COMPUTER SCIENCE (CS)

CS 106 - Introduction to Computer Science I
Credits: 4
An introduction to the principles of design, implementation, and testing of computer programs. The course covers language features such as control structures, classes, file I/0, and basic data structures including arrays. Other topics include recursion and fundamental algorithms, such as elementary searching and sorting algorithms. May not be taken for credit by students who have taken or are currently taking CS 107, CS 206, CS 209 or CS 226.
Prerequisites: *Placement in AQR or completion of a FQR course or MA 108 or PH207.*
Note(s): May not be taken for credit by students who have taken or are currently taking CS 107, CS 206, CS 209 or CS 226. Fulfills QR2 requirement.

CS 107 - An Introduction to Computer Science with Animations and 2D Games
Credits: 4
An introduction to computer science. Students will develop simple 2D games, animations and simulations using the Java programming language and Processing, a Java package designed to make programming accessible to visual artists. The course introduces the fundamental techniques of computer programming, software design, and algorithm development.
Note(s): May not be taken for credit by students who have taken or are currently taking CS 106, CS 206, CS 209 or CS 226.

CS 123 - System Administration
Credits: 1
Students will explore three topic areas focused on computer system administration: shell scripting, server administration, and networking. The goal of the course is to provide sufficient detail and hands-on learning for each topic area, enabling students to effectively handle routine aspects of server management while identifying and mitigating security risks related to server configuration and operation. Students with prior programming experience similar to CS106 may contact the professor to request a prerequisite override.
Prerequisites: *CS106.*

CS 151 - Introductory Topics in Computer Science
Credits: 1-4
An investigation of a particular computer science subject area not available in existing course offerings. This course may be repeated for credit only when the subject area is different.

CS 202 - Computers and Society
Credits: 3
An overview of computers' impact on society and discussions focused on software developer accountability, with particular attention to questions of power, justice, and identity. Topics include professional conduct, privacy, surveillance and free speech, vulnerable populations, human factors in security and privacy, case studies of software risks, user attention and engagement, bias and fairness, propaganda and misinformation, intellectual property, copyright and patents, and government and technology.
Note(s): Fulfills Bridge Experience requirement. Does not count toward the CS major or minor.

CS 209 - Data Structures and Mathematical Foundations
Credits: 4
An introduction to data structures and the mathematical foundations of algorithms. Properly organizing the data within a software application is critical to the efficiency of the application's execution as well as the ease with which the application is developed. This course will introduce the fundamental data structures used in computer science, including linked lists, stacks, queues, priority queues, search trees, and hash tables. In addition, the course will introduce foundational discrete mathematical concepts used in the design and analysis of algorithms, including mathematical induction, asymptotic analysis and recurrence relations.
Prerequisites: *CS 106 or CS 107 or permission of instructor.*

CS 218 - Introduction to Computer Systems
Credits: 4
A bottom-up approach to learning how a computer works. We begin with binary data representation and logic circuits, and build up to how a processor runs a program and cache enables the processor to quickly access data. Students use a systems programming language and assembly language for exploring the interaction between software and hardware and for introducing parallel computing concepts.
Prerequisites: *CS106.*

CS 225 - Applied Data Science
Credits: 4
An introduction to Knowledge Discovery and Data Mining (KDD), also known as Machine Learning. Students will gain hands-on experience with a variety of concepts and tools associated with the field of KDD. Students will also study and apply KDD processes, tools, and techniques, working with small and large data sets representing various business domains and problem types. The class will cover topics such as common database interactions (relational, document, and graph databases), data set creation, data quality analysis, dimension reduction, variance and bias in data, classifier types, and model assessment approaches.
Prerequisites: *MS 104 or MS 204 or a similar statistics course.*

CS 226 - Software Design
Credits: 4
An introduction to building complex software. Students will explore object-oriented (OO) programming and design patterns in depth.
We will also focus on developing skills for testing and debugging of software. Finally, we will utilize a set of frameworks related to software development and testing.
Prerequisites: *CS 106 or CS 107.*

CS 275 - Introduction to Research in Computer Science
Credits: 1
An introductory exploration of research in computer science. The students, in collaboration with a faculty mentor, will participate in a research project in a particular area of computer science. The research projects may, for example, include designing new algorithms for computational problems, surveying the research literature, implementing existing algorithms from the research literature, or performing computational experiments.
Prerequisites: *Permission of instructor.*
Note(s): Students may enroll for CS 275 four times in their careers, but may take no more than two in any given semester. Does not count toward the CS major. Must be taken S/U.

CS 275H - Introduction to Research in Computer Science
Credits: 1
An introductory exploration of research in computer science. The students, in collaboration with a faculty mentor, will participate in a research project in a particular area of computer science. The research projects may, for example, include designing new algorithms for computational problems, surveying the research literature, implementing existing algorithms from the research literature, or performing computational experiments.
Prerequisites: *Permission of instructor.*
Note(s): Students may only take four CS 275H courses in their careers and may take no more than two in any given semester. If two are taken in a single semester, each must be a different section. CS 275H may not be counted toward the CS major. Must be taken S/U.

CS 276 - Selected Topics in Computer Science
Credits: 1-4
Topics that complement the established lower level course offerings in computer science will be selected. May be repeated for credit.

CS 277 - Topics in Computer Science with Lab
Credits: 4
Topics that complement the established lower level course offerings in computer science will be selected.
Prerequisites: *Permission of instructor.*
Note(s): May be repeated for credit.

CS 305 - Design and Analysis of Algorithms
Credits: 4
A study of techniques used to design algorithms for complex computational problems that are efficient in terms of time and memory required during execution. Students will also learn the techniques used to evaluate an algorithm's efficiency. Topics include advanced sorting techniques, advanced data structures, dynamic programming, greedy algorithms, amortized analysis, graph algorithms, network flow algorithms, and linear programming.
Prerequisites: *CS 206 and MA 215, or CS 209; and a calculus course.*

CS 306 - Computability, Complexity, and Heuristics
Credits: 4
Using abstract machine models to measure the complexity of computational problems and to explore the limits of computational power. In addition, students will investigate strategies to deal with intractable computational problems when they arise. Topics include finite automata, Turing machines, undecidability, NP-completeness, approximation algorithms, heuristic algorithms, and experimental algorithmics.
Prerequisites: *CS 305.*

CS 316 - Foundations of Machine Learning
Credits: 4
An introduction to the mathematical foundations of machine learning. Students will investigate the mathematics underlying much of machine learning and explore some of the major techniques used in the field. Topics may include gradient descent, perceptrons, support vector machines, kernel methods, backpropagation, and principal components analysis. Three hours of lecture and two hours of lab each week. In the labs, students will apply machine learning techniques to empirical data and quantitatively evaluate and compare the effectiveness of the techniques.

CS 318 - Introduction to Computer Organization
Credits: 4
An introduction to multilevel machines, including basic components of a computer, digital circuits, Boolean algebra, microprogramming, machine and assembly languages, and operating systems.
Prerequisites: *CS 206 or CS 226.*
Note(s): Does not count toward the mathematics major.

CS 322 - Artificial Intelligence
Credits: 4
An introduction to the field of artificial intelligence. The course covers the main techniques used to develop computer programs to solve problems that we normally think of as requiring intelligence. Topics include search, games, knowledge representation, logical reasoning systems, and machine learning.
Prerequisites: *MA 111, or both MA 108 MA 109, or MA 113; and CS 305; and CS 206 or CS 226.*
Note(s): Fulfills Senior Coda requirement.

CS 325 - Computer Graphics
Credits: 4
Computer graphics involves using computers to generate images, as opposed to generating images using cameras. Computer graphics images typically try to mimic reality. In this course, students will explore the necessary background for further study in computer graphics. Students will explore the basics of human vision that influence the way computers generate images; projections from three-dimensional space to two-dimensional space; various models of real-world entities such as lighting, surface reflectance, and color; and classic algorithms in computer graphics that students will implement and with which they will have the opportunity to experiment.
Prerequisites: *CS 226 and CS 209, or CS 206; and MA 200.*

CS 326 - Software Engineering
Credits: 4
An exploration of software engineering and organization principles vital to building large enterprise-scale applications. Leveraging the lessons-learned from readings and using management tools, the class will form a software development team focused on designing, developing, and deploying a multi-tier application. Includes significant reading and programming effort.
Prerequisites: *CS 226 and CS 209.*
Note(s): Fulfills Senior Coda requirement.

CS 327 - Computer Networks
Credits: 4
An introduction to the fundamental concepts of computer networks. Students will learn how the Internet works. Students will explore real data as it passes through a network; learn how data is interpreted and forwarded from the source to the destination address; implement services to send, transport, and receive data correctly; devise analytical techniques to better understand data collected from real network users; and gather information about known network security attacks.
Prerequisites: *CS 209 and CS 218 and CS 226*

CS 328 - Mobile Computing
Credits: 4
An introduction to the design, implementation and publishing of mobile applications. Students will learn how to take their innovative ideas from conception to a working prototype mobile application through a series of rigorous hands-on programming assignments and group projects.
Prerequisites: *CS 226 and CS 209.*
Note(s): Fulfills Senior Coda requirement.

CS 329 - Operating Systems
Credits: 4
An introduction to operating systems: software that safely and fairly shares computer hardware resources among multiple, simultaneously running applications. Topics covered include computer processor (CPU) sharing and scheduling, memory virtualization and management, and file systems. Students will complete programming projects to implement concepts in a real operating system.
Prerequisites: *CS 209 and CS 218 and CS 226.*

CS 330 - Programming Languages and Compilers
Credits: 4
A study of the design and implementation of programming languages, emphasizing theoretical foundations and practical application. Students explore major language paradigms—imperative, object-oriented, functional, and declarative—through the lens of syntax, semantics, and language design trade-offs. Topics include regular expressions, grammars, and formal semantics, providing the tools to reason about language correctness and design. A central feature of the course is a semester-long project in which students implement a compiler, applying theoretical concepts to construct a working system. By the end of the course, students will have developed a deeper understanding of how language designers create programming languages, how languages shape problem-solving, and how to effectively evaluate and learn new languages.
Prerequisites: *CS 209 and CS 226 and*
Note(s): CS 218 or CS 318.

CS 331 - Computer Vision
Credits: 4
Computer Vision (CV) trains machines to understand images and video. Classifying and detecting/recognizing objects in images are common problems that CV tackles. Machine Learning techniques, specifically Convolutional Neural Networks (CNNs), are often used. Students will learn digital image processing techniques that form the basis of many vision algorithms, as well as the concepts behind CNNs for classification.
Prerequisites: *CS 209 and MA 200 and (MA111 or MA113 or (MA108 and MA109)).*
Note(s): Fulfills Senior Coda requirement.

CS 332 - Deep Learning
Credits: 4
An introduction to deep learning. Deep learning is a powerful technique for finding patterns in data that has been the driving force behind the advancement of AI in the twenty-first century. Students will investigate the primary techniques that fall under the umbrella of deep learning as well as the underlying mathematics. Topics include probability, gradient descent, backpropagation, neural networks, recurrent neural networks, transformers, and large language models. Three hours of lecture and two hours of lab each week. In the labs, students will develop machine learning applications and experiment with those applications on real data.
Prerequisites: *MA 111 (or equivalent); MA 200; at least one of CS209, (CS106 and MA215), MA316, or PY331; or permission of the instructor.*
Note(s): Fulfills Applied Quantitative Reasoning requirement.

CS 355 - Database Systems
Credits: 4
An introduction to database systems: software that stores, manages, and provides efficient access to a collection of structured information. Topics covered include the relational model, the structured query language (SQL), and algorithms and data structures for efficiently searching and managing data that is larger than main memory. Students will complete a project using a relational database to store and query data related to an application of their choice.
Prerequisites: *CS 209.*
Note(s): Fulfills Senior Coda requirement.

CS 371 - Independent Study in Computer Science
Credits: 1-4
Special study in computing outside of the regular departmental offerings.
Prerequisites: *Consent of department.*

CS 376 - Advanced Topics In Computer Science
Credits: 3,4
Advanced topics that complement the established course offerings in computer science will be selected.
Note(s): May be repeated for credit.

CS 381 - Senior Research
Credits: 3
Optional for computer science majors. Recommended for those working toward professional careers or graduate study in computer science, and those seeking to satisfy the criteria for departmental honors.
Note(s): Fulfills Senior Coda requirement.

CS 382 - Senior Research
Credits: 3
Optional for computer science majors. Recommended for those working toward professional careers or graduate study in computer science, and those seeking to satisfy the criteria for departmental honors.
Note(s): Fulfills Senior Coda requirement.

CS 399 - Internship in Computer Science
Credits: 1-9
Professional experience at an advanced level for juniors and seniors with substantial academic experience in computer science and mathematics. With faculty sponsorship and departmental approval, students may extend their educational experience in computer science, software engineering, or applied mathematics.
Prerequisites: *CS 206 or CS 226 or CS 209 and one additional course in mathematics or computer science at the 200 level or above and permission of the department.*
Note(s): Fulfills Senior Coda requirement. This course may not be used to satisfy the requirements of any major or minor in the department. Not for liberal arts credit. Must be taken S/U.