Course Descriptions

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Summer 2026 Computer Science courses

- You can register for summer courses at the same time you register for fall courses
- Summer courses can span
  - Summer session 1 (five weeks of May - June)
  - Summer session 2 (five weeks of July - August)
  - Both sessions (ten week courses spanning both sessions)

The next group of slides lists the summer courses. Unless noted, the course will be offered face-to-face.

Session 1: CS 1100: Discrete Mathematics

A study of discrete mathematics as it applies to computer science. Concepts covered include number systems, sets, logic, Boolean algebra, digital circuits, combinatorics, relations, functions, vectors, matrices, graphs, and induction proofs. **Prerequisite:** MAT 1025 or equivalent with a grade of "C-" (1.7) or higher or satisfactory. Calculus Readiness Test score.

Professor: Danielle Lapensee-Rankine

Note: This course will be offered **synchronous online**

Session 1: CS 2490: Introduction to Theoretical Computer Science

This course provides a rigorous but intuitive introduction to computer theory. Topics covered include formal languages, regular expressions, finite automata, grammars, pushdown automata, and Turing machines.
Prerequisites: CS 1100 and CS 2440 with a minimum grade of "C" (2.0) in each.

Professor: Val Lapensee-Rankine

Ten Weeks: CS 1440: Computer Science I

A first programming course using an object-oriented language. Emphasis is placed on problem-solving and appropriate programming standards. Topics include: classes, objects, data types, expressions, conditional statements, loops, strings, arrays, collections, debugging, inheritance, and polymorphism. Lecture three hours, laboratory two hours. Students with doubts about their mathematics and computing background should consider taking CS 1425 first. Prerequisite: MAT 1025 or equivalent with a minimum grade of "C-" (1.7) or higher or satisfactory Calculus Readiness Test score.

Professor: Abdelbaset Hamza

Note: This course will be offered **synchronous online**

Ten Weeks: CS 2440: Computer Science II

This course follows CS 1440 - Computer Science I (4). The course introduces students to advanced programming concepts through the development of small to medium sized projects using software component libraries. Topics emphasize conceptual understanding and applications and include inheritance, polymorphism, recursion, interfaces, collections, stream I/O, exceptions, graphical interfaces, and threads. Lecture three hours, laboratory two hours. **Prerequisite:** CS 1440 or CS 2435 with a minimum grade of "C" (2.0). **Corequisite**: CS 1100.

Professor: Courtney Dixon

Note: This course will be offered **asynchronous online**

Ten Weeks: CS 2450: Introduction to Computer Systems

This course includes data representation, digital logic, digital circuits, instruction set architecture, and assembly language programming.
Prerequisites: CS 1100 and CS 2440 with a minimum grade of "C" (2.0) in each.

Professor: Joel Swanson

Note: This course will be offered **synchronous online**

Ten Weeks: CS 3537: Cloud Computing

In this course we will cover a number of topics relevant to cloud computing. This will include different cloud service models; cloud administration and security; cloud storage; software architectures related to, or enabled by, cloud; cloud application support; DevOps; and APIs. Upon completion of this course each student will be able to: compare and contrast different service models for cloud computing, e.g., IaaS, PaaS, SaaS; configure and administer security, billing, networking, and logging for cloud services; select and configure appropriate storage solutions for cloud applications, including file-based, relational/SQL, and NoSQL storage alternatives; utilize cloud services to support typical application execution scenarios; configure and use DevOps build pipelines, including support for application build, automated test, containerization, and deployment; and use and create RESTful APIs.

Prerequisites: CS 3430: Database and CS 3667: Software Engineering

Professor: Mark Hills

Note: This course will be offered **asynchronous online**

This course counts toward the 12 required hours of CS electives

Ten Weeks: CS 3667: Software Engineering

This course covers the design and implementation of software systems. Topics include requirements analysis, object design, system design, frameworks and patterns, and implementation and testing issues. **Prerequisite**: CS 2440 with a grade of "C" (2.0) or higher.

Professor: Nazia Sharmin

Note: This course will be offered **asynchronous online**

Session 2: CS 3460: Data Strucures

Data Structures is the study of organizing data in memory in order to access them efficiently. In this class, we study data structures for storing sets and sequences in the form of arrays, linked lists, stacks, queues, priority queues, hash tables, and binary search trees. We also learn the art of abstraction by treating these data structures as black boxes to solve more complex algorithms. Data structures are vital in almost every field of computer science, and we cover applications in text compression, security, parsing, and more. We learn to model certain problems as a graph, and study graph algorithms for traversing and computing shortest paths. Prerequisite: C_S 1100 and C_S 2440 with a minimum grade of "C" (2.0) in each.

Professor: Mohammad Ali Javidian

Note: This course will be offered **asynchronous online**

Session 2: CS 3539: Robot Modeling & Control

This online course introduces the theory and practice of robot modeling, manipulation, and navigation, with an emphasis on simulation-based learning. It provides an in-depth overview of robotic systems, including kinematics, statics, and dynamics of robot manipulators, as well as navigation techniques for wheeled robots. Students will explore motion planning, state estimation, environment mapping, and control strategies that enable robots to operate autonomously in complex environments.

The course integrates theoretical foundations with practical implementation through simulation tools (ROS 2) and programming environments. Students will develop and analyze robotic models, implement algorithms for manipulation and navigation, and evaluate system performance in virtual settings. By the end of the course, students will gain the skills necessary to design, model, and control robotic systems for real-world applications. **Prerequisite**: MAT 2240 Linear Algebra or CS 3538 Data Sci Foundations in Python

Professor: Yeganeh Madadi

Note: This course will be offered **asynchronous online**

This course counts toward the 12 required hours of CS electives

Fall 2026 Computer Science courses

- Every required course is offered every fall and spring semester
- Elective courses loosely follow the schedule indicated in the bulletin
  - To see what is actually offered, you need to check the registrar's site: Registration
  - DON'T ASSUME A COURSE WILL BE OFFERED BECAUSE OF WHAT THE BULLETIN SAYS, CHECK THE REGISTRAR's SITE
- The next set of slides describes each of the CS **elective** courses offered in the Fall 2026 semester

CS 2531: Computational Reasoning

From the most elementary hardware to the most sophisticated software, all of computer science is based in discrete mathematics. This course covers a range of topics in discrete mathematics that are particularly important in computer science, emphasizing relationships between certain mathematical structures on the one hand, and their applications in computer science on the other. But since it treats mathematical knowledge as primary rather than as something to be picked up ``on the fly", this course provides an opportunity to focus on building a solid mathematical foundation for computer science. This is important --- after all, no computer scientist has ever said that they wished they had less mathematical background or understood mathematics less well! Specific topics to be covered include propositional logic, predicate logic, proof techniques, basic set theory, functions, relations, counting principles, inductively defined sets, inductive proof, and recursive definitions. **Prerequisite:** CS 1100 and permission of instructor; email johannp@appstate.edu

Professor: Patricia Johann

This course counts toward the 12 required hours of CS electives

CS 3341: Incident Response with Threat Intelligence

The course addresses the emerging cyber threat landscapes and trends of future cyberattacks. In order to provide security of digital assets and infrastructures, it is important to understand how cyber attacks can happen and investigate them thoroughly. With the increase in cyber threats, Incident Response has been a common practice among organizations and/or security teams to secure their perimeters and become more resilient and proactive during a cyberattack. The course will highlight the basic concepts of Incident Response (IR), profiling threat actors based on their footprints, introducing Cyber Kill ChainTM to better understand attack TTPs (technique, tactics, procedures), familiarize students with current practices of threat intelligence, threat hunting, and SOAR (Security Orchestration, Automation, and Response) capabilities for enhancing digital assets' and infrastructures' security. Students will also learn to use analytics and detection engineering tools and techniques in Cyber Threat Incident Response. Lastly, there will be a brief introduction of cyber deception strategies to detect advanced persistent threats (APTs) and deceive them. There will be hands-on lab exercises for students to get experiential learning experience from this course. **Prerequisite**: CS 2440 or equivalent with a minimum grade of "C" (2.0).

Professor: Nazia Sharmin

This course counts toward the 12 required hours of CS electives

CS 3440: Client-side Web Programming

This course studies client-side graphical user interface programming using current internet technologies including browser scripting languages, GUI presentation, asynchronous server communication, event handling, and XML processing. A major individual project is required.
Prerequisite: CS 2440 with a minimum grade of "C" (2.0).

Professor: Joel Swanson

This course counts toward the 12 required hours of CS electives

CS 3532: Competitive Programming

Competitive programming is all about solving mathematical and computational problems. In this course, we look at various problem solving paradigms to tackle a wide variety of fun and interesting problems. The skills developed in this course reinforce skills such as problem solving, rapid prototyping, and programming proficiency. We meet for three hours, one hour for a lecture on a topic related to competitive programming, then one hour to work on a handful of problems alone or in small groups, and then an hour to go over solutions to proposed problems. This covers topics such as advanced data structures, graph algorithms, string matching, and programming paradigms such as complete search, divide and conquer, and dynamic programming.

Prerequisite: CS 3460: Data Structures with C- or higher.

Professor: Chad Waters

This course counts toward the 12 required hours of CS electives

CS 3538: Data Science Foundations in Python

Data Science Foundations with Python gives students practical, hands-on skills to turn raw data into insight and action. Across today's industries—healthcare, finance, government, tech, and beyond—decisions are increasingly data-driven. This course teaches the end-to-end workflow: gathering and cleaning data, exploring it visually, building and evaluating predictive models, and communicating results clearly. Students leave with a working toolkit (Python, SQL, NumPy/Pandas, matplotlib, and core ML methods) that's valuable for internships, research, and entry-level analytics roles, and a strong platform for advanced study in machine learning and AI.

Prerequisite: CS 2440 or CS 2435 with a grade of C (2.0) or higher in either.

Professor: Mohammad Ali Javidian

This course counts toward the 12 required hours of CS electives

CS 3539: Machine Learning in Robotics

This in-person course explores the integration of machine learning techniques with robotic systems to enable intelligent perception, decision-making, and control. Students will learn how robots can acquire knowledge from data and improve their performance in dynamic and uncertain environments. The course covers core machine learning methods, including supervised, unsupervised, and reinforcement learning, and their application to key robotics problems such as perception, localization, mapping, manipulation, and autonomous navigation.

Emphasis is placed on hands-on learning through laboratory activities using real robotic platforms and simulation tools. Students will implement machine learning algorithms for tasks such as object recognition, sensor data interpretation, motion prediction, and policy learning for control. The course also introduces modern approaches, including deep learning and learning-based control, with applications in human–robot interaction and autonomous systems.

By the end of the course, students will be able to design, train, and deploy machine learning models that enhance robotic capabilities in real-world scenarios. **Prerequisites**: CS 3460: Data Structures AND (CS 4755: Applied ML OR CS 4440: AI OR CS 3538: Data Sci Foundations in Python)

Professor: Yeganeh Madadi

This course counts toward the 12 required hours of CS electives

CS 3543: Theory of Computation

This course covers theoretical computer science topics beyond automata theory.

Through a rigorous treatment of Turing machines, the course describes models of computation and their limits. It describes (un)decidable problems, polynomial reduction, and time and space complexity. The course aims at equipping the students with the tool set necessary to understand and explore one of the biggest challenge of modern computer science: the P vs NP conjecture.

Prerequisite: CS 2490

Professor: Pierre Cagne

This course counts toward the 12 required hours of CS electives

CS 4450: Data Communication & Networking

When Offered: Fall. Odd-numbered years. Introduction to data transmission concepts and techniques; channel characteristics; encoding methods; line control and error detection/correction protocols; circuit, message, and packet switching; layered network architectures and protocols; addressing, routing and flow control strategies; access methods; performance criteria and tradeoffs.

Prerequisite: CS 3481

Professor: Abdelbaset Hamza

This course counts toward the 12 required hours of CS electives

CS 4755: Applied Machine Learning

Machine Learning is the process of teaching a computer what to do by providing a model for learning and many examples but without explicit instructions. This course introduces algorithms and processes for machine learning, including topics such as feature selection, parameter tuning, model selection, and performance estimation, as well as algorithms for classification, regression, and clustering.

Prerequisites: CS 3460 with a minimum grade of "C-" (1.7) or CS 3435; MAT 2240.

Professor: Tinghao Feng

This course counts toward the 12 required hours of CS electives

Fall 2026 Data Science courses

- Data Science courses can help you earn the Data Science certificate
- In addition to other courses required by the CS major, you will need to take:
  - **CS 3435: Data Collection and Visualization (offered in Fall 2026)**
    - **This course does not count as a CS elective**
  - **One of these courses:**
    - **CS 4755: Applied Machine Learning (offered in Fall 2026)**
    - **CS 3750 Applied Neural Networks**
    - **CS 4440 Artificial Intelligence**
      - Each of these courses count as a CS elective as well as meeting a Data Science certificate requirement

CS 2435: Introduction to Scientific Programming

When Offered: Fall; Spring. GEN ED: Quantitative Literacy. This course provides an introduction to problem solving and computer programming using tools such as MATLAB or Python. The course material is motivated by interdisciplinary applications focusing on computational approaches to solving problems using data. Fundamental topics in computer programming will be covered in the course. Lecture three hours, laboratory two hours.

Corequisite: MAT 1020 or MAT 1025 or equivalent with a minimum grade of "C-" (1.7) or MAT 1110, or satisfactory Calculus Readiness Test score.

Professors: Courtney Dixon, Danielle Lapensee-Rankine

This course counts for the Data Science certificate but CS students can substitute CS 2440 for this requirement. CS 2440 is required for the CS major. This course is not required for the CS major.

CS 3435: Data Collection and Visualization

This class provides students an opportunity to develop skills to access and organize data, scrape data from websites, determine and improve data quality, and produce interactive graphical representations to help discover patterns and answer questions. A class project will provide students the opportunity to apply their learning to a disciplinary problem.
Prerequisite: CS 2440 or CS 2435.

Professor: Mitch Parry

This course counts for the Data Science certificate but does not count as a CS elective.

CS 4755: Applied Machine Learning

Machine Learning is the process of teaching a computer what to do by providing a model for learning and many examples but without explicit instructions. This course introduces algorithms and processes for machine learning, including topics such as feature selection, parameter tuning, model selection, and performance estimation, as well as algorithms for classification, regression, and clustering.

Prerequisites: CS 3460 with a minimum grade of "C-" (1.7) or CS 3435; MAT 2240.

Professor: Tinghao Feng

This course counts for the Data Science certificate and **also counts** as a CS elective.

Fall 2026 Graduate/Honors Courses

- Senior (90 hours) with a minimum 3.0 GPA can take grad courses
- Graduate courses **count as CS electives** for the undergraduate CS degree
- Graduate courses count as **honors credits**
- If you are in the Accelerated Master's Program then graduate courses count toward both the undergraduate degree and the graduate degree:
- Unless you are in the Accelerated Master's Program, you will need to complete the Request for Special Permission Form to register for a graduate course
    - Forms | Cratis D. Williams School of Graduate Studies

CS 5100: Design and Analysis of Algorithms

Discussion and presentation of current topics in computer science. Each student will make oral and written reports on the results of research conducted on an instructor approved topic. Professional development aspects are also covered, including resume writing and interviewing skills.
Prerequisite: graduate status in computer science.

Professor: Mohammad Ali Javidian

CS 5450: Computer Networking

Computer network architectures. The Internet protocol suite including TCP, UDP, ICMP, and IP. Routing and congestion control. Network monitoring and management. Specification, design, and implementation of network protocols. Creation of a socket-based client/server distributed application.

Professor: Abdelbaset Hamza

CS 5539: Machine Learning in Robotics

This in-person course explores the integration of machine learning techniques with robotic systems to enable intelligent perception, decision-making, and control. Students will learn how robots can acquire knowledge from data and improve their performance in dynamic and uncertain environments. The course covers core machine learning methods, including supervised, unsupervised, and reinforcement learning, and their application to key robotics problems such as perception, localization, mapping, manipulation, and autonomous navigation.

Emphasis is placed on hands-on learning through laboratory activities using real robotic platforms and simulation tools. Students will implement machine learning algorithms for tasks such as object recognition, sensor data interpretation, motion prediction, and policy learning for control. The course also introduces modern approaches, including deep learning and learning-based control, with applications in human–robot interaction and autonomous systems.

By the end of the course, students will be able to design, train, and deploy machine learning models that enhance robotic capabilities in real-world scenarios. **Prerequisites**: CS 3460: Data Structures AND (CS 4755: Applied ML OR CS 4440: AI OR CS 3538: Data Sci Foundations in Python)

Professor: Yeganeh Madadi

CS 5569: Human Computer Interfaces

This course covers topics related to the design and evaluation of human-computer interfaces (HCI). Topics include: understanding the user audience, HCI architectures, design issues related to various interface components, measuring HCI usability, incorporating HCI design into system development, and social issues. Students are required to complete a group project in HCI presented in written form and orally to the class. Prerequisite: permission of the instructor. [Dual-listed with CS 4570.] Offered even-numbered years.

Professor: Courtney Dixon

CS 5540: Interactive Theorem Proving

This course introduces students to theorem proving using the proofs-as-programs paradigm, which allows mathematical concepts to be developed on a computer. We will use a functional programming language with dependent types and an interactive programming style. The course will show how standard logical reasoning patterns can be represented in code, covering propositional logic, predicate logic, induction, structural induction and higher-order reasoning. These techniques will then be applied to formalization of concepts from theoretical computer science, programming language theory, and program verification.

Prerequisite: CS 3490 (Programming Languages) or equivalent

Professor: Andrew Polonsky

CS 5666: Software Engineering

Methodical development of large software systems. Topics include: models, project life cycle, requirements and specification, structure charts and design criteria, incremental implementation, software metrics. Use of module and source code management, symbolic debugging, and project planning software. Students will participate in the realization of both group and individual software systems. **Prerequisite:** CS 3481.

Professor: Jay Fenwick

CS 5750: Topics in Data Science & Visual Computing Fall 2026 Topic: Demystifying LLMs

This course examines advanced topics in data science and visual computing, such as bioinformatics, computer vision, music informatics, security informatics, social informatics, video processing, and visual analytics. May be repeated for a maximum of 6 hours when content does not duplicate.

Prerequisite: CS 3460 (Data Structures) or by permission of graduate program director.

Professor: Mitch Parry