
Computer Science

In the College of Sciences

OFFICE: Geology/Mathematics/Computer Science 413

TELEPHONE: 619-594-6191

<http://www.cs.sdsu.edu>

The B.S. degree in Computer Science is accredited by the Computing Accreditation Commission of ABET, Inc.

Faculty

Emeritus: Anantha, Baase-Mayers, Donald, Marovac, Vinge

Chair: Beck

Professors: Beck, Carroll, Stewart, Swiniarski, Tarokh, Vuskovic

Associate Professors: Eckberg, Roch, Valafar, Whitney

Assistant Professors: Edwards, Xie

Lecturers: Bajic, Lewis, Riggins

Adjunct: Root, Thomas

Offered by the Department

Master of Science degree in computer science.

Major in computer science with the B.S. degree in applied arts and sciences.

Major in computer science with the B.A. degree in liberal arts and sciences.

Minor in computer science.

Certificate in geographic information science.

The Major

Computer Science is the study of computers and their applications. It is concerned with methods for storing and retrieving information, with the design and use of languages for writing computer programs, with the hardware systems that interpret such languages, and with the theoretical principles that form the foundations of computing. Computer Science includes a wide variety of specialties and application areas such as artificial intelligence, robotics, graphics, systems programming, simulation, and computer networks.

The Bachelor of Science in Computer Science is designed to provide students with a fundamental understanding of modern computing methodology and programming practices along with a complementary knowledge of hardware. The first two years provide the basic preparation in programming, data structures and architecture. The final two years are devoted to more advanced fundamentals and specialized electives.

Computers are used to store and manage information, to analyze scientific data, and in a wide variety of other applications. Computing technology is found in an almost limitless number of settings, ranging from automobiles to household appliances to toys. Because of this, a wide range of jobs are open to people trained in Computer Science. Employment opportunities are expected to remain very strong.

Major Academic Plans (MAPs)

Visit <http://www.sdsu.edu/mymap> for the recommended courses needed to fulfill your major requirements. The MAPs Web site was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

Computer Science Major

With the B.S. Degree in Applied Arts and Sciences

(Major Code: 07011)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

A minor is not required for this major.

Preparation for the Major. Computer Science 107, 108, 237; Mathematics 150, 151, 245, 254; Statistics 250; and 12 units of science courses selected with approval of computer science adviser. The science courses must include one of the following two-semester sequences with laboratory: Physics 195, 195L, 196, 196L; or Chemistry 200, 201; or Biology 203, 203L, 204, 204L. The remainder of the 12 units must be science courses or courses that enhance the student's ability to apply the scientific method. (38 units)

Graduation Writing Assessment Requirement. Passing the Writing Proficiency Assessment with a score of 10 or above or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

Major. A minimum of 37 upper division units to include Computer Science 310, 320, 370, 440, 490, 530, 560, 570; at least one course selected from Mathematics 541, 579, Statistics 350A, 550, or 551A; and 12 units of computer science electives selected with the approval of a computer science major adviser. At least nine units of electives must be in computer science.

Master Plan. A master plan of the courses taken to fulfill the major must be approved by a major adviser and filed with the Office of Advising and Evaluations.

Computer Science Major

(Imperial Valley Campus)

With the B.A. Degree in Liberal Arts and Sciences

(Major Code: 07011)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

A minor is not required for this major.

Preparation for the Major. Computer Science 107, 108, 237; Mathematics 150, 151, 245, 254; Statistics 250; and 12 units of science courses selected with approval of computer science adviser. The science courses must include one of the following two-semester sequences with laboratory: Physics 195, 195L, 196, 196L; or Chemistry 200, 201; or Biology 203, 203L, 204, 204L. The remainder of the 12 units must be science courses or courses that enhance the student's ability to apply the scientific method. (38 units)

Language Requirement. Competency (equivalent to that which is normally attained through three consecutive semesters of college study) is required in one foreign language to fulfill the graduation requirement. Refer to the section of this catalog on "Graduation Requirements."

Graduation Writing Assessment Requirement. Passing the Writing Proficiency Assessment with a score of 10 or above or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

Major. A minimum of 25 upper division units to include Computer Science 310, 320, 370, 440, 490, 530, 560, 570; and either one additional three unit 500-level computer science elective or one course selected from Mathematics 541, 561, 579, or Statistics 550.

Master Plan. A master plan of the courses taken to fulfill the major must be approved by a major adviser and filed with the Office of Advising and Evaluations.

Computer Science Minor

The minor in computer science consists of a minimum of 18-24 units in computer science and mathematics to include Computer Science 107, 108; and at least 12 upper division units, or at least nine upper division units if the student completes a full calculus sequence, i.e., Mathematics 121 and 122, or 150 and 151. The courses selected are subject to the approval of the minor adviser.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

Geographic Information Science Certificate*

The purpose of the program is to prepare students to acquire, manage, and visualize geospatial data in public and private organizations. Students must apply for admission to the program before the completion of 12 certificate units and must complete the required units with a 2.5 grade point average.

The certificate requires 27 units distributed between the departments of Computer Science and Geography as follows: 12-15 units selected from Computer Science 105, 107, 108, 220, 310, 320, 503, 514, 520, 535, 551, 575, and 12-15 units selected from Geography 104, 381, 484, 581-589. Courses with relevant content (e.g. Computer Science 596 or Geography 596) may be substituted for the computer science and geography courses with the approval of the certificate adviser. Courses in the certificate may be counted toward the major in computer science if applicable.

* Additional prerequisites required for this certificate.

Courses (cs)

Refer to *Curricula and Courses and University Policies* sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

LOWER DIVISION COURSES

CS 100. Fundamental Ideas in Computer Science (3) [GE]

Prerequisite: Satisfaction of the Entry-Level Mathematics requirement.

Capabilities and applications of computers. Algorithmic problem-solving methods and computer programming. Using computers to examine questions from other fields of study. Practical and theoretical limits to computation. Machine intelligence and heuristic problem solving. Social and legal impact of computers.

CS 105. Visual Basic Programming (3)

Programming and problem solving using Visual Basic programming language on the PC. Applications to GIS, computer games.

CS 106. Introduction to Computer Programming with FORTRAN (3)

Prerequisite: Satisfaction of the Entry-Level Mathematics requirement.

Introduction to problem solving on a computer, design of algorithms, and use of FORTRAN language. Extensive programming.

CS 107. Introduction to Computer Programming (3)

Prerequisite: Satisfaction of the Entry-Level Mathematics requirement.

Programming methodology and problem solving. Basic concepts of computer systems, algorithm design and development, data types, program structures. Extensive programming in Java.

CS 108. Intermediate Computer Programming (3)

Prerequisites: Qualification on the Mathematics Departmental Placement Examination, Part IA; and Computer Science 107.

Further training in program design and development. Introduction to data structures: stacks, queues, linear lists, trees, sets, and recursion. Extensive programming in Java.

CS 205. Introduction to Computational Programming and Visualization (3)

Prerequisite: First semester calculus (either Mathematics 120 or 121 or 150).

Problem solving skills for needs of science. Use of computing and software tools of computational science introduced to gain competence in computer communications, programming and visualization. Supervised computer laboratory.

CS 220. UNIX and the C Programming Language (3)

Prerequisite: Computer Science 108.

Introduction to the UNIX operating system: shell programming, major system services and utilities. The C language: its features and their significance in the UNIX programming environment.

CS 237. Machine Organization and Assembly Language (3)

Prerequisite: Computer Science 108.

General concepts of machine and assembly language, data representation, looping and addressing techniques, arrays, subroutines, macros. Extensive assembly language programming.

CS 296. Experimental Topics (1-4)

Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

CS 299. Special Study (1-3)

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

UPPER DIVISION COURSES (Intended for Undergraduates)

CS 301. Computers and Society (3) [GE]

Prerequisite: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning.

Impact of computers and computing technology on society: applications, benefits, and risks. Topics include privacy, copyright, computer crime, constitutional issues, risks of computer failures, evaluating reliability of computer models, computers in the workplace, trade and communications in the global village. Not open to computer science majors or to students with credit in Computer Science 440.

CS 310. Data Structures (3)

Prerequisites: Computer Science 108 and Mathematics 245.

Representations and operations on basic data structures. Arrays, linked lists, stacks, queues, and recursion; binary search trees and balanced trees; hash tables, dynamic storage management; introduction to graphs. An object oriented programming language will be used.

CS 320. Programming Languages (3)

Prerequisite: Computer Science 108.

Principles of high-level programming languages, including formal techniques for syntax specification and implementation issues. Languages studied should include at least C++, FORTRAN, and LISP.

CS 370. Computer Architecture (3)

Prerequisite: Computer Science 237.

Logic gates, combinational circuits, sequential circuits, memory and bus system, control unit, CPU, exception processing, traps and interrupts, input-output and communication, reduced instruction set computers, use of simulators for analysis and design of computer circuits, and traps/interrupts.

CS 425. Tcl and Tk Interface Programming (3)

Prerequisite: Computer Science 220.

Presentation of Toolkit Command Language (Tcl) and Toolkit (Tk) languages, a portable programming environment for creating graphical user interfaces under X Windows, Microsoft Windows, and Macintosh. Writing scripts for Tcl, Tk, and extensions such as Expect.

CS 435. Advanced Java Programming (3)

Prerequisite: Computer Science 310.

Object oriented modeling techniques and tools; use cases; UML models and diagrams. Exception handling, I/O with objects, random access I/O, subclasses and inheritance, overloading versus overriding, interfaces and abstract classes, threads, cloning, packages, documentation aids, archiving and compression, iterators and comparators.

CS 440. Social, Legal, and Ethical Issues in Computing (3)

Prerequisite: Computer Science 108.

Impact of computers, applications, and benefits, copyright, privacy, computer crime, constitutional issues, risks of computer failures, evaluating reliability of computer models, trade and communications in the global village, computers in the workplace, responsibilities of the computer professional. Not open to students with credit in Computer Science 301.

CS 470. UNIX System Administration (3)

Prerequisite: Computer Science 220.

Installing the UNIX operating system on a UNIX workstation, adding user accounts, backing up and restoring user files, installing windows, adding network capabilities, adding printers and other peripherals.

CS 490. Senior Seminar (1)

Prerequisite: Fifteen units of upper division computer science courses.

Preparation and delivery of oral presentations on advanced topics in computer science. General principles of organization and style appropriate for presenting such material.

CS 496. Experimental Topics (1-4)

Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

CS 497. Undergraduate Research Seminar (3)

Six hours of laboratory and one hour with adviser.

Prerequisites: Computer Science 560 or 570, minimum grade point average of 3.3, and consent of instructor.

Designing and carrying out independent research in one of the areas of computer science. Literature search, technical report writing, and oral presentation of results.

CS 499. Special Study (1-3)

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

UPPER DIVISION COURSES (Also Acceptable for Advanced Degrees)

CS 501. Computational Software (3)

Prerequisites: Computer Science 106 and 310.

Design and implementation of software for computational science. Makefiles in UNIX environment, efficient Fortran and OO programming, use of common application libraries, file and source code management, software documentation, construction of libraries and applications. Designed for computational science students. Computer science majors must obtain adviser approval.

CS 503. Scientific Database Techniques (3)

Prerequisites: Computer Science 205, 310, and Mathematics 245.

Fundamental data models for handling scientific data, including flat file, indexed compressed files, relational databases, and object oriented databases, and their associated query technologies; e.g. file formats, input/output libraries, string searching, structured query language, object-oriented structured query language, hypertext markup language/common gateway interface, and other specialized interfaces. Designed for computational science students. Computer science majors must obtain adviser approval. See Computer Science 514.

CS 505. Parallel Computing (3)

Prerequisite: Computer Science 310. Recommended: Computer Science 501.

Motivations and methods of high performance computing. Modern computer architecture characteristics, uniprocessor programming and tuning, shared and distributed memory programming techniques, benchmarking. Designed for computational science students. Computer science majors must obtain consent of adviser.

CS 514. Database Theory and Implementation (3)

Prerequisites: Computer Science 310 and Mathematics 245.

Database systems architecture. Storage structures and access techniques. Relational model, relational algebra and calculus, normalization of relations, hierarchical and network models. Current database systems.

CS 520. Advanced Programming Languages (3)

Prerequisites: Computer Science 237, 310, and 320.

Object oriented programming, concurrent programming, logic programming. Implementation issues.

CS 524. Compiler Construction (3)

Prerequisites: Computer Science 237, 310, and 320.

Syntactical specification of languages. Scanners and parsers. Precedence grammars. Run-time storage organization. Code generation and optimization.

CS 530. Systems Programming (3)

Prerequisites: Computer Science 237 and 310.

Design and implementation of system software. Relationship between software design and machine architecture. Topics from assemblers, loaders and linkers, macro processors, compilers, debuggers, editors. Introduction to software engineering and review of programming fundamentals and object oriented concepts. Large project in object oriented programming is required. Not acceptable for the M.S. degree in computer science.

CS 532. Software Engineering (3)

Prerequisites: Computer Science 320 and 530.

Theory and methodology of programming complex computer software. Analysis, design, and implementation of programs. Team projects required.

CS 533. Component Based Software Engineering (3)

Prerequisites: Computer Science 310 and 320.

Component based (CB) software development using UML and other design methods. Development of components for use in CB systems; CB software architectures; development of CB systems; comparison of traditional and CB system development methods.

CS 534. Software Measurement (3)

Prerequisite: Computer Science 532.

Basics of software measurement and use of measurement information to ensure quality software and determine software process effectiveness. Software estimation, cost estimation models, definition of various measures, tools to support measurement collection and analysis, analysis techniques, and case studies.

CS 535. Object-Oriented Programming and Design (3)

Prerequisites: Computer Science 310 and 320.

Basic concepts of object-oriented programming; classes, objects, messages, data abstraction, inheritance, encapsulation. Object-oriented design methodology.

CS 537. Component GIS Architectures (3)

Prerequisite: Computer Science 310 or Geography 484.

Customization of Geographic Information Science application development platforms with emphasis on object oriented programming and component architecture. Prominent examples are Map Objects with Visual Basic, Map Objects with Java. Considerable programming effort required, especially in Graphical User Interface development.

CS 540. Software Internationalization (3)

Prerequisite: Computer Science 310.

Principles, techniques, and resources for design and implementation of software localizable to multiple languages and/or cultures, including detailed examination of internationalization features provided by one or more widely used modern programming languages.

CS 541. Online Documentation and Help Systems (3)

Prerequisite: Computer Science 310.

Design, implementation, and maintenance of online documentation and help systems, including authoring principles and standards; theory and practice of single-source content management; survey of available development tools and resources; internationalization; and project management.

CS 542. XML for Multilingual and Multicultural Applications (3)

Prerequisite: Computer Science 310.

Principles, techniques, and resources for designing and utilizing globalized XML documents in multilingual and multicultural information systems.

CS 550. Artificial Intelligence (3)

Prerequisites: Computer Science 108 and either Mathematics 245 or 523.

Heuristic approaches to problem solving. Systematic methods of search of the problem state space. Theorem proving by machine. Resolution principle and its applications.

CS 551. User Interface Environments (3)

Prerequisites: Computer Science 310 and 320.

Design of user-machine interfaces in interactive systems. Problems faced by user of an interactive system; basic issues and principles involved in design and implementation of good and friendly user-machine graphical interfaces.

CS 552. Artificial Intelligence II (3)

Prerequisite: Computer Science 550.

Limitations of symbol-based approach to artificial intelligence from Computer Science 550. Presented alternatives are genetic and probabilistic approaches, connectionist and emergent representation and learning, natural language processing, intelligence measures and cognitive models. Seminal publications shaping these techniques.

CS 553. Neural Networks (3)

Prerequisites: Computer Science 320 and Mathematics 254.

Principles of neural networks, their theory and applications.

CS 556. Robotics: Mathematics, Programming, and Control (3)

Prerequisites: Computer Science 320, Mathematics 254, knowledge of the C programming language.

Robotic systems including manipulators, actuators, sensors, and controllers. Kinematics of planar robots. Design and implementation of robot joint controllers. Robot programming languages and environments, and robot command interfaces.

CS 558. Computer Simulation (3)

Prerequisites: Computer Science 310 and Statistics 550.

Methodology of simulation for discrete and continuous dynamic systems. State-of-the-art programming techniques and languages. Statistical aspects of simulation. Students will design, program, execute, and document a simulation of their choice.

CS 559. Computer Vision (3)

Prerequisites: Computer Science 310 and Mathematics 254.

Algorithms and computer methods for processing of images. Visual perception as a computational problem, image formation, characterization of images, feature extraction, regional and edge detection, computer architectures for machine vision.

CS 560. Algorithms and Their Analysis (3)

Prerequisite: Computer Science 310.

Algorithms for solving frequently occurring problems. Analysis techniques and solutions to recurrence relations. Searching and sorting algorithms. Graph problems (shortest paths, minimal spanning trees, graph search, etc.). NP complete problems. Not acceptable for the M.S. degree in Computer Science.

CS 561. Web Application Development (3)

Prerequisite: Computer Science 310.

Architectural elements for programming web pages and dynamic Web sites. Development of web applications using xhtml, CSS, client-side browser languages, and dynamic web applications using backend server languages with database systems.

CS 562. Automata Theory (3)

Prerequisite: Mathematics 245 or 521A.

Definition of finite automata. Classification of finite automaton definable languages. Minimization of finite automata. Nondeterministic finite automata. Sequential machines with output. Regular sets and expressions. Introduction to grammars.

CS 566. Queuing Theory (3)

Prerequisites: Computer Science 108 and Statistics 119 or 250.

Performance prediction of computer networks and other systems (e.g., inventory control, customer service lines) via queuing theory techniques. Operational analysis.

CS 570. Operating Systems (3)

Prerequisites: Computer Science 310, 370, and knowledge of the C programming language.

File systems, processes, CPU scheduling, concurrent programming, memory management, protection. Relationship between the operating system and underlying architecture. Not acceptable for the M.S. degree in Computer Science.

CS 572. Microprocessor Architecture (3)

Prerequisites: Computer Science 370 and knowledge of the C programming language.

Architecture of state-of-the-art microprocessor. Internal pipeline, internal cache, external cache, and memory management. Programming a uniprocessor. Communication among computers in a distributed environment. Architecture and programming of a multiprocessor system.

CS 574. Computer Security (3)

Prerequisites: Computer Science 310; Mathematics 245; Statistics 550; and credit or concurrent registration in Computer Science 570.

Principles of computer security and application of principles to operating systems, database systems, and computer networks. Topics include encryption techniques, access controls, and information flow controls.

CS 576. Computer Networks and Distributed Systems (3)

Prerequisite: Credit or concurrent registration in Computer Science 570.

Basic networking concepts such as seven-layer reference model, transmission media, addressing, subnetting and supernetting, networking devices, LANs and WANs, internetworking, distributed processing, and client-server model. Basic concepts and protocols of TCP/IP protocol suite and basic Internet services.

CS 580. Client-Server Programming (3)

Prerequisites: Computer Science 570 and knowledge of an object-oriented programming language. Recommended: Computer Science 576.

Client-server model, networking protocols for client-server programs, algorithmic issues in client-server programs, client-server protocols, implementing client-server applications.

**CS 581. Computational Linguistics (3)
(Same course as Linguistics 581)**

Prerequisites: Computer Science 320 or Linguistics 571; Linguistics 570 or Mathematics 245.

Basic concepts in computational linguistics including regular expressions, finite-state automata, finite-state transducers, weighted finite-state automata, and n-gram language models. Applications to phonology, orthography, morphology, syntax. Probabilistic models. Statistical techniques for speech recognition.

CS 582. Introduction to Speech Processing (3)

Prerequisite: Computer Science 310.

Fundamentals of speech processing and speech recognition. Physical aspects of speech production and perception. Mathematical models for speech recognition. Corpus development: data collection, processing, and evaluation. Applications of speech processing and associated research topics.

CS 583. 3D Game Programming (3)

Prerequisite: Computer Science 310 or equivalent programming background.

Development of programming skills using software environment of a game engine and its scripting language. 3D concepts for game play, modeling, and programming. Roles needed in software development team. Contrast creation of original 3D object models for game world with incorporation of pre-created generic models.

CS 596. Advanced Topics in Computer Science (1-4)

Prerequisite: Consent of instructor.

Selected topics in computer science. May be repeated with the approval of the instructor. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

For additional courses useful to computer scientists, see:

Mathematics 541.	Introduction to Numerical Analysis and Computing
Mathematics 542.	Introduction to Numerical Solutions of Differential Equations
Mathematics 561.	Applied Graph Theory
Mathematics 579.	Combinatorics

GRADUATE COURSES
Refer to the *Graduate Bulletin*.