SOFTWARE ENGINEERING (BS)

Offered at: San Luis Obispo Campus

The BS in Software Engineering prepares students to become software professionals who develop software products on time, within budget, and that meet customer requirements. Building on the fundamentals of computer science, the program focuses on practical aspects of building and deploying software systems in a socially responsible way. The program's educational mission supports the faculty in research and professional development that keeps them current in their field and in touch with current industry practices and trends.

The hallmark of the program is "hands on" experience where students follow a curriculum that builds on traditional computer science but differs from the BS in Computer Science in the following ways:

1. Classes emphasize the team approach to building software and provide leadership opportunities for every student.
2. Classes place an emphasis on software processes and lifecycles.
3. Classes include significant learning in engineering and management areas such as quality assurance, testing, metrics, maintenance, configuration management, and interpersonal management skills.
4. The curriculum has a stronger emphasis on mathematics and the use of engineering methods in software design.

The software engineering curriculum culminates in a year-long capstone sequence where the students work in teams to build a large software system.

The software industry increasingly requires both a software and an engineering background for their cutting-edge projects. Graduates with a BS in Software Engineering can expect to find significant opportunities in software development and management, software engineering, and marketing.

The Software Engineering program has four broad program educational objectives (PEOs) that graduates are expected to attain within five years of graduation:

- Technical Competence. Graduates have applied the software engineering body of knowledge and other technical skills to specify, design, and implement complex software systems, doing so with state-of-the art technologies.
- Interpersonal Skills. Graduates have communicated effectively and worked collaboratively in a multi- disciplinary team environment.
- Professional Awareness. Graduates have maintained a positive and ethical attitude concerning the computing profession and its impact on individuals, organizations, and society.
- Intellectual Growth. Graduates have continued to grow intellectually and professionally in their chosen field, including successful pursuit of graduate study if such study was a desired goal.

The BS Software Engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.ABET.org).

Program Learning Objectives

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Degree Requirements and Curriculum

In addition to the program requirements listed on this page, students must also satisfy requirements outlined in more detail in the Minimum Requirements for Graduation (https://catalog.calpoly.edu/academic-standards-policies/general-requirements-bachelors-degree/) section of this catalog, including:

- 40 units of upper-division courses
- 2.0 GPA

- Graduation Writing Requirements (GWR)
- U.S. Cultural Pluralism (USCP)

Note: No Major or Support courses may be selected as credit/no credit. In addition, no more than 12 units of cooperative or internship courses can count towards your degree requirements.

Code	Title	Units
MAJOR COURSES		
CSC/CPE 1000	Computing Majors Orientation	1
CSC 1001 & 1001L	Fundamentals of Computer Science and Fundamentals of Computer Science Laboratory	4
CSC/CPE 1024	Introduction to Computing	2
CSC 2001 & 2001L	Data Structures and Data Structures Laboratory	4
CSC/CPE 2050	System Software Mechanics	3
CSC 3001	Modern Application Development	4
CSC 3100	Software Engineering	4
CSC/CPE 3201	Introduction to Computer Security	3
CSC 3300	Programming Languages	3
CSC 3449	Algorithms and Complexity	4
CSC 3660	Introduction to Databases [1]	2-4
or CSC 3665	Introduction to Database Management Systems	
CSC 4160	Software Engineering Capstone I	4
CSC 4161	Senior Project - Software Engineering Capstone II	4
Software Engineering Electives		
Select from the following: [2]		3-4
CSC 4100	Software Evaluation	
CSC 4170	Special Advanced Topics in Software Engineering	
CSC 4184	User-Centered UI/UX Design	
CSC 4186	Human-Computer Interaction	
CSC 4191	Seminars in Software Engineering	
CSC 4192	Research Experience in Software Engineering	
CSC 4193	Projects in Software Engineering	
CSC 4210	Software Security	
CSC 4471	Special Advanced Laboratory	
CSC 4472	Special Advanced Activity	
CSC 5100	Modern Software Engineering	
CSC 5170	Special Advanced Topics in Software Engineering	
CSC 5571	Special Advanced Laboratory	
CSC 5572	Special Advanced Activity	
Technical Electives		
Select from the list in Technical Electives below: [2]		3-7
SUPPORT COURSES		
Select from the following: (5A & 5C) [3]		4
CHEM 1120	Fundamentals of Chemical Structure and Properties	
PHYS 1141	General Physics I	
MATH 1151	Linear Algebra	3
Select from the following: (2) [3]		8
MATH 1261 & MATH 1262	Calculus I and Calculus II	
MATH 1264 & MATH 1265	Calculus for Data Science I and Calculus for Data Science II	
MATH 2031	Transition to Advanced Mathematics	3
PHIL 3323	Ethics, Science, and Technology (Upper-Division 3) [3]	3

PSY 2201	Introductory Psychology (4B) [3]	3
Select from the following: [4]		3-4
COMS 2217	Small Group Collaboration and Creativity	
PSY 3350	Teamwork	
STAT 3210	Engineering Statistics (Upper-Division 2/5) [3]	3
WGQS/ES 3350	Gender, Race, Culture, Science, and Technology	4
or WGQS 3351	Gender, Race, Class, Nation: Critical Computing and Engineering Studies	
Life Science Support Electives		
Select from the following: (5B) [3]		4
BIO 1111 & BIO 1112	General Biology and Biology Laboratory for Non-Majors	
BIO 1150	Life: History and Diversity	
BIO 1151	Life: Molecules and Cells	
BOT 1121	General Botany	
MCRO 2221	Introduction to Microbiology	
Approved Mathematics/Statistics/Science Electives		
Select from the list in Approved Mathematics/Statistics/Science Electives below:		6
GENERAL EDUCATION (GE)		
(See GE program requirements below)		24
FREE ELECTIVES		
Free Electives		0
Total Units		**120**

1 CSC 3665 will satisfy this requirement and 2 units of Technical Electives.

2 A combined maximum of 6 units may be taken from CPE 4491, CPE 4492, CPE 4493, CSC 4091, CSC 4092, CSC 4093, CSC 4191, CSC 4192, CSC 4193, CSC 4291, CSC 4292, CSC 4293, CSC 4400, CSC 4495, CSC 4691, CSC 4692, CSC 4693, CSC 4791, CSC 4792, CSC 4793, CSC 4891, CSC 4892, CSC 4893, CSC 4991, CSC 4992, CSC 4993, DATA 4720, ENGR 2995, and ENGR 4995; of which up to a combined 4 units may be taken from CPE 4491, CSC 4091, CSC 4191, CSC 4291, CSC 4400, CSC 4495, CSC 4691, CSC 4791, CSC 4891, CSC 4991, and DATA 4720.

3 Required in Major or Support; also satisfies General Education (GE) requirement.

4 PSY 3350 will satisfy this requirement and 1 unit of Technical Electives.

Technical Electives

Guidelines: Courses used to satisfy any other Major, Support, or General Education requirement are not allowed to count toward the Technical Electives requirement. Credit/No Credit grading is not allowed.

Code	Title	Units
REQUIRED COURSES		
Select from the following: [1]		3-7
CSC 3113	Teaching Computing	
CSC 3203	Cryptography Engineering and Applications	
CSC 3250	Introduction to Privacy: Policy and Technology	
CSC 3445	Theory of Computation	
CSC 3662	Introduction to Non-Relational Database Systems	
CSC 3710	Game Design and Development	
CSC 3760	Introduction to Mixed Reality	
CSC 3780	Game Engineering and Critical Analysis	
CSC 4036	Mobile Application Development	
CSC 4037	Web Development	
CSC 4091	Seminars in Computer Science	
CSC 4092	Research Experience in Computer Science	
CSC 4093	Projects in Computer Science	
CSC 4100	Software Evaluation	
CSC 4170	Special Advanced Topics in Software Engineering	
CSC 4184	User-Centered UI/UX Design	

CSC 4186	Human-Computer Interaction
CSC 4191	Seminars in Software Engineering
CSC 4192	Research Experience in Software Engineering
CSC 4193	Projects in Software Engineering
CSC 4210	Software Security
CSC 4212	Malware Design and Analysis
CSC 4214	Binary Exploitation: Tools and Techniques
CSC 4230	Web and Cloud Security
CSC/CPE 4260	Interdisciplinary Privacy and Security Capstone I
CSC/CPE 4261	Senior Project - Privacy and Security Capstone II
CSC 4270	Special Advanced Topics in Computer Security
CSC 4291	Seminars in Privacy and Security
CSC 4292	Research Experience in Privacy and Security
CSC 4293	Projects in Privacy and Security
CSC 4310	Compiler Construction
CSC 4400	Special Problems
CSC 4448	Bioinformatics Algorithms
CSC 4470	Special Advanced Topics
CSC 4471	Special Advanced Laboratory
CSC 4472	Special Advanced Activity
CSC 4495	Cooperative Education Experience
CSC/CPE 4553	Introduction to Operating Systems
CSC 4554	Implementation of Operating Systems
CSC 4570	Special Advanced Topics in Computer Systems
CSC 4665	Database Management Systems Organization
CSC 4691	Seminars in Data Engineering
CSC 4692	Research Experience in Data Engineering
CSC 4693	Projects in Data Engineering
CSC 4710	Introduction to Computer Graphics
CSC 4730	Advanced Rendering Techniques
CSC 4740	Computer Animation
CSC 4760	Real-Time 3D Computer Graphics Software
CSC 4770	Special Advanced Topics in Computer Graphics
CSC 4791	Seminars in Graphics
CSC 4792	Research Experience in Graphics
CSC 4793	Projects in Graphics
CSC 4880	Artificial Intelligence
CSC 4888	Computer Vision
CSC 4891	Seminars in Artificial Intelligence and Machine Learning
CSC 4892	Research Experience in Artificial Intelligence and Machine Learning
CSC 4893	Projects in Artificial Intelligence and Machine Learning
CSC 4991	Seminars in Game Development
CSC 4992	Research Experience in Game Development
CSC 4993	Projects in Game Development
CSC 5100	Modern Software Engineering
CSC 5113	Computing Education Research and Practice
CSC 5170	Special Advanced Topics in Software Engineering
CSC 5201	Computer Security and Privacy
CSC 5210	Software Security
CSC 5220	Advanced Network Security and Privacy
CSC 5270	Special Advanced Topics in Computer Security
CSC 5281	System Security

CSC 5370	Special Advanced Topics in Programming Languages
CSC 5445	Advanced Theory of Decidability and Reducibility
CSC 5447	Advanced Algorithmic Graph Theory
CSC 5449	Advanced Algorithm Design and Analysis
CSC 5550	Research in Operating Systems
CSC 5570	Special Advanced Topics
CSC 5571	Special Advanced Laboratory
CSC 5572	Special Advanced Activity
CSC 5660	Advanced Database Management Systems
CSC 5669	Distributed Computing
CSC 5670	Special Advanced Topics in Computer Systems
CSC 5710	Computer Graphics
CSC 5740	Advanced Compute Shaders in Computer Graphics
CSC 5770	Special Advanced Topics in Computer Graphics
CSC 5870	Special Advanced Topics in Artificial Intelligence
CPE 2300	Introduction to Computer Systems
CPE 2301	Introduction to HDL and Digital Design Laboratory
CPE 3160	Microcontrollers and Embedded Applications
CPE 4190	Applied Parallel Computing
CPE 4220	Network Security
CPE 4250	Wireless Security
CPE 4464	Introduction to Computer Networks
CPE 4465	Advanced Computer Networks
CPE 4470	Special Advanced Topics
CPE 4471	Special Advanced Laboratory
CPE 4472	Special Advanced Activity
CPE 4491	Seminar in Computer Engineering
CPE 4492	Research Experience in Computer Engineering
CPE 4493	Projects in Computer Engineering
CPE 4650	Scalable Server Implementation and Testing
CPE 4669	Distributed Systems
CPE 5564	Research Topics in Computer Networks
DATA 3301	Introduction to Data Science
DATA 4632	Graph Mining
DATA 4720	Data Science Seminar
ENGR 2995	Vertically Integrated Project Experience I
ENGR 4995	Vertically Integrated Project Experience II

[1] A combined maximum of 6 units may be taken from CPE 4491, CPE 4492, CPE 4493, CSC 4091, CSC 4092, CSC 4093, CSC 4191, CSC 4192, CSC 4193, CSC 4291, CSC 4292, CSC 4293, CSC 4400, CSC 4495, CSC 4691, CSC 4692, CSC 4693, CSC 4791, CSC 4792, CSC 4793, CSC 4891, CSC 4892, CSC 4893, CSC 4991, CSC 4992, CSC 4993, DATA 4720, ENGR 2995, and ENGR 4995; of which up to a combined 4 units may be taken from CPE 4491, CSC 4091, CSC 4191, CSC 4291, CSC 4400, CSC 4495, CSC 4691, CSC 4791, CSC 4891, CSC 4991, and DATA 4720.

Approved Mathematics/Statistics/Science Electives

Guidelines: Courses used to satisfy any other Major or Support requirement are not allowed to count toward the Approved Mathematics/Statistics/Science Electives requirement. Credit/No Credit grading is not allowed.

Code	Title	Units
REQUIRED COURSES		
Select from the following:		6
ASTR 3301	Stars and Planetary Systems	
ASTR 3302	Galaxies and Cosmology	
BIO 1113	Biology of Sex	

BIO 1114	Plant Diversity and Ecology
BIO 2213	Life Science for Engineers
BIO 2217	Wildlife Conservation Biology
BIO 2252	Orientation to Biotechnology
BIO 3312	Human Genetics
BIO 3315	Biology of Cancer
BIO 3318	Genetic Engineering Technology
BIO 3351	Principles of Genetics
CHEM 1122	Fundamentals of Chemical Reactivity
GEOL 2240	Physical Geology
GEOL 2241	Physical Geology Laboratory
MATH 2263	Calculus III
MATH 2341	Linear Analysis
MATH 2343	Differential Equations
MATH 2621	Introduction to Mathematical Optimization
MATH 3011	History of Mathematics
MATH 3051	Combinatorics I
MATH 3055	Graph Theory
MATH 3111	Number Theory
MATH 3511	Euclidean Geometry
MATH 3622	Mathematics of Data Science
MATH 3651	Introduction to Numerical Analysis
MATH 3681	Mathematical Programming
MATH 4052	Combinatorics II
MATH 4531	Differential Geometry
MATH 4911	Game Theory
MCRO 2227	General Microbiology II
MCRO 3301	Wine Microbiology
MCRO 3342	Public Health Microbiology
MCRO 4421	Food Microbiology
MSCI 1111	The Oceans
MSCI 1112	The Oceans Laboratory
PHYS 1141	General Physics I
STAT 1510	Statistics I
STAT 1810	Introduction to Statistical Computing with R
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 3800	Introduction to Statistical Computing with SAS and SQL
STAT 3820	Intermediate Statistical Computing with R
STAT 4610	Probability Theory
STAT 4750	Bayesian Reasoning and Methods
STAT 4770	Survival Analysis Methods
STAT 4790	Applied Multivariate Statistics

General Education (GE) Requirements

- 43 units required, 19 of which are specified in Major and/or Support.
- If any of the remaining 24 Units is used to satisfy a Major or Support requirement, additional units of Free Electives may be needed to complete the total units required for the degree.
- See the complete GE course listing (https://catalog.calpoly.edu/academic-standards-policies/general-requirements-bachelors-degree/#generaleducationtext).

- A grade of C- or better is required in one course in each of the following GE Areas: 1A (English Composition), 1B (Critical Thinking), 1C (Oral Communication), and 2 (Mathematics and Quantitative Reasoning).

Lower-Division General Education

Area 1	**English Communication and Critical Thinking**	
1A	Written Communication	3
1B	Critical Thinking	3
1C	Oral Communication	3
Area 2	**Mathematics and Quantitative Reasoning**	
2	Mathematics and Quantitative Reasoning (3 units in Support) [1]	0
Area 3	**Arts and Humanities**	
3A	Arts	3
3B	Humanities: Literature, Philosophy, Languages other than English	3
Area 4	**Social and Behavioral Sciences (Area 4 courses must come from at least two different course prefixes.)**	
4A	American Institutions (Title 5, Section 40404 Requirement)	3
4B	Social and Behavioral Sciences (3 units in Support) [1]	0
Area 5	**Physical and Life Sciences**	
5A	Physical Sciences (3 units in Support) [1]	0
5B	Life Sciences (3 units in Support) [1]	0
5C	Laboratory (may be embedded in a 5A or 5B course) (1 units in Support) [1]	0
Area 6	**Ethnic Studies**	
6	Ethnic Studies	3
Upper-Division General Education		
Upper-Division 2/5	Mathematics and Quantitative Reasoning or Physical and Life Sciences (3 units in Support) [1]	0
Upper-Division 3	Arts and Humanities (3 units in Support) [1]	0
Upper-Division 4	Social and Behavioral Sciences (Area 4 courses must come from at least two different course prefixes.)	3
Total Units		**24**

[1] Required in Major or Support; also satisfies General Education (GE) requirement.

Coming soon