS 302</td>
<td>Computerized Database Systems</td>
<td></td>
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<tr>
<td>CS 305</td>
<td>Advanced Computerized Database Systems</td>
<td></td>
</tr>
<tr>
<td>CS 340</td>
<td>Legal &amp; Ethical Issues in Comp</td>
<td></td>
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<tr>
<td>CS 345</td>
<td>Advanced Legal and Ethical Issues in Computing</td>
<td></td>
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<tr>
<td>CS 385</td>
<td>Prototyping In Visual Environn</td>
<td></td>
</tr>
<tr>
<td>CS 391</td>
<td>Special Topics</td>
<td></td>
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</tbody>
</table>

Total Hours: 18

*CS 391 Special Topics courses will count towards the 18 hours for this minor. However, they do not carry a C-designation and thus cannot be used towards your Core Curriculum requirements.

The following courses all carry a C-designation and thus can be used towards the completion of your Core Curriculum requirements: CS 202 Intro to the Internet, CS 205 Web Site Design, CS 285 Microcomputer Appl II, CS 302 Computerized Database Systems, CS 340 Legal & Ethical Issues in Comp, CS 345 Advanced Legal and Ethical Issues in Computing, and CS 385 Prototyping In Visual Environn.

Students who pass the CS 102 Microcomputer Applications placement test must still complete 18 hours of CS coursework.

For students in the College of Arts and Sciences, at least two of your CS courses must be 300 level or higher.

Upper-level Residency

A minimum of six hours of 300- or 400-level courses in the minor must be earned on this campus.

Ancillary Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 302</td>
<td>Topics in Discrete Mathematics</td>
<td>1</td>
</tr>
</tbody>
</table>

Additional Minor Requirements

Students are responsible for ensuring that they have met all University, college, major and minor requirements. However, each student must meet with an adviser for the major department for academic planning and to be cleared for registration each semester. College advisers are also available for additional assistance with minor, college and University requirements.
Faculty
Professor and Department Head
Cordes, David W.

Professors
Brown, David B.
Gray, Jeff
Parrish, Allen
Xiao, Yang

Associate Professor
Anderson, Monica
Borie, Richard B.
Brown, Marcus E.
Carver, Jeffrey
Dixon, Brandon
Hong, Xiaoyan
Lusth, John
Smith, Randy K.
Vrbisky, Susan V.
Zhang, Jingyuan

Instructors
Rebecca Odom-Bartel
Dixon, Leslie
Hooper, Dana
Hooper, Ralph E.
Morris, Kathleen
Prater, James M.
Marc Skipwith
Wright, Kimberly

Courses

CS 100. CS I for Majors. 4 sem. hrs.
A first course in programming for students majoring in computer science. Language concepts include primitives, variables, sequences, function, selection, iteration and recursion. Software engineering concepts include testing and debugging. System concepts include directories, paths, files, and text editing.
Prerequisite(s): (CS 102 or CS 150 or CBH 101 or CS 100 or PLCS of 380).

CS 101. CS II for Majors. 4 sem. hrs.
A second course in programming for students majoring in computer science. Using a high-level language, student use object-oriented practices to study fundamental data structures and algorithms. Issues such as computability, problem complexity and algorithm analysis, efficient searching and sorting, data structures, and the object-oriented programming paradigm are introduced and explained.
Prerequisite(s): (CS 100 or CBH 102 or (CS 150 and ECE 285)) and (Math 125 or Math 145).

CS 102. Microcomputer Applications. 3 sem. hrs.
Familiarization with Windows, fundamental and intermediate word processing commands, spreadsheet applications, and database management. (Credit for this course will not be applied to the requirements for a computer science degree).

CS 104. Computer Science Principles. 3 sem. hrs.
An introductory course that overviews the core principles of computer science from a broad spectrum of topics. The course content is focused on computing and its relation to creativity, abstraction, algorithms, programming, Big Data, Internet networking, and societal impact. Students will work on team-based projects that explore topics in Big Data, investigate the impact of the internet, and create their own games and/or smartphone applications. This course is restricted to Math and Math Education majors only.
Prerequisite(s) with concurrency: MATH 112 or MATH 115 or MATH 125 or MATH 126 or MATH 145 or MATH 146.

CS 120. Business Programming I. 3 sem. hrs.
An introduction to programming. The topics include procedural information enabled problem formulation, design and development of business computer solutions. This course concentrates on the construction and testing of individual programs.
Prerequisite(s): MATH 112 or MATH 115 or MATH 121 or MATH 125.

CS 121. The Discipline of Computing. 1 sem. hr.
An introduction to the discipline of computing designed for students who are considering a major or minor in computer science.
Prerequisite(s): MATH 112 OR higher OR UA Math Placement Test Score of 380
Prerequisite(s) with concurrency: MATH 112.

CS 150. Programming I. 2 sem. hrs.
An introductory course that teaches programming and program development. The emphasis of the course is the rapid acquisition of programming, testing, debugging and system skills. Topics include sequence, selection, iteration, arrays, functions and recursion.
Prerequisite(s): (Math 112 and Math 113) or Math 115 or UA Subject Math Placement Test Score (PLAC) of 565 or UA Math Placement Test Score (PLMA) of 440
Prerequisite(s) with concurrency: MATH 125 and MATH 126 and MATH 145 and MATH 146.

CS 160. Computer Science Concepts. 1 sem. hr.
Introductory programming laboratory that focuses on basic problem solving concepts.
Prerequisite(s): Credit for MATH 112 or placement into MATH 115 or above.

CS 200. Software Design and Engineering. 4 sem. hrs.
Introduction to software engineering: the software crisis, program life cycle, software systems analysis techniques, software modeling, theory and practice of design, program testing methodologies, programmer team organization, and program verification and synthesis.
Prerequisite(s): CS 101.

CS 201. Data Structures and Algorithms. 4 sem. hrs.
Data structures including balanced search trees, heaps, hash tables, and graphs. Algorithm design techniques including divide-and-conquer, greedy method, and dynamic programming. Emphasis on problem solving, design, analysis, and reasoning about data structures and algorithms.
Prerequisite(s): CS 101 and Math 301
Prerequisite(s) with concurrency: Math 302.

CS 202. Intro to the Internet. 3 sem. hrs.
Introduces the student to the fundamentals of the internet and web page design and development. Students will be shown how to use the internet, text editors, and build basic web pages using HTML coding. This will include, but not be limited to hyperlinks, tables, basic CSS styling, frames and forms. The student will also be given demonstrations and assignments using a WYSIWYG editor.
Prerequisite(s): CS 102 or CS 150 or CBH 101 or CS 100 or PLCS of 380.

CS 205. Web Site Design. 3 sem. hrs.
A course designed to teach website design principles and implementation techniques. This class is not cross-listed as a graduate course. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 202.

This course builds on the concepts and expertise gained in data driven problem solving and computer programming. It explores problem formulation, solution designing and object-oriented construction of business applications. This course concentrates on problem decomposition, design, construction and testing of individual programs. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 120 or CBH 101.

CS 250. Programming II. 2 sem. hrs.
A second course in programming that builds upon the concepts covered in CS 150. The emphasis is to improve and solidify program development skills as well as to introduce students to multimedia programming. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 150 or CS 100.

CS 260. Foundations of Comp Science. 3 sem. hrs.
An introduction to the science of Computer Science. Topics include: introduction to complexity, O(n), searching, sorting, design strategies, problem solving, arrays, linked lists, stacks, queues, and binary search trees.
Prerequisite(s): CS 150 or CS 100 or CBH 101 and (CS 160 or ECE 285).

CS 285. Microcomputer Appl II. 3 sem. hrs.
Use of spreadsheets and other environments to build business and scientific applications. Course includes development of problem-solving skills and an introduction to the object-oriented paradigm. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 102 or CS 150 or CBH 101 or CS 100 or PLCS of 380.
CS 302. Computerized Database Systems. 3 sem. hrs.
An introduction to commercial database packages. Students will gain familiarity with both creating and using standard database software packages to solve real-world problems. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 102 or CS 150 or CBH 101 or CS 100 or PLCS of 380.

CS 305. Advanced Computerized Database Systems. 3 sem. hrs.
This course is designed for non-majors wishing to learn more about the use of database systems in a wide variety of applications. Coverage includes advanced database topics such as advanced queries, custom forms and custom reports.
Prerequisite(s): CS 302.

CS 315. Software Engineering. 3 sem. hrs.
Introduction to software engineering: the software crisis, program life cycle, software systems analysis techniques, software modeling, theory and practice of design, program testing methodologies, programmer team organization, and program verification and synthesis.
Prerequisite(s): CS 260 and (CS 250 or ECE 285).

CS 340. Legal & Ethical Issues in Comp. 3 sem. hrs.
By way of case study, the course finds and frames issues related to legal and ethical issues in computing. Topics include privacy, free speech, intellectual property, security, and software reliability and liability issues. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 102 or CS 150 or CBH 101 or CS 100 or PLCS of 380.

CS 345. Advanced Legal and Ethical Issues in Computing. 3 sem. hrs.
Using case study and fact pattern analysis, students will find and frame legal and ethical issues presented by past, contemporary and emerging technology. Students will engage in service learning to enhance their sense of civic responsibility.
Prerequisite(s): CS 340.

CS 350. Programming III: Java. 2 sem. hrs.
The third course in programming that builds upon the concepts covered in CS 250 and transitions to the Java programming language. The emphasis is on building larger projects using production languages and development environments. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 250 or CS 260.

CS 351. Programming III: C++. 2 sem. hrs.
The third course in programming that builds upon the concepts covered in CS 250 and transitions to the C++ programming language. The emphasis is on building larger projects using production languages and development environments. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 250 or CS 260.

CS 360. Data Structures & Algorithms. 4 sem. hrs.
Basic concepts of data, linear lists, strings, arrays, trees, graphs, and the related storage of representations and structures. Applications include expression conversion, sorting, searching and dynamic storage allocation. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): MATH 301 and CS 250 or ECE 285; and CS 260; and concurrency: MATH 302 and CS 350 and CS 351 and CS 352.

CS 385. Prototyping In Visual Environm. 3 sem. hrs.
Design and construction of standard user interfaces using a visual programming environment. Course includes the prototyping of several standard user interface mechanisms. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): CS 285.

CS 391. Special Topics. 3 sem. hrs.
Special topics in computing.

CS 395. Competitive Programming I. 1 sem. hr.
A study of techniques and practices that promote success in competitive programming contests.

CS 396. Competitive Programming II. 1 sem. hr.
Advanced study of techniques and practices that promote success in competitive programming contests. Must have 3 hours of credit in CS 395.
Prerequisite(s): CS 395.

CS 403. Programming Languages. 3 sem. hrs.
Formal study of programming language specification, analysis, implementation, and run-time support structures; organization of programming languages with emphasis on language constructs and mechanisms; and study of non-procedural programming paradigms.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 407. Software Interface Design. 3 sem. hrs.
Basic concepts of human-computer interaction, including guidelines for interface design, evaluation of interface designs, virtual environments, menus, forms, natural language interactions, novel interaction devices, information search and information visualization.
Prerequisite(s): CS 315, CS 360, and ECE 383; and CS 350 or CS 351 or CS 352.

CS 415. Software Design & Development. 3 sem. hrs.
Object-oriented design and development using UML and Java, design patterns, and architectural patterns.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 416. Testing and Quality Assurance. 3 sem. hrs.
Study of verification & validation and related processes. Topics include techniques and tools for software analysis, testing, and quality assurance.
Prerequisite(s): CS 315, CS 350 or CS 351, CS 360, and ECE 383.

CS 417. Requirements Engineering. 3 sem. hrs.
Study of requirements engineering and it's phases. Topics include formal, semi-formal, and informal paradigms for elicitation, documentation, and management of software system requirements.
Prerequisite(s): CS 315, (CS 350 or CS 351), CS 360, and ECE 383.

CS 420. Software Mainten. & Evolution. 3 sem. hrs.
Study of software and its phases. Topics include techniques and tools for concept location, impact analysis, actualization, refactoring, and validation.
Prerequisite(s): CS 315 and CS 350 or CS 351; and CS 360 and ECE 383.

CS 426. Intro Operating Systems. 3 sem. hrs.
Study of basic operating system concepts with an emphasis on memory, processor, device, and information management.
Prerequisite(s): CS 315 and CS 350 or CS 351 or CS 352; and CS 360 and ECE 383.

An examination of computer security concepts, such as cryptographic tools, user authentication, access control, database security, intrusion detection, malicious software, denial of service, firewalls and intrusion prevention systems, trusted computing and multilevel security, buffer overflow, software security, physical and infrastructure security, human factors, and security auditing.
Prerequisite(s): CS 315 and ECE 383; and CS 350 or CS 351 or CS 352; and CS 360.

CS 434. Compiler Construction. 3 sem. hrs.
Syntax and semantics of procedure-oriented languages and translation techniques used in their compilation; includes computer implementation.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360 and ECE 383.

Fundamentals of interactive 3-D computer graphics, including modeling and transformations, viewing, lighting and shading, mapping methods, graphics pipeline, shading languages, and interaction techniques. Programming projects are required.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 438. Comptr Common Networks. 3 sem. hrs.
The study of the issues related to computer communications. Topics include physical topologies, switching, error detection and correction, routing, congestion control, and connection management for global networks (such as the Internet) and local area networks (such as Ethernet). In addition, network programming and applications will be considered.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 440. Computers, Ethics and Society. 3 sem. hrs.
Social, legal, and ethical aspects of computing: privacy, free speech, intellectual property, crimes, the work place, risks, and professional ethics and responsibilities.
Prerequisite(s): CS 315 and CS 360 and ECE 383 and CS 350 or CS 351 or CS 352.

CS 448. Network Security. 3 sem. hrs.
Concepts concerning network security, including an examination of network security concepts, algorithms, and protocols.
Prerequisite(s): CS 200, CS 201 and ECE 383.

CS 457. Database Management Systems. 3 sem. hrs.
Constituent parts of database management (design, creation, and manipulation of databases), including the conceptual and relational data models, SQL, normalization and security. Writing proficiency within this discipline is required for a passing grade in this course.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 460. Intro to Autonomous Robotics. 3 sem. hrs.
Issues involved with the implementation of robot control software including motion, kinematics, simulation testing, sensor incorporation and unmodeled factors.
Prerequisite(s): CS 426.
CS 465. Artificial Intelligence. 3 sem. hrs.
The advanced study of topics under the umbrella of artificial intelligence including problem solving, knowledge representation, planning and machine learning.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 470. Computer Algorithms. 3 sem. hrs.
Construction of efficient algorithms for computer implementation.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 475. Formal Languages & Machines. 3 sem. hrs.
Regular expressions and finite automata. Context free grammars and pushdown automata. Recursively enumerable languages and the Turing machine. The Chomsky hierarchy.
Prerequisite(s): CS 315, CS 360, and ECE 383; and CS 350 or CS 351 or CS 352.

CS 480. Computer Simulation. 3 sem. hrs.
Introduction to simulation and use of computer simulation models; simulation methodology, including generation of random numbers and variants, model design, and analysis of data generated by simulation experiments.
Prerequisite(s): CS 360; and CS 315 and CS 350 or CS 351 or CS 352; and ECE 383.

CS 491. Special Topics. 3 sem. hrs.
Formal courses that cover new and innovative topics in computer science and do not yet have their own course numbers. Specific course titles will be announced from time to time.
Prerequisite(s): CS 315; and CS 350 or CS 351 or CS 352; and CS 360; and ECE 383.

CS 492. Special Prob (Area). 1-3 sem. hr.
Reading and research course designed to meet the needs of individual students. This course cannot be used as a required 400-level computer science elective.

CS 495. Capstone Computing. 3 sem. hrs.
A culminating capstone project course that integrates the skills and abilities throughout the curriculum into a comprehensive design and development experience for computer science majors. Writing proficiency within this discipline is required for a passing grade in this course, and ethical issues are applied to the students' future professions.
Prerequisite(s): CS 350 or CS 351 or CS 352; and CS 315 and CS 360 and ECE 383.

CS 497. . 1 sem. hr.
Provides a unique opportunity to explore new problem solving techniques in a way that is not covered traditionally in the curriculum, helping students improve their software development skills.
Prerequisite(s): CS 360.

CS 499. Undergraduate Thesis Research. 3 sem. hrs.
Independent research and participation within a faculty member’s research group. Writing proficiency within this discipline is required for a passing grade in this course. Permission of the supervising faculty member is required.
Prerequisite(s): CS 315; and CS 350 or CS 351; and CS 360 and ECE 383.