

# COMPUTER SCIENCE (COMPSCI)

---

## Courses

### COMPSCI 162 COMPUTER APPLICATIONS 3 Units

A thorough introduction to commonly used computer applications, covering word processing, spreadsheets, data storage and retrieval, and presentation software. Students will learn the vocabulary of computing, the concepts of computing and problem solving, and how computer applications can be applied to a wide range of problems.

COREQ: MATH 139 OR MATH 140 OR MATH 141 OR MATH 142

### COMPSCI 165 INTRODUCTION TO COMPUTATIONAL THINKING 3 Units

This course introduces computational thinking and provides a broad high-level understanding of how computers and related technical developments are changing the world. Students will learn how computers are built and operated, and they will apply computational thinking skills such as algorithmic and procedural thinking, problem decomposition, pattern recognition, and abstraction to write programs and solve problems. Students will also study computing innovations such as the Internet, data and information, artificial intelligence and machine learning, human-computer interaction, and cryptography; and they will explore how these innovations affect privacy, security, intellectual property and other important issues.

PREREQ: MATH 41 OR PLACEMENT INTO MATH 139 OR HIGHER

### COMPSCI 170 INTRODUCTION TO PYTHON PROGRAMMING 3 Units

An introduction to computational thinking and computer programming using the Python language, with applications in science, business, education, and other areas. Students will develop structured programs based on simple algorithms that involve input, output, mathematical operations, decisions, and loops. No previous programming experience is needed.

PREREQ: MATH 139 WITH A GRADE OF C OR BETTER, OR MATH 141, OR MATH 142

### COMPSCI 172 INTRODUCTION TO JAVA 3 Units

This course teaches the essentials of object-oriented programming in Java. Students will learn to formulate solutions for real problems and implement those solutions in Java programs that employ objects and classes. Students will be introduced to object-oriented design, class construction, selection statements, loops, methods and message passing, debugging, arrays, string processing, and file processing.

PREREQ: (MATH 139 OR MATH 141 OR MATH 142 OR MATH 152) WITH A GRADE OF C OR BETTER, OR SCORE OF 3 OR HIGHER ON AP CS PRINCIPLES EXAM

### COMPSCI 174 INTRODUCTION TO C++ 3 Units

This course teaches basic programming skills using the structured high-level language C++. Topics include basic input and output, declaration and use of variables, use of control statements, implementation of functions using value and reference parameters, debugging, arrays, classes, and objects. Students will write moderately complex applications using C++.

PREREQ: (MATH 139 OR MATH 141 OR MATH 142 OR MATH 152) WITH A GRADE OF C OR BETTER, OR SCORE OF 3 OR HIGHER ON AP CS PRINCIPLES EXAM

### COMPSCI 180 DATA SCIENCE FOR EVERYONE 3 Units

An introduction to data science and its implementation using the R language, with applications in natural and social science, public health and welfare, and other areas. Students will explore methods of data analysis and visualization and cultivate marketable data-literacy skills. No prior knowledge of statistics or programming is needed.

PREREQ: MATH 139 WITH A GRADE OF C OR BETTER, OR MATH 141, OR MATH 142, OR MATH 152

### COMPSCI 181 INTRODUCTION TO DATABASE AND THE WEB 3 Units

This course provides the student with a comprehensive working knowledge of a modern database package including the creation of a database, construction of a wide range of queries, use of forms, and report writing features. The course also gives an introduction to the creation of World Wide Web pages using the Extended Hypertext Markup Language (XHTML).

PREREQ: MATH 139 OR MATH 141 OR MATH 142 OR MATH 152

### COMPSCI 215 DISCRETE STRUCTURES 3 Units

The course offers a formal approach to the mathematics of Computer Science, including set theory, methods of proof, propositional logic, discrete probability, sequences, recurrence relations, introduction to graphs, and algorithmic analysis.

PREREQ: (MATH 142 OR MATH 143 OR MATH 152) WITH A GRADE OF C OR BETTER

### COMPSCI 219 ACCELERATED PROGRAMMING WITH JAVA 5 Units

This is an intense Java course, appropriate for those who need to accelerate in getting the undergraduate degree or removing deficiencies for graduate studies in computer science. Topics include data types and variables, conditional and loop statements, methods, arrays, classes/objects, interfaces, inheritance and polymorphism, exceptions, files, and graphical user interfaces.

PREREQ: COMPSCI 170 W/C OR HIGHER, OR SCORE OF 3 OR HIGHER ON AP CS PRINCIPLES EXAM, OR EQUIVALENT PROGRAMMING EXPERIENCE (AND INSTRUCTOR CONSENT), OR (MATH 142 OR MATH 143 OR MATH 152) W/C OR HIGHER, OR CONCURRENT REGISTRATION IN MATH 253

### COMPSCI 220 INTERMEDIATE JAVA 3 Units

This course teaches more advanced topics in object-oriented program design and the Java programming language. Coverage includes multi-dimensional arrays, methods, recursion and search/sort algorithms, error handling, strings, regular expressions, encapsulation, inheritance, polymorphism, generic types, file processing, event handling, and program debugging and testing. Coverage may also include databases, graphical user interfaces, or functional programming.

PREREQ: COMPSCI 172 WITH A GRADE OF C OR BETTER, OR (COMPSCI 174 WITH A GRADE OF C OR BETTER AND CONSENT OF INSTRUCTOR)

### COMPSCI 221 INTERMEDIATE PROGRAMMING IN C# 3 Units

This course introduces C#, a programming language that is widely used in software, web, game, and mobile development. Topics include basic syntax, classes, object-oriented programming (overloading, inheritance, polymorphism), multi-dimensional arrays, file input/output, recursion, lambda expressions, and LINQ. Basic software engineering knowledge including coding standards and testing will also be covered.

PREREQ: C OR BETTER IN (COMPSCI 172 OR COMPSCI 174)

**COMPSCI 222 INTERMEDIATE C++ 3 Units**

This course will cover more advanced issues of C++, including memory management, pointers and user-defined data types. Topics will include reading and writing files; dynamic arrays and multi-dimensional arrays; recursion and search/sort algorithms; implementation of the principles of object oriented design including encapsulation, inheritance, polymorphism, and templates; and planning and testing. Students will write complex applications using C++.

PREREQ: COMPSCI 174 WITH A GRADE OF C OR BETTER OR (COMPSCI 172 WITH A GRADE OF C OR BETTER AND CONSENT OF INSTRUCTOR)

**COMPSCI 223 DATA STRUCTURES 3 Units**

This course introduces data structures, which is a fundamental concept of computer science and forms the backbone of various important algorithms. These algorithms are not only of immense theoretical importance, but also are key ingredients of various important real-time applications such as GPS and web-searching. The main topics include basic data structures (lists, stacks, queues, trees, and graphs), searching and sorting, shortest-path algorithms, and hashing. Students will write programs that implement a variety of data structures and algorithms.

PREREQ: C OR BETTER IN (COMPSCI 220 OR COMPSCI 221 OR COMPSCI 222)

**COMPSCI 230 ADVANCED PROGRAMMING 3 Units**

The third course in our programming fundamentals sequence that introduces data structures, related algorithms, and high-level programming concepts. It presumes that students understand and use function and object-oriented design and abstract data types as needed. The main topics to be covered include lambda functions; graphical user interface; complexity analysis, basic data structures like lists, stacks, and queues; searching and sorting; hashing table; trees; graphs and shortest-path algorithms. The course emphasizes programming for implementing and using data structures.

PREREQ: C OR BETTER IN (COMPSCI 220 OR COMPSCI 221 OR COMPSCI 222)

**COMPSCI 271 COMPUTER ORGANIZATION AND ASSEMBLY PROGRAMMING 3 Units**

This course covers an introduction to computer organization and the use of an assembly language based on a standard (RISC or CISC) processor architecture including writing, linking, and executing a program. Also covered are number systems, arithmetic and logical operations, Boolean algebra, logic circuits, basic hardware components, memory access, loops, declaring variables, interrupts, machine language, segments, stacks, procedure writing, and file handling.

PREREQ: COMPSCI 172 OR COMPSCI 174

**COMPSCI 290 WORKSHOP Repeatable 1-3 Units**

Variable topics. Group activity oriented presentations emphasizing "hands on" and participatory instructional techniques. Repeatable. Instructor Consent required.

**COMPSCI 296 SPECIAL STUDIES Repeatable 1-3 Units**

Variable topics. Group activity. Not offered regularly in the curriculum but offered on topics selected on the basis of timeliness, need, and interest, and generally in the format of regularly scheduled Catalog offerings. Repeatable. Instructor Consent required.

**COMPSCI 312 INTERMEDIATE DATA SCIENCE 3 Units**

This course introduces intermediate data science and its implementation using R and Python, with applications in natural and social science, public health and welfare, and other areas. Students will explore methods of data analysis, cleaning, simulation and visualization and machine learning. Prior knowledge of programming and statistical analysis is assumed.

PREREQ: ((COMPSCI 170 AND COMPSCI 180) OR (COMPSCI 220 OR COMPSCI 221 OR COMPSCI 222)) AND ONE COURSE IN STATISTICS (BIOLOGY 303 OR ECON 245 OR STAT 230 OR STAT 342 OR PSYCH 215 OR SOCIOLOGY 295 OR SOCWORK 250) OR INSTRUCTOR CONSENT

**COMPSCI 320 CONCEPTS OF PROGRAMMING LANGUAGES 3 Units**

An exploration of the core concepts upon which all programming languages are built. Students will apply these concepts to write programs in several specialized programming languages, including functional and logic programming languages. Emphasis is placed upon evaluating the strengths and weaknesses of particular languages for various tasks.

PREREQ: COMPSCI 223 AND (COMPSCI 215 OR MATH 280)

**COMPSCI 322 COMPUTER LANGUAGES AND COMPILERS 3 Units**

In this course, we will study the process of translating computer programs into machine code that runs on a computer. Students will learn the structure and functionality of a compiler, program working versions of all parts of a simple compiler, and test the various parts of a simple compiler for bugs.

PREREQ: COMPSCI 223 AND COMPSCI 271

**COMPSCI 332 INTRODUCTION TO ARTIFICIAL INTELLIGENCE 3 Units**

This course introduces basic artificial intelligence principles including simple representation schemes, problem solving paradigms, constraint propagation, search strategies and learning approaches. Knowledge representation, natural language processing, gaming, machine learning and user modeling will be explored. Students should have written moderately complex computer programs in a high level language.

PREREQ: COMPSCI 222 OR COMPSCI 220

**COMPSCI 342 DIGITAL FORENSICS 3 Units**

This course focuses on the procedures and techniques of digital forensics. It involves the preservation, identification, extraction and documentation of evidence stored on a computer. The detailed contents include general forensics procedure, computer crime law and digital evidence collection procedure, data collection, data recovery, file system analysis, evidence analysis, tools for forensics analysis, and basic internet application forensics.

PREREQ: COMPSCI 271 OR CYBER 101

**COMPSCI 353 CYBERSECURITY LAW AND POLICY 3 Units**

This course will provide students exposure to the key legal and policy issues related to cybersecurity. It includes such topics as data security laws and enforcement actions, cybersecurity litigation, anti-hacking laws, cybersecurity and corporate governance, privacy law, the Fourth Amendment, surveillance, and international cybersecurity law.

**COMPSCI 354 INTRUSION DETECTION AND INCIDENT RESPONSE 3 Units**

A blend of theoretical and practical knowledge on design and implementation of intrusion detection and incident response. Topics include intrusion prevention systems, anomaly and signature-based intrusion detection, host-based and network-based intrusion detection, tools for intrusion detection and response, automated and manual response to attacks, and legal/organizational issues of intrusion detection and incident response systems.

PREREQ: ITSCM 221 OR COMPSCI 271

**COMPSCI 364 CLOUD SOFTWARE DEVELOPMENT 3 Units**

An introduction to cloud computing and Software as a Service, focused on developing, deploying, and managing cloud-based applications. Students will design and configure cloud computing environments that satisfy cost, performance, and security requirements; create and deploy software in a cloud environment; and monitor and improve cloud application performance.

PREREQ: COMPSCI 220 OR COMPSCI 221 OR COMPSCI 222

**COMPSCI 366 DATABASE MANAGEMENT SYSTEMS 3 Units**

This course offers an introduction to the design and programming of databases and the implementation of database management systems from a computer science perspective. Contents include the relational model; SQL; database application development; and concepts and algorithms for building database management systems.

PREREQ: COMPSCI 223 OR CONSENT OF INSTRUCTOR

**COMPSCI 381 JAVASCRIPT AND DHTML 3 Units**

JavaScript is a computer language globally used for adding flexibility and functionality to web pages. A powerful language in its own right, it supports event-driven, functional, and imperative programming styles. It also has the capability to make asynchronous calls to server-side scripts. Students in this course will gain a thorough understanding of JavaScript, and learn to harness its abilities to create custom user interfaces and manage windows, forms, events, etc.

PREREQ: COMPSCI 172 OR COMPSCI 174 OR EQUIVALENT PREPARATION AND CONSENT OF INSTRUCTOR

**COMPSCI 382 SERVER-SIDE SCRIPTING 3 Units**

This course will provide a thorough introduction to the concepts utilized in building modern web applications. Students will learn to create web applications that use SQL/NoSQL to access and update the information in a database.

PREREQ: COMPSCI 172 OR COMPSCI 174 OR EQUIVALENT PREPARATION AND CONSENT OF INSTRUCTOR

**COMPSCI 412 EMBEDDED SYSTEMS 3 Units**

An embedded system is a microprocessor/microcontroller-based system that is designed to perform a dedicated function with its sensors and peripherals. Many robotic, automobile, medical, industrial systems are just a few examples. This course is going to introduce the basic tools and knowledge to help you design simple embedded systems.

PREREQ: COMPSCI 271 OR PHYSCS 221

**COMPSCI 424 OPERATING SYSTEMS 3 Units**

This course covers problems encountered by computer operating systems including resource management, memory management, virtual memory, concurrent programming, and distributed systems. Algorithms are presented for deadlock, memory paging, job scheduling, memory allocation, and performance measurement. Operating systems such as WINDOWS, DOS, UNIX, VMS, and MVS are discussed.

PREREQ: COMPSCI 223 AND COMPSCI 271

**COMPSCI 432 INTRODUCTION TO MACHINE LEARNING 3 Units**

The course is structured to establish a solid foundation at the intersection of probability and statistics theory with machine learning concepts. Students will cultivate a deep understanding of the core probabilistic principles and tools that serve as the foundation for a wide array of machine learning algorithms and methodologies. The curriculum will extensively delve into both classical and contemporary machine learning theories and algorithms, elucidating their practical application in tasks like classification and regression.

PREREQ: ((COMPSCI 332 OR STAT 342) AND MATH 355) OR INSTRUCTOR CONSENT

**COMPSCI 433 THEORY OF ALGORITHMS 3 Units**

This course is a survey of algorithms needed for searching, sorting, pattern matching, analyzing graphs, and a variety of other problems of discrete mathematics. Analysis of algorithm efficiency and space/time tradeoffs are discussed.

PREREQ: COMPSCI 223 AND (COMPSCI 215 OR MATH 280)

**COMPSCI 434 THEORY OF COMPUTATION 3 Units**

This course is an introduction to the theory of computation. It discusses finite automata and Turing machines as models of computation. It includes discussions of regular sets, recursive and partially recursive functions, context free grammars, the halting problem, undecidable problems, complexity, and Np-completeness.

PREREQ: MATH 280 OR COMPSCI 215

**COMPSCI 437 NATURAL LANGUAGE PROCESSING AND LARGE LANGUAGE MODELING 3 Units**

This course provides a broad introduction to Natural Language Processing as needed by various applications in Data Science and Artificial Intelligence. Particular focus will be placed on implementations of the methods using Python.

PREREQ: (COMPSCI 223 OR COMPSCI 230) AND COMPSCI 332

**COMPSCI 441 WEB SECURITY 3 Units**

The web is our gateway to many critical services and is also becoming the top channel for attacks. This course covers the common security and privacy attacks upon web applications along with how to defend against such attacks. The detailed contents include basic web programming and exploits, browser security, attacks and defense on authentication, access control, database, and back-end components.

PREREQ: COMPSCI 220 OR COMPSCI 221 OR COMPSCI 222

**COMPSCI 448 BIOINFORMATICS 3 Units**

Bioinformatics is an introduction to computer applications and algorithms currently used in the analysis of biological data, especially genomic and sequence data. The course entails lectures, discussions, readings and hands-on experience with bioinformatic software. Through exercises and individual research projects students acquire a working knowledge of contemporary computational methods and software.

PREREQ: BIOLOGY 141 WITH A GRADE OF C OR BETTER AND ONE OF THE FOLLOWING WITH A GRADE OF C OR BETTER: BIOLOGY 303, PSYCH 215, STAT 230, OR STAT 342

**COMPSCI 451 TOPICS IN APPLIED COMPUTING *Repeatable* 3 Units**

This course covers emerging topics in modern applied computing. Sample topics include: new computing platforms, blockchain, machine learning, cloud computing, data mining and recommender systems, user modeling, and human-computer interaction. Repeatable with change in topic.

PREREQ: COMPSCI 223

**COMPSCI 452 MALWARE ANALYSIS 3 Units**

This course focuses on the working principles of malicious software, how to detect it, and how to defend against it. The detailed contents include static analysis, dynamic analysis, disassembly tools, malware code analysis and debugging, obfuscation and ransomware analysis, code injection and hooking, malware detection using memory forensics, and malware defense technique. This is a hands-on course with a large amount of practical analysis work using tools.

PREREQ: COMPSCI 271

**COMPSCI 454 MACHINE LEARNING FOR CYBERSECURITY 3 Units**  
Artificial Intelligence (AI) is positioned to help with detecting and preventing security and privacy attacks. This course seeks to introduce successful AI approaches to securing enterprise networks through hands-on assignments. Specifically, it focuses on the use of machine learning algorithms to enhance security in-depth approaches such as spam filtering, phishing detection, network/host intrusion detection, malware detection, and secure authentication. It also investigates the attacks using AI and corresponding prevention methods.  
PREREQ: COMPSCI 354 OR COMPSCI 432 OR INSTRUCTOR CONSENT

**COMPSCI 455 CRYPTOGRAPHY AND NETWORK SECURITY 3 Units**  
This course covers the fundamental cryptographic algorithms and security protocols for computer networks. Topics include security attacks and security services, classical ciphers, modern block and stream ciphers, public key cryptography, digital signatures, key management and distribution, authentication, and security network protocols. The class involves a significant amount of programming projects and assignments about cipher algorithms and security protocols.  
PREREQ: (COMPSCI 223 OR COMPSCI 230) AND COMPSCI 271 AND (COMPSCI 215 OR MATH 280)

**COMPSCI 456 COMPUTER SYSTEM SECURITY 3 Units**  
General concepts and applied methods of computer system security, especially as they relate to confidentiality, integrity, and availability of information assets. Topics include system security analysis, access control and various security models, information flow, protection against external and internal threats, malware, and reverse engineering. This is a hands-on course, where you will learn by working on programming assignments and projects.  
PREREQ: (COMPSCI 223 OR COMPSCI 230) AND COMPSCI 271

**COMPSCI 460 COMPUTER NETWORKING 3 Units**  
This course introduces the principles, applications, protocols, and architectures of data networks. It places an equal emphasis on practical experience as well as theoretical foundations. There will be abundant network programming and lab activities around application layer, transportation layer, and routing.  
PREREQ: (COMPSCI 223 OR COMPSCI 230) AND COMPSCI 271

**COMPSCI 461 MOBILE COMPUTING ARCHITECTURE 3 Units**  
This course discusses fundamentals of wireless communication and mobile computing, and emphasizes the analysis and design of network architectures in support of mobility related services. It involves intensive critical thinking practices, programming, and hands-on experiments.  
PREREQ: (COMPSCI 223 AND COMPSCI 271) OR INSTRUCTOR CONSENT

**COMPSCI 476 SOFTWARE ENGINEERING 3 Units**  
This capstone course introduces concepts and techniques relevant to the production of large software systems. Topics include: modularity; specification; data abstraction; object modeling; design patterns; and testing. Students work in groups to complete a significant software development project using concepts taught in this course and in prior Computer Science courses.  
PREREQ: COMPSCI 223

**COMPSCI 481 WEB SERVER AND UNIX ADMINISTRATION 3 Units**  
This course is intended to introduce students to Web Server software and UNIX and UNIX-like operating systems from the perspective of the System Administrator. Linux, the fastest growing operating system, will be studied in detail, together with the Apache web server. Web server configuration will be studied, including optimization, security issues and virtual server administration. Additional topics will include shell programming, system monitoring, file systems and the X Windows GUI. This course will focus on common system administration duties on the Linux platform. Students will acquire competency in using shell programming skills to automate the maintenance of server activity. Emphasis will be placed on using Linux as an Internet server.  
PREREQ: COMPSCI 172 OR COMPSCI 174 OR EQUIVALENT PREPARATION AND CONSENT OF INSTRUCTOR

**COMPSCI 482 ADVANCED WEB APPLICATION DEVELOPMENT 3 Units**  
This course will introduce students to popular technologies utilized in building modern Web applications. These include application frameworks, application design patterns, Web services, databases, and security.  
PREREQ: COMPSCI 381 AND COMPSCI 382 OR EQUIVALENT PREPARATION OR CONSENT OF INSTRUCTOR

**COMPSCI 485 PROJECT *Repeatable* 1-3 Units**  
This course provides students with the opportunity to participate on a student project team under the management of a faculty member and industry practitioners. The project will be sponsored by a partnering business firm and may involve a wide array of technologies, functional areas and geographically dispersed teammates. This course will only be offered when projects are available. Students will be carefully chosen through an interview process. The number of credits will be determined by the complexity of the project and the level of student involvement.  
PREREQ: COMPSCI 223 AND CONSENT OF DEPARTMENT

**COMPSCI 490 WORKSHOP *Repeatable* 1-3 Units**  
Variable topics. Group activity oriented presentations emphasizing "hands on" and participatory instructional techniques. Repeatable. Instructor Consent required.

**COMPSCI 493 INTERNSHIP IN COMPUTER SCIENCE *Repeatable* 1-12 Units**  
S/NC grade basis only.

**COMPSCI 494 SEMINAR 2 Units**  
Variable topics. Group activity. An advanced course of study in a defined subject matter area emphasizing a small group in intense study with a faculty member.

**COMPSCI 496 SPECIAL STUDIES *Repeatable* 1-3 Units**  
Variable topics. Group activity. Not offered regularly in the curriculum but offered on topics selected on the basis of timeliness, need, and interest, and generally in the format of regularly scheduled Catalog offerings. Repeatable. Instructor Consent required.

**COMPSCI 497 EXCHANGE STUDY *Repeatable* 1-12 Units**  
Variable topics.

**COMPSCI 498 INDEPENDENT STUDY IN COMPUTER SCIENCE *Repeatable* 1-3 Units**  
Study of a selected topic or topics under the direction of a faculty member. Repeatable. Department Consent required.

**COMPSCI 498R INDEPENDENT STUDY - UNDERGRADUATE RESEARCH *Repeatable* 1-3 Units**  
Study of a selected topic or topics under the direction of a faculty member. Repeatable. Department Consent required.