BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Students intending to enter this program at the freshman level should have completed two years of algebra and one semester of trigonometry in high school. One year each of high school geometry and physics, as well as basic knowledge of computer organization and programming, are very desirable.

All lower division courses (course numbers below 300) included among the degree requirements are available at many community colleges in California; students intending to enter the program upon transferring to San Francisco State University from a community college should take as many of those courses there as possible.

Students should plan their program of study in the major with the help of a departmental advisor as soon as possible so that the correct sequence of courses is taken and a set of four electives is chosen. It is also suggested that students consult with an advisor before selecting courses to meet the General Education requirements. (See program overview for acceptable science electives.)

Several endowed scholarship funds offer annual awards to computer science majors who show scholarly accomplishment and demonstrate financial need. An Entrepreneurship Program and Developers Prize, funded by our alumni, encourage and support innovation and entrepreneurship among students.

Program Learning Outcomes

a. Students will be able to design, develop, document, and test software using current techniques.
b. Students will understand the fundamentals of computer architecture and computing theory.
c. Students will be able to solve problems working in group settings.
d. Students will demonstrate the ability to give presentations and write technical reports.
e. Students will demonstrate an understanding of the importance of social and ethical issues related to the profession.

Computer Science (B.S.) 74 units

- CR/NC grades are not accepted in courses for the Computer Science major.
- Grades of C or better are required for CSC 510 and CSC 648.

Mathematics and Physics (22 units)

Code	Title	Units
MATH 225	Introduction to Linear Algebra	3
MATH 226	Calculus I	4
MATH 227	Calculus II	4
MATH 324	Probability and Statistics with Computing	3
PHYS 220	General Physics with Calculus I	3
PHYS 222	General Physics with Calculus I Laboratory	1
PHYS 230	General Physics with Calculus II	3
PHYS 232	General Physics with Calculus II Laboratory	1

Core Computer Science Requirements (28 units)

Code	Title	Units
CSC 101	Introduction to Computing	3
CSC 215	Intermediate Computer Programming	4
CSC 220	Data Structures	3
CSC 230	Discrete Mathematical Structures for Computer Science	3
CSC 256	Machine Structures	3
CSC 300GW	Ethics, Communication, and Tools for Software Development - GWAR	3
CSC 317	Introduction to Web Software Development	3
CSC 340	Programming Methodology	3
CSC 413	Software Development	3

Advanced Computer Science Requirements (9 units)

Code	Title	Units
CSC 415	Operating System Principles	3
CSC 510	Analysis of Algorithms I	3
CSC 648	Software Engineering	3

Electives (15 units)

All students must complete five 3-unit senior electives. At least 12 units must be CSC courses. In addition to the courses listed below, any 600-level CSC course, with the exception of CSC 601, CSC 602, CSC 648, and CSC 694 can be used as an elective. The department also allows one CSC graduate course to be used as a senior elective (700-level or higher, and non-paired excluding CSC 895, CSC 898, CSC 897, CSC 899). Exceptions must be approved in advance by a senior advisor.

Code	Title	Units
CSC 520	Theory of Computing	3
CSC 600	Programming Paradigms and Languages	3
CSC 615	UNIX Programming	3
CSC 620	Natural Language Technologies	3
CSC 621	Biomedical Imaging and Analysis	3
CSC 630	Computer Graphics Systems Design	3
CSC 631	Multiplayer Game Development	3
CSC 641	Computer Performance Evaluation	3
CSC 642	Human-Computer Interaction	3
CSC 645	Computer Networks	3
CSC 647	Introduction to Quantum Computing and Quantum Information Science	3
CSC 649	Search Engines	3
CSC 651	System Administration	3
CSC 652	Introduction to Security and Data Privacy	3
CSC 656	Computer Organization	3
CSC 657	Bioinformatics Computing	3
CSC 658	Programming Cafe	3
CSC 664	Multimedia Systems	3
CSC 665	Artificial Intelligence	3
CSC 667	Internet Application Design and Development	3
CSC 668	Advanced Object Oriented Software Design and Development	3
CSC 671	Deep Learning	3
CSC 675	Introduction to Database Systems	3

CSC 676	Soft Computing and Decision Support Systems	3
CSC 680	Application Development for Mobile Devices	3
CSC 690	Interactive Multimedia Application Development	3
CSC 698	Topics in Computing	3
CSC 699	Independent Study	1-3
MATH 400	Numerical Analysis	3
MATH 425	Applied and Computational Linear Algebra	3
MATH 448	Introduction to Statistical Learning and Data Mining	3

General Education Requirements

Requirement	Course Level	Units	Area Designation
Oral Communication	LD	3	A1
Written English Communication	LD	3	A2
Critical Thinking	LD	3	A3
Physical Science	LD	3	B1
Life Science	LD	3	B2
Lab Science	LD	1	B3
Mathematics/ Quantitative Reasoning	LD	3	B4
Arts	LD	3	C1
Humanities	LD	3	C2
Arts or Humanities	LD	3	C1 or C2
Social Sciences	LD	3	D1
Social Sciences: US History	LD	3	D2
Lifelong Learning and Self-Development (LLD)	LD	3	E
Ethnic Studies	LD	3	F
Physical and/or Life Science	UD	3	UD-B
Arts and/or Humanities	UD	3	UD-C
Social Sciences	UD	3	UD-D
SF State Studies			
Courses certified as meeting the SF State Studies requirements may be upper or lower division in General Education (GE), a major or minor, or an elective.			
American Ethnic and Racial Minorities	LD or UD	3	AERM
Environmental Sustainability	LD or UD	3	ES
Global Perspectives	LD or UD	3	GP
Social Justice	LD or UD	3	SJ

Note: LD = Lower-Division; UD = Upper-Division.

First-Time Student Roadmap (4 Year)

The roadmaps presented in this Bulletin are intended as suggested plans of study and do not replace meeting with an advisor. For a more personalized roadmap, please use the Degree Planner (https://registrar.sfsu.edu/degreeplanner/) tool found in your Student Center.

First-Time Student Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/computer-science/bs-computer-science/roadmap-i-ii-eng/)

Transfer Student Roadmap (2 Year)

For students with an AS-T in **Computer Science**.
COMP ADT Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/computer-science/bs-computer-science/adt-roadmap/)

This degree program is an approved pathway ("similar" major) for students earning the ADT in Computer Science

California legislation SB 1440 (2009) mandated the creation of the Associate Degree for Transfer (ADT) to be awarded by the California Community Colleges. Two types of ADTs are awarded: Associate in Arts for Transfer (AA-T) and Associate in Science for Transfer (AS-T).

Note: no specific degree is required for admission as an upper-division student. However, the ADT includes specific guarantees related to admission and graduation and is designed to clarify the transfer process and strengthen lower-division preparation for the major.

An ADT totals 60 units and in most cases includes completion of all lower-division General Education requirements and at least 18 units in a specific major. (The Biology, Chemistry, and Environmental Science AS-T degrees defer 3 units in lower-division GE area C and 3 units in lower-division GE area D until after transfer.) Students pursuing an ADT are guaranteed admission to the CSU if minimum eligibility requirements are met, though not necessarily to the CSU campus of primary choice.

Upon verification that the ADT has been awarded prior to matriculation at SF State, students are guaranteed B.A. or B.S. completion in 60 units if pursuing a "similar" major after transfer. Determinations about "similar" majors at SF State are made by faculty in the discipline.

Degree completion in 60 units cannot be guaranteed when a student simultaneously pursues an additional major, a minor, certificate, or credential.

A sample advising roadmap for students who have earned an ADT and continue in a "similar" major at SF State is available on the Roadmaps tab on the degree requirements page for the major. The roadmap displays:

- How many lower-division units required for the major have been completed upon entry based on the award of a specific ADT;
- Which lower-division requirements are considered complete upon entry based on the award of a specific ADT;
- How to complete the remaining 60 units for the degree in four semesters.

Students who have earned an ADT should seek advising in the major department during the first semester of attendance.

General Advising Information for Transfer Students

a. Before transfer, complete as many lower-division requirements or electives for this major as possible.
b. The following courses are not required for admission but are required for graduation. Students are strongly encouraged to complete these units before transfer; doing so will provide more flexibility in course selection after transfer.
    - a course in U.S. History
    - a course in U.S. & California Government

For information about satisfying the requirements described in (1) and (2) above at a California Community College (CCC), please visit http://www.assist.org (http://assist.org). Check any geographically accessible CCCs; sometimes options include more than one college. Use ASSIST to determine:

- Which courses at a CCC satisfy any lower-division major requirements for this major;
- Which courses at a CCC satisfy CSU GE, US History, and US & CA Government requirements.

Remedial courses are not transferable and do not apply to the minimum 60 semester units/90 quarter units required for admission.

Additional units for courses that are repeated do not apply to the minimum 60 units required for upper-division transfer (for example, if a course was not passed on the first attempt or was taken to earn a better grade).

Before leaving the last California Community College of attendance, obtain a summary of completion of lower-division General Education units (IGETC or CSU GE Breadth). This is often referred to as a GE certification worksheet. SF State does not require delivery of this certification to Admissions, but students should retain this document for verifying degree progress after transfer.

Credit for Advanced Placement, International Baccalaureate, or College-Level Examination Program courses: AP/IB/CLEP credit is not automatically transferred from the previous institution. Units are transferred only when an official score report is delivered to SF State. Credit is based on the academic year during which exams were taken. Refer to the University Bulletin in effect during the year of AP/IB/CLEP examination(s) for details regarding the award of credit for AP/IB/CLEP.

Students pursuing majors in science, technology, engineering, and mathematics (STEM) disciplines often defer 6-9 units of lower-division General Education in Areas C and D until after transfer to focus on preparation courses for the major. This advice does not apply to students pursuing associate degree completion before transfer.

Transferring From Institutions Other Than CCCs or CSUs

Review SF State's lower-division General Education requirements. Note that, as described below, the four basic skills courses required for admission meet A1, A2, A3, and B4 in the SF State GE pattern. Courses that fulfill the remaining areas of SF State's lower-division GE pattern are available at most two-year and four-year colleges and universities.

Of the four required basic skills courses, a course in critical thinking (A3) may not be widely offered outside the CCC and CSU systems. Students should attempt to identify and take an appropriate course no later than the term of application to the CSU. To review more information about the A3 requirement, please visit bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL.

Waiting until after transfer to take a single course at SF State that meets both US and CA/local government requirements may be an appropriate option, particularly if transferring from outside of California.