Computer Science offers study in the fields of computer architecture, operating systems, networking, mobile computing, computer security, robotics, algorithm design, artificial intelligence, software and web engineering, programming languages, database design and data mining, human–computer interaction, computer-supported cooperative work, machine learning, lifelong learning and design, numerical and parallel computation, speech and language processing, scientific computing and theoretical computer science.

Graduates typically take positions as software engineers for computer manufacturers or software firms, advanced applications programmers in scientific research firms or technically oriented usability experts or systems designers in commercial or government settings.

Computer science is an exciting and challenging field that has impact on many parts of our lives. Computer scientists craft the technologies that enable the digital devices we use every day. They develop the large-scale software that powers business and industry, and advance the computational techniques, and write the software that supports scientists in their study of the world around us. Many new applications of computing technology remain to be discovered. Indeed, computing will be at the heart of future revolutions in business, science and society. Students who study computer science now will be at the forefront of those important advances.

Computer science is concerned with how computers are constructed, how they store and process data, how they are used in problem-solving and how the quality of those solutions is assessed. It is about the science of creating software for a variety of users. It is about understanding how that software interacts with the hardware on which it is run and goes well beyond the machine to the study of how people interact with the technologies around them. Applications of computer science reach far and wide.

For more information, visit the Department of Computer Science (http://www.colorado.edu/cs) website.

Course code for this program is CSCI.

Career Possibilities

Computer science graduates from CU Boulder are engaged in a wide variety of jobs with many different companies in locations all over the world. They produce the software and systems that touch lives every day in fields that include scientific exploration, communication, finance, publishing and research. Many are software developers, but others become teachers, writers, doctors, lawyers, scientists, military leaders and entrepreneurs. They work at some of the largest, most influential companies in the world, at research institutions, nonprofits and at the smallest start-ups of every type imaginable. And many lead highly successful companies that they themselves have founded.

Facilities, Programs and Opportunities

The Department of Computer Science utilizes a modern computing infrastructure that supports its research and educational missions. This includes general purpose computing labs provided by the university, additional instructional labs and administrative computing resources provided by the department, and specialized labs dedicated to the work of individual research groups. A wide variety of computing resources are available so that students have the opportunity to learn about and use cutting-edge equipment and software. The university research computing service maintains a supercomputer, high-speed networking and advanced computing infrastructure for the campus. While not required, the computer science educational culture emphasizes the use of individual laptop computers, including their use in courses and group work.

There are many networking opportunities available with companies offering paid internships. Boulder’s tech start-up community, national research labs and traditional tech companies such as Google, IBM, Oracle and Microsoft, gives students with computer science skills many employment opportunities while earning their degrees. There are also extensive opportunities for undergraduate students to participate in research projects across the campus.

Bachelor’s Degree

• Computer Science - Bachelor of Science (BS) (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-bachelor-science-bscs)

Minor

• Computer Science - Minor (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-minor)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member’s home department.

Anderson, Kenneth M (https://experts.colorado.edu/display/fsid_113566) Professor; PhD, University of California-Irvine

Bennett, John Knox (https://experts.colorado.edu/display/fsid_116933) Professor; PhD, University of Washington

Black, John (https://experts.colorado.edu/display/fsid_126540) Associate Professor; PhD, University of California-Davis

Boese, Elizabeth Sugar (https://experts.colorado.edu/display/fsid_154230) Instructor; MS, Colorado State University

Bradley, Elizabeth (https://experts.colorado.edu/display/fsid_100546) Professor; PhD, Massachusetts Institute of Technology

Brown, Timothy X (https://experts.colorado.edu/display/fsid_107534) Professor; PhD, California Institute of Technology

Brubaker, Jed Richards (https://experts.colorado.edu/display/fsid_156193) Assistant Professor; PhD, University of California-Irvine

Byrd, Richard H. Professor Emeritus; PhD, Rice University

Cai, Xiao-Chuan (https://experts.colorado.edu/display/fsid_100636) Professor; PhD, New York University

Cerny, Pavol (https://experts.colorado.edu/display/fsid_151749) Assistant Professor; PhD, University of Pennsylvania

Professor; PhD, University of California-Irvine

Professor; PhD, University of Washington

Associate Professor; PhD, University of California-Davis

Instructor; MS, Colorado State University

Professor; PhD, Massachusetts Institute of Technology

Professor; PhD, California Institute of Technology

Assistant Professor; PhD, University of California-Irvine

Professor Emeritus; PhD, Rice University

Professor; PhD, New York University

Assistant Professor; PhD, University of Pennsylvania
Chang, Bor-Yuh Evan (https://experts.colorado.edu/display/fisid_146087)
Assistant Professor; PhD, University of California-Berkeley

Chen, Lijun (https://experts.colorado.edu/display/fisid_149472)
Assistant Professor; PhD, California Institute of Technology

Colunga, Eliana (https://experts.colorado.edu/display/fisid_129477)
Associate Professor; PhD, Indiana University Bloomington

Correll, Nicolaus J (https://experts.colorado.edu/display/fisid_147555)
Assistant Professor; PhD, Ecole Polytech Federale de Lausanne (Switzerland)

Dowell-Deen, Robin DeAnne (https://experts.colorado.edu/display/fisid_147779)
Assistant Professor; DSc, Washington University

Ehrenfeucht, Andrzej
Professor Emeritus

Eisenberg, Michael A (https://experts.colorado.edu/display/fisid_100427)
Professor; PhD, Massachusetts Institute of Technology

Ellis, Clarence A.
Professor Emeritus

Fischer, Gerhard
Professor Emeritus; PhD, University of Hamburg

Fosdick, Lloyd D.
Professor Emeritus

Frew, Eric W (https://experts.colorado.edu/display/fisid_134685)
Associate Professor; PhD, Stanford University

Frongillo, Rafael M (https://experts.colorado.edu/display/fisid_156416)
Assistant Professor; PhD, University of California-Berkeley

Gabow, Harold
Professor Emeritus; PhD, Stanford University

Gross, Mark D (https://experts.colorado.edu/display/fisid_100095)
Professor; PhD, Massachusetts Institute of Technology

Grunwald, Dirk C (https://experts.colorado.edu/display/fisid_102261)
Professor; PhD, University of Illinois at Urbana-Champaign

Ha, Sangtae (https://experts.colorado.edu/display/fisid_153246)
Assistant Professor; PhD, North Carolina State University at Raleigh

Hall, David Matthew (https://experts.colorado.edu/display/fisid_147474)
Asst Research Professor

Hammer, Matthew A (https://experts.colorado.edu/display/fisid_156066)
Assistant Professor; PhD, University of Chicago

Han, Richard Yehweii (https://experts.colorado.edu/display/fisid_122947)
Associate Professor; PhD, University of California-Berkeley

Hoenigman, Rhonda Olcott (https://experts.colorado.edu/display/fisid_152997)
Instructor; PhD, University of Colorado Boulder

Hunter, Lawrence E (https://experts.colorado.edu/display/fisid_143568)
Professor

Jansen, Kenneth E (https://experts.colorado.edu/display/fisid_147360)
Professor; PhD, Stanford University

Jessup, Elizabeth R (https://experts.colorado.edu/display/fisid_102065)
Professor; PhD, Yale University

Kallen-Brown, Jedediah A (https://experts.colorado.edu/display/fisid_153965)
Assistant Professor; DSc, ETH Zurich (Switzerland)

Kane, Shaun Kevin (https://experts.colorado.edu/display/fisid_154603)
Assistant Professor; PhD, University of Washington

Keegan, Brian (https://experts.colorado.edu/display/fisid_158122)
Assistant Professor; PhD, Northwestern University

Keller, Eric Robert (https://experts.colorado.edu/display/fisid_151647)
Assistant Professor; PhD, Princeton University

Ketelsen, Christian W (https://experts.colorado.edu/display/fisid_147863)
Instructor; PhD, University of Colorado Boulder

King, Roger A.
Professor Emeritus

Knox, David Allen (https://experts.colorado.edu/display/fisid_158054)
Instructor; PhD, University of Colorado Health Sciences Center

Lewis, Clayton H (https://experts.colorado.edu/display/fisid_100307)
Professor; PhD, University of Michigan Ann Arbor

Lv, Qin (https://experts.colorado.edu/display/fisid_145832)
Associate Professor; PhD, Princeton University

Main, Michael G.
Professor Emeritus; PhD, Washington State University

Martin, James H (https://experts.colorado.edu/display/fisid_100495)
Professor; PhD, University of California-Berkeley

McBryan, Oliver
Professor Emeritus

Mishra, Shivakant (https://experts.colorado.edu/display/fisid_118376)
Professor; PhD, University of Arizona

Mozer, Michael C (https://experts.colorado.edu/display/fisid_105922)
Professor; PhD, University of California-San Diego

Nutt, Gary J.
Professor Emeritus

Palen, Leysia A (https://experts.colorado.edu/display/fisid_114604)
Professor; PhD, University of California-Irvine

Palmer, Martha (https://experts.colorado.edu/display/fisid_138162)
Professor; PhD, Univ of Edinburgh (Scotland)

Paul, Michael J (https://experts.colorado.edu/display/fisid_156070)
Assistant Professor; PhD, Johns Hopkins University

Repenning, Alexander (https://experts.colorado.edu/display/fisid_104946)
Research Professor; PhD, University of Colorado Boulder
Courses

CSCI 1000 (1) Computer Science as a Field of Work and Study
Introduces curriculum, learning techniques, time management and career opportunities in Computer Science. Includes presentations from alumni and others with relevant educational and professional experience.
**Requisites:** Restricted to students with 0-26 credits (Freshmen) Computer Science (CSEN-BS, CSEN-ADL, CSCI-BA or CSCI-ADL) majors only.
**Additional Information:** Departmental Category: General Computer Science

CSCI 1200 (3) The Art of Computational Thinking and Computer Programming
Teaches computational thinking and techniques for writing computer programs using the Python programming language. Intended for students who realize that obtaining computational skills is beneficial to all fields of study, but who have little or no experience in programming or are not Computer Science majors. Students will be expected to create computer programs to solve problems in a range of disciplines.
**Additional Information:** Departmental Category: General Computer Science

CSCI 1220 (4) Virtual Worlds: An Introduction to Computer Science
Introduces the fundamental principles of computer science using an online virtual world called Second Life as the "Laboratory" for the course. Students will learn how to program by creating objects of interest in Second Life. In-class and in-world discussions and readings will introduce the student to important ideas and concepts that shape the field of computer science.
**Equivalent - Duplicate Degree Credit Not Granted:** ATLS 1220
**Additional Information:** Departmental Category: General Computer Science

CSCI 1240 (3) The Computational World
Introduces and explores the "computational style of thinking" and its influence in science, mathematics, engineering and the arts. Does not focus on the nuts and bolts of any particular programming language, but rather on the way in which computing has affected human culture and thought in the past half century.
**Equivalent - Duplicate Degree Credit Not Granted:** ATLS 1240
**Additional Information:** Departmental Category: General Computer Science

CSCI 1300 (4) Computer Science 1: Starting Computing
Teaches techniques for writing computer programs in higher level programming languages to solve problems of interest in a range of application domains. Intended for students with little to no experience in computing or programming.
**Equivalent - Duplicate Degree Credit Not Granted:** CSCI 1310 or CSCI 1320 or ECEN 1310
**Requisites:** Requires a prerequisite or corequisite course of MATH 1300 or MATH 1310 or APPM 1345 or APPM 1350 (all minimum grade C-).
**Additional Information:** Departmental Category: General Computer Science
CSCI 1310 (4) Computer Science 1: Starting Computing - Experienced
Intended for students with some prior experience in programming and basic knowledge of variables, conditionals, and loops. Teaches techniques for writing computer programs in higher level programming languages to solve problems of interest in a range of application domains.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 1300 or CSCI 1320 or ECEN 1310
Requisites: Requires a prerequisite or corequisite course of MATH 1300 or MATH 1310 or APPM 1345 or APPM 1350 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 1320 (4) Computer Science 1: Starting Computing-Engineering Applications
Intended for students with no prior experience in programming. Class outcomes and goals are identical to CSCI 1300, but uses problems and tools from Engineering. Teaching techniques for writing computer programs in higher level programming languages to solve problems of interest in Engineering and other domains.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 1300 or CSCI 1310 or ECEN 1310
Requisites: Requires a prerequisite or corequisite course of MATH 1300 or MATH 1310 or APPM 1345 or APPM 1350 (all minimum grade C-). Restricted to College of Engineering or Pre-Engineering Arts and Science (PREN) majors only.
Additional Information: Departmental Category: General Computer Science

CSCI 2270 (4) Computer Science 2: Data Structures
Studies data abstractions (e.g., stacks, queues, lists, trees) and their representation techniques (e.g., linking, arrays). Introduces concepts used in algorithm design and analysis including criteria for selecting data structures to fit their applications.
Requisites: Requires prerequisite courses of CSCI 1300 or CSCI 1310 or CSCI 1320 or ECEN 1030 or ECEN 1310 and APPM 1345 or APPM 1350 or MATH 1300 or MATH 1310 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 2400 (4) Computer Systems
Covers how programs are represented and executed by modern computers, including low-level machine representations of programs and data, an understanding of how computer components and the memory hierarchy influence performance.
Requisites: Requires prerequisite course of CSCI 2270 and a prerequisite or corequisite course of CSCI 2824 or ECEN 2703 or a prerequisite course of MATH 2001 or APPM 3170 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 2820 (3) Linear Algebra with Computer Science Applications
Introduces the fundamentals of linear algebra in the context of computer science applications. Includes vector spaces, matrices, linear systems, and eigenvalues. Includes the basics of floating point computation and numerical linear algebra.
Requisites: Requires prerequisite courses of CSCI 2270 and APPM 1360 or MATH 2300 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 2824 (3) Discrete Structures
Covers foundational materials for computer science that is often assumed in advanced courses. Topics include set theory, Boolean algebra, functions and relations, graphs, propositional and predicate calculus, proofs, mathematical induction, recurrence relations, combinatorics, discrete probability. Focuses on examples based on diverse applications of computer science.
Requisites: Requires prerequisite courses of CSCI 1200 or CSCI 1300 or CSCI 1310 or CSCI 1320 or ECEN 1030 or ECEN 1310 and APPM 1345 or APPM 1350 or MATH 1300 or MATH 1310 (all minimum grade C-).
Additional Information: Departmental Category: Theory of Computation

CSCI 2830 (1-3) Special Topics in Computer Science
Covers topics of interest in computer science at the sophomore level. Content varies from semester to semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: General Computer Science

CSCI 2900 (1-3) Lower Division, Undergraduate Level Independent Study
Offers selected topics at the elementary level for students with little or no previous computing experience.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: General Computer Science

CSCI 3002 (3) HCC Foundations/User-Centered Design and Development
Introduces the practice and research of human-centered computing, including the evolution of human-computer interaction to its forms today and the techniques of user-centered design. Surveys topics that include social computing; tangible computing; mobility; and more. It will cover computing in society at large with respect to domains such as health, education, assistive technology, emergency response and environment.
Requisites: Restricted to students with 27-180 credits (Sophomores, Juniors or Seniors) only.
Additional Information: Departmental Category: Artificial Intelligence

CSCI 3010 (3) Programming Project Workshop
A semester-long projects course guided by an instructor to help design and develop a programming project.
Requisites: Requires a prerequisite course of CSCI 2270 (minimum grade C-).

CSCI 3022 (3) Introduction to Data Science Algorithms
Introduces students to the tools methods and theory behind extracting insights from data using computer science algorithms. Covers algorithms that maximize likelihood objective functions; linear prediction algorithms; making decisions based on data assembled from large datasets; discovering and quantifying connections between observations in real-world data such as text and images; representing and manipulating data on a computer.
Requisites: Requires prerequisite courses of CSCI 2270 and APPM 1360 or MATH 2300 (all minimum grade C-).
Grading Basis: Letter Grade
Additional Information: Departmental Category: Artificial Intelligence
CSCI 3100 (1) Software and Society
Provides students with an understanding of the professional, ethical, legal and social issues and responsibilities of software developers, as well as providing them with the ability to analyze the local and global impacts of computing on individuals, organizations and society.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 4308 and CSCI 4328 and CSCI 4338 and CSCI 4348
Requisites: Requires prerequisite course of CSCI 3308 (minimum grade C-). Restricted to Computer Science (CSEN-BS, CSEN-ADL, CSCI-BA, CSCI-ADL) majors only.
Grading Basis: Letter Grade
Additional Information: Departmental Category: General Computer Science

CSCI 3104 (4) Algorithms
Covers advanced data structures, computational geometry, cryptography, dynamic programming, greedy algorithms, divide-and-conquer, graph algorithms (e.g., depth-first search), network algorithms (e.g., shortest paths), approximation algorithms.
Requisites: Requires prerequisite courses of CSCI 2270 and APPM 1360 or MATH 2300 and one of the following: CSCI 2824 or ECEN 2703 or APPM 3170 or MATH 2001 (all minimum grade C-).
Additional Information: Departmental Category: Theory of Computation

CSCI 3112 (1-3) Human-Centered Computing Professional Development
Supports students in developing professional skills and practices in human-computer interaction, design of interactive systems, computer supported cooperative work, computer supported collaborative learning, educational technology, tools that support creativity, user-developed knowledge collections and gaming.
Equivalent - Duplicate Degree Credit Not Granted: ATLS 3112
Repeatable: Repeatable for up to 3.00 total credit hours.
Additional Information: Departmental Category: Artificial Intelligence

CSCI 3155 (4) Principles of Programming Languages
Study fundamental concepts on which programming of languages are based, and execution models supporting them. Topics include values, variables, bindings, type systems, control structures, exceptions, concurrency, and modularity. Learn how to select a language and to adapt to a new language.
Requisites: Requires prerequisite courses of CSCI 2270 and CSCI 2824 or ECEN 2703 or APPM 3170 or MATH 2001 (all minimum grade C-).
Additional Information: Departmental Category: Programming Languages

CSCI 3202 (3) Introduction to Artificial Intelligence
Surveys artificial intelligence techniques of search, knowledge representation and reasoning, probabilistic inference, machine learning, and natural language.
Requisites: Requires prerequisite courses of CSCI 2270 and CSCI 2824 or MATH 2001 or ECEN 2703 or APPM 3170 and one of the following: APPM 3570, 4570, 4520, CSCI 3022, MATH 3510, 4510, CVEN 3227, ECEN 3810, MCEN 4120 or ECON 3818 (all minimum grade C-).
Additional Information: Departmental Category: Artificial Intelligence

CSCI 3287 (3) Design and Analysis of Data Systems
Analyzes design of data systems, including data stored in file systems, database management systems and physical data organizations. Studies calculus of data models, query languages, concurrency and data privacy and security.
Requisites: Requires prerequisite course of CSCI 3104 (minimum grade C-).
Additional Information: Departmental Category: Database Systems

CSCI 3302 (3) Introduction to Robotics
Introduces students to fundamental concepts in autonomous, mobile robotics: mechanisms, locomotion, kinematics, control, perception and planning. The course consists of lectures and lab sessions that are geared toward developing a complete navigation stack on a miniature mobile robotic platform.
Equivalent - Duplicate Degree Credit Not Granted: ECEN 3303
Requisites: Requires prerequisite courses of CSCI 2270 and CSCI 2824 or ECEN 2703 or APPM 3170 or MATH 2001 (all minimum grade C-).
Additional Information: Departmental Category: Artificial Intelligence

CSCI 3308 (3) Software Development Methods and Tools
Covers tools and practices for software development with a strong focus on best practices used in industry and professional development, such as agile methodologies, pair-programming and test-driven design. Students develop web services and applications while learning these methods and tools.
Requisites: Requires prerequisite course of CSCI 2270 (minimum grade C-).
Additional Information: Departmental Category: Software Engineering

CSCI 3434 (3) Theory of Computation
Introduces the foundations of formal language theory, computability, and complexity. Shows relationship between automata and various classes of languages. Addresses the issue of which problems can be solved by computational means, and studies complexity of solutions.
Requisites: Requires prerequisite courses of CSCI 3104 and CSCI 3155 (all minimum grade C-).
Additional Information: Departmental Category: Theory of Computation

CSCI 3656 (3) Numerical Computation
Covers development, computer implementation, and analysis of numerical methods for applied mathematical problems. Topics include floating point arithmetic, numerical solution of linear systems of equations, root finding, numerical interpolation, differentiation, and integration.
Requisites: Requires prerequisite courses of CSCI 1300 or CSCI 1310 or CSCI 1320 or ECEN 1310 and APPM 1360 or MATH 2300 and MATH 2130 or APPM 2360 or APPM 3310 or CSCI 2820 (all minimum grade C-).
Additional Information: Departmental Category: Numerical Computation

CSCI 3702 (3) Cognitive Science
Introduces cognitive science, drawing from psychology, philosophy, artificial intelligence, neuroscience, and linguistics. Studies the linguistic relativity hypothesis, consciousness, categorization, linguistic rules, the mind-body problem, nature versus nurture, conceptual structure and metaphor, logic/problem solving and judgment. Emphasizes the nature, implications and limitations of the computational model of mind.
Equivalent - Duplicate Degree Credit Not Granted: LING 3005 and PHIL 3310 and PSYC 3005 and SLHS 3003
Recommended: Prerequisites two of the following CSCI 1300 or LING 2000 or PHIL 2440 or PSYC 2145.
Additional Information: Departmental Category: Artificial Intelligence

CSCI 3753 (4) Design and Analysis of Operating Systems
Analyzes the software that extends hardware to provide a computing environment, including the role of linkers, file systems, resource sharing, security and networking. Studies the history of operating system organization and design and their influence on security, functionality and reliability.
Requisites: Requires prerequisite courses of CSCI 2270 and either CSCI 2400 or ECEN 3350 (all minimum grade C-).
Additional Information: Departmental Category: Operating Systems and Hardware
CSCI 3832 (3) Machine Translation
Provides a comprehensive overview of current techniques in statistical machine translation of natural language, e., automatically translating from Spanish to English. Covers language models, reordering, hierarchical translation and evaluating whether a translation is effective.

Requisites: Requires prerequisite courses of CSCI 2270 and CSCI 2824 or MATH 2001 or ECEN 2703 or APPM 3170 (all minimum grade C-).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Artificial Intelligence

CSCI 4229 (3) Computer Graphics Studies design, analysis and implementation of computer graphics techniques. Topics include interactive techniques, 2D and 3D viewing, clipping, segmentation, translation, rotation and projection. Involves removal of hidden edges, shading and color. Knowledge of basic linear algebra is required.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5229
Requisites: Requires prerequisite course of CSCI 2270 (minimum grade C-).

Additional Information: Departmental Category: Graphics

CSCI 4239 (3) Advanced Computer Graphics Studies design, analysis and implementation of advanced computer graphics techniques. Topics include shaders, using the GPU for high performance computing, graphics programming on embedded devices such as mobile phones; advanced graphics techniques such as ray tracing.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5239
Requisites: Requires prerequisite course of CSCI 4229 (minimum grade C-).

Additional Information: Departmental Category: Graphics

CSCI 4250 (3) Computer Science: The Canon Explores the "great works" of computer science through intensive reading and discussion. Readings include works by Babbage, Turing, Von Neumann, Goedel, Shannon and Minsky, among others. Does not count as CS credit for the Computer Science BA, BS or minor.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5250
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).

Additional Information: Departmental Category: General Computer Science

CSCI 4253 (3) Datacenter Scale Computing - Methods, Systems and Techniques Covers the primary problem solving strategies, methods and tools needed for data-intensive programs using large collections of computers typically called "warehouse scale" or "data-center scale" computers. Examines methods and algorithms for processing data-intensive applications, methods for deploying and managing large collections of computers in an on-demand infrastructure and issues of large-scale computer system design.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5253
Requisites: Requires prerequisite course of CSCI 3753 (minimum grade C). Restricted to students with 57-180 credits (Juniors or Seniors).

Recommended: Prerequisite CSCI 4273.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Operating Systems and Hardware

CSCI 4273 (3) Network Systems
Focuses on design and implementation of network programs and systems, including topics in network protocols, file transfer, client-server computing, remote procedure call and other contemporary network system design and programming techniques. Familiarity with C and Unix is required.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5273 and ECEN 5273
Requisites: Requires prerequisite course of CSCI 3753 (minimum grade C).

Additional Information: Departmental Category: Operating Systems and Hardware

CSCI 4302 (3) Advanced Robotics Exposes students to current research topics in the field of robotics and provides hands-on experience in solving a grand challenge problem.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5302
Requisites: Requires prerequisite course of CSCI 3302 (minimum grade C).

Additional Information: Departmental Category: Artificial Intelligence

CSCI 4308 (4) Software Engineering Project 1 Advanced practicum in which students design, implement, document and test software systems for use in industry, non-profits, government and research institutions. Also offers extensive experience in oral and written communication throughout the development process. Department enforced prerequisite: successful completion of a minimum of 36 credit hours of Computer Science coursework and approved WRTG.

Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 3308 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Computer Science (CSEN) majors or Computer Science Concurrent Degree majors only.

Recommended: Prerequisite CSCI 4448.

Additional Information: Departmental Category: Software Engineering

CSCI 4314 (3) Algorithms for Molecular Biology Surveys molecular biology and combinatorial algorithms used to understand DNA, RNA and proteins. Students work in groups to define and tackle meaningful biological problems and learn to collaborate effectively with scientists in other disciplines.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5314
Requisites: Requires a prerequisite course of CSCI 3104 (minimum grade C).

Recommended: Prerequisite comfort with mathematics and/or programming experience, and more advanced understanding (upper undergraduate level) of any relevant discipline.

Additional Information: Departmental Category: Theory of Computation

CSCI 4318 (4) Software Engineering Project 2 Second semester of an advanced practicum in computer science. Students must take this course and CSCI 4308 contiguously as the project spans the entire academic year.

Requisites: Requires prerequisite course of CSCI 4308 (minimum grade C).

Additional Information: Departmental Category: Software Engineering
CSCI 4328 (4) Software Project Management and Mentoring
Review software project management and discuss the latest approaches, methodologies and standards of software development. Learn to develop software quality, documentation, testing, and prototype goals. Study project risk management and cost estimation approaches. Experience mentoring Senior Software Project Team. Intended for professional software developers. Department consent required, see Senior Project Director for permission.
Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 3308 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Computer Science (CSEN) majors or Computer Science Concurrent Degree majors only.
Grading Basis: Letter Grade
Additional Information: Departmental Category: Software Engineering

CSCI 4338 (2) Software Project Management
Review software project management and discuss the latest approaches, methodologies and standards of software development. Learn to develop software quality, documentation, testing, and prototype goals. Study project risk management and cost estimation approaches. Intended for double majors doing interdisciplinary projects in other departments. Department consent required, see Senior Project Director for permission.
Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 3308 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Computer Science (CSEN) majors or Computer Science Concurrent Degree majors only.
Grading Basis: Letter Grade
Additional Information: Departmental Category: Software Engineering

CSCI 4348 (4) Startup Essentials: Entrepreneurial Projects in Computing
Provide students with the tools to be successful technical co-founders of their own startups. Explores the initial stages of founding a startup, including team formation, idea validation, pivoting and pitching, while employing an iterative methodology. Student teams will develop a minimum viable product, pitch their final startup concept, and be evaluated on product/market fit. Department enforced restriction, successful completion of a minimum of 36 credit hours of Computer Science coursework and approved WRTG. Formerly CSCI 4000.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5340
Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 3308 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Computer Science (CSEN) majors or Computer Science Concurrent Degree majors only.
Additional Information: Departmental Category: General Computer Science

CSCI 4358 (4) Entrepreneurial Projects II
Follows CSCI 4348. In the second semester of this entrepreneurial project capstone, student teams will seek to find market traction for a high-fidelity Minimum Viable Product (MVP), software and/or hardware, that they will develop as part of their startup project. Teams will further learn to incorporate principles of marketing, business finance and legal issues into the business model for their startup concept.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5350
Requisites: Requires a prerequisite course of CSCI 4348 (minimum grade C).
Additional Information: Departmental Category: General Computer Science

CSCI 4413 (3) Computer Security and Ethical Hacking
Teaches basic exploit design and development through hands-on experimentation and testing. Uses a controlled environment to give students a "playground" in which to test penetration skills that are normally not allowed on live networks.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5413
Requisites: Requires prerequisite course of CSCI 4273 (minimum grade C).
Additional Information: Departmental Category: Operating Systems and Hardware

CSCI 4446 (3) Chaotic Dynamics
Explores chaotic dynamics theoretically and through computer simulations. Covers the standard computational and analytical tools used in nonlinear dynamics and concludes with an overview of leading-edge chaos research. Topics include time and phase-space dynamics, surfaces of section, bifurcation diagrams, fractal dimension and Lyapunov exponents.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5446 and ECEN 4423 and ECEN 5423
Requisites: Requires prerequisite course of CSCI 1300 or CSCI 1310 or CSCI 1320 or ECEN 1310 and APPM 2350 or MATH 2400 (all minimum grade C).
Recommended: Prerequisites PHYS 1120 and CSCI 3656 and MATH 2130.
Additional Information: Departmental Category: Numerical Computation

CSCI 4448 (3) Object-Oriented Analysis and Design
An applied analysis and design class addressing the use of object-oriented techniques. Topics include domain modeling, use cases, architectural design and modeling notations. Students apply the techniques in analysis and design projects.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5448
Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 3308 (all minimum grade C).
Additional Information: Departmental Category: Software Engineering

CSCI 4502 (3) Data Mining
Introduces basic data mining concepts and techniques for discovering interesting patterns hidden in large-scale data sets, focusing on issues relating to effectiveness and efficiency. Topics covered include data preprocessing, data warehouse, association, classification, clustering, and mining specific data types such as time-series, social networks, multimedia, and Web data.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5502
Requisites: Requires prerequisite course of CSCI 2270 (minimum grade C).
Additional Information: Departmental Category: Artificial Intelligence

CSCI 4555 (3) Compiler Construction
Introduces the basic techniques used in translating programming languages: scanning, parsing, definition table management, operator identification and coercion, code selection and register allocation, error recovery. Students build a complete compiler for a simple language.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5525 and ECEN 4553 and ECEN 5523
Requisites: Requires prerequisite courses of CSCI 3155 and CSCI 2400 or ECEN 3350 (all minimum grade C).
Additional Information: Departmental Category: Programming Languages
CSCI 4576 (4) High-Performance Scientific Computing
Introduces computing systems, software and methods used to solve large-scale problems in science and engineering. Students use high-performance workstations and a supercomputer. First course in a two-semester sequence.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5576
Recommended: Prerequisite CSCI 3656.
Additional Information: Departmental Category: Numerical Computation

CSCI 4586 (4) High-Performance Scientific Computing 2
Introduces computing systems, software, and methods to solve large-scale problems in science and engineering. Students use high-performance workstations and a supercomputer. Second course in a two-semester sequence.
Requisites: Requires prerequisite course of CSCI 4576 (minimum grade C-).
Additional Information: Departmental Category: Numerical Computation

CSCI 4593 (3) Computer Organization
Studies computer design at the gate level. Discusses instruction set architecture design, arithmetic and logic unit design, control logic, memory design and caches, simple pipelining, I/O and peripheral devices. Briefly covers aspects of modern computer architecture, such as multicore processors and cache coherence for these.
Equivalent - Duplicate Degree Credit Not Granted: ECEN 4593
Requisites: Requires prerequisite course of CSCI 3753 and MATH 2300 or APPM 1360 (all minimum grade C-).
Recommended: Prerequisite course of CSCI 2820 or CSCI 3022 or CVEN 3227 or ECEN 3810 or APPM 4520 or APPM 4570 or MATH 2130 or MATH 3510 or CSCI 4809 (3) Computer Animation
Develops a firm understanding of the general principles of computer animation. Lectures cover the creation of models, materials, textures, surfaces, and lighting. Path and key frame animation, particle dynamics, and rendering are introduced. Students are assigned a number of animation tutorials to carry out.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5809 and ATLS 4809 and ATLS 5809
Additional Information: Departmental Category: Graphics

CSCI 4810 (1) Seminar in Computational Biology
Provides an overview of current research topics in computational biology and health informatics, with a focus on research conducted on campus. Each week students will attend an on-campus seminar or a presentation by an on-campus research group. Prepares students to participate in a research project.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 6810
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Departmental Category: General Computer Science

CSCI 4830 (1-3) Special Topics in Computer Science
Covers topics of interest in computer science at the undergraduate level. Content varies from semester to semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisite course of CSCI 2400 or ECEN 3350 (minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 4831 (1-3) Special Topics in Algorithms
Covers topics of interest in computer science at the upper-division undergraduate level. Content varies from semester to semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisite courses of CSCI 3104 and CSCI 2820 or MATH 2130 or APPM 3310 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 4802 (1) Data Science Team Companion Course
Gives students hands-on experience applying data science techniques and machine learning algorithms to real-world problems. Students work in small teams on internal challenges, many of which will be sponsored by local companies and organizations and will represent the university in larger teams for external challenges at the national and global level, such as those hosted by Kaggle. Students will be expected to participate in both internal and external challenges, attend meetings and present short presentations to the group when appropriate.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5802
Repeatable: Repeatable for up to 3.00 total credit hours.
Requisites: Requires a prerequisite course of APPM 3310 or APPM 3570 or APPM 4520 or APPM 4570 or MATH 2130 or MATH 3510 or MATH 4510 or CSCI 2820 or CSCI 3022 or CVEN 3227 or ECEN 3810 or MCEN 4120 (minimum grade C-).
Additional Information: Departmental Category: Artificial Intelligence

CSCI 5809 (3) Computer Animation
Develops a firm understanding of the general principles of computer animation. Lectures cover the creation of models, materials, textures, surfaces, and lighting. Path and key frame animation, particle dynamics, and rendering are introduced. Students are assigned a number of animation tutorials to carry out.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 5809 and ATLS 4809 and ATLS 5809
Additional Information: Departmental Category: Graphics

CSCI 4810 (1) Seminar in Computational Biology
Provides an overview of current research topics in computational biology and health informatics, with a focus on research conducted on campus. Each week students will attend an on-campus seminar or a presentation by an on-campus research group. Prepares students to participate in a research project.
Equivalent - Duplicate Degree Credit Not Granted: CSCI 6810
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Departmental Category: General Computer Science

CSCI 4830 (1-3) Special Topics in Computer Science
Covers topics of interest in computer science at the undergraduate level. Content varies from semester to semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisite course of CSCI 2400 or ECEN 3350 (minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 4831 (1-3) Special Topics in Algorithms
Covers topics of interest in computer science at the upper-division undergraduate level. Content varies from semester to semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisite courses of CSCI 3104 and CSCI 2820 or MATH 2130 or APPM 3310 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 4900 (1-3) Upper Division, Undergraduate Level Independent Study
Provides opportunities for independent study at the upper-division undergraduate level. Students work on a small research problem or tutor lower-division computer science students.
Repeatable: Repeatable for up to 12.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisite course of CSCI 1300 or CSCI 1310 or CSCI 1320 (all minimum grade C-).
Additional Information: Departmental Category: General Computer Science

CSCI 4950 (2-4) Senior Thesis
Provides an opportunity for senior computer science majors to conduct exploratory research in computer science. Department enforced restriction, successful completion of a minimum of 36 credit hours of Computer Science coursework and approved WRTG.
Repeatable: Repeatable for up to 8.00 total credit hours.
Requisites: Requires a prerequisite or corequisite course of CSCI 3100 (minimum grade C-). Restricted to students with 87-180 credits (Senior, Fifth Year Senior).
Additional Information: Departmental Category: General Computer Science
CSCI 4960 (2-4) Computer Science Honors Thesis
Provides an opportunity for senior Computer Science majors to complete an honors thesis by conducting exploratory research in computer science. Department enforced prerequisites: successful completion of a minimum of 36 credit hours of Computer Science foundation and Computer Science electives and a writing requirement.

**Repeatable:** Repeatable for up to 8.00 total credit hours.

**Requisites:** Restricted to students with 87-180 credits (Senior, Fifth Year Senior).

**Grading Basis:** Letter Grade

**Additional Information:** Departmental Category: General Computer Science