

COMPUTER SCIENCE (BS)

Offered at: San Luis Obispo Campus

The BS Computer Science program provides in-depth study of computer science fundamentals and practice, including programming concepts and languages, software engineering, operating systems and computer organization.

In addition, the major offers a wide choice of technical electives that allows students to focus on particular areas of computer science and their application. Typical areas of emphasis include databases, distributed computing, operating systems, computer graphics, computer security, game development, and artificial intelligence.

The curriculum is project-oriented and develops students' abilities to solve problems using modern computing concepts. Students can expect to complete many projects in a variety of programming languages and on a variety of computer systems. During their last year of study, students complete a senior project, either individually or as members of a team.

Graduates of the computer science program are well prepared to become successful professionals and to pursue graduate study. They are sought by the computer industry for positions as software developers, quality assurance and test engineers, and other technical positions in computer-related industries.

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

- **Technical Competence.** Graduates have applied current technical knowledge and skills to develop effective computer solutions, using state-of-the-art technologies.
- **Interpersonal Skills.** Graduates have communicated effectively and worked collaboratively in a 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 Computer Science program is accredited by the Computing Accreditation Commission of ABET (<http://www.ABET.org>).

Concentrations

General Curriculum in Computer Science

Offered at: San Luis Obispo Campus

The General Curriculum in Computer Science allows students to take coursework across all areas of computer science. Students that do not declare a concentration will default to the General Curriculum.

Artificial Intelligence and Machine Learning

Offered at: San Luis Obispo Campus

The Artificial Intelligence and Machine Learning concentration prepares students for success in technical careers in the fields of artificial intelligence and machine learning, providing students with in-depth coursework and skills in the areas of traditional artificial intelligence, machine learning, data modeling and analysis, and natural language processing.

Data Engineering

Offered at: San Luis Obispo Campus

The Data Engineering concentration provides in-depth skills for students interested, as their career path, in building modern data management and distributed computing systems, and/or in working on designing sophisticated databases and data processing solutions.

Game Development

Offered at: San Luis Obispo Campus

The [Game Development](#) concentration focuses on providing the preparation necessary to succeed in technical-oriented careers relating to [the development](#) and [design of video games and other](#) interactive experiences. Students will take part in multiple project-based courses involving significant programming and design work and will employ relevant industry practices.

Graphics

Offered at: San Luis Obispo Campus

The Graphics concentration in Computer Science focuses on providing the preparation necessary to succeed in technical-oriented careers relating to the development of computer graphics, digital animation, and video games, to the design of video games, and to the development of other interactive experiences. Students will take part in multiple project-based courses involving significant programming and design work and will employ relevant industry practices.

Privacy and Security

Offered at: San Luis Obispo Campus

The Privacy and Security concentration prepares students for success in technical careers in cybersecurity. Students will take a breadth of relevant courses developing their skills in hardware and software design.

Program Learning Objectives

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Concentrations

Artificial Intelligence

1. Apply machine learning methods to the problems of intelligent analysis of data.
2. Design and implement heuristic solutions to a wide range of computational optimization problems.
3. Document the findings of data analysis and communicate them to both technical and non-technical audiences.
4. Identify ethical considerations related to various data analytical challenges, and incorporate them in their decision making and problem solving.

Data Engineering

1. Design relational and non-relational database representations of stakeholder's data storage needs, and develop appropriate database schemata to store the data.
2. Design and develop data-intensive computer applications, incorporating, when necessary, distributed computing techniques.
3. Communicate with other professionals and broad audiences on matters regarding database modeling and management.
4. Articulate how modern database management systems and distributed systems work, and contribute to the design and development of such systems.

Game Development

1. Critique the design and production of computer games.
2. Apply computational theory and software development skills toward interactive entertainment projects.
3. Employ game design principles, game development best practices, digital storytelling, artificial character development, and computer graphics, animation, and advanced rendering techniques in interactive entertainment projects.
4. Collaborate in game development teams employing standard industry practices.

Graphics

1. Create interactive 3D computer graphics applications via a mastery of the graphics pipeline and the basic implementation of the pipeline in modern hardware (and graphics libraries).
2. Apply appropriate skills from mathematics such as coordinate transforms, basic geometric computations for modeling, and spatial queries.
3. Explain and implement rasterization, local shading models and/or global illumination for rendering.
4. Explain and implement hierarchical animation and physically based animation (including the use of motion capture animation data).
5. Explain and use texture mapping and frame buffers for image-based effects in computer graphics applications.
6. Convincingly communicate with broad audiences about computer graphics related topics.
7. Identify the ethical considerations related to the development of interactive entertainment applications and the industry as a whole.

Privacy and Security

1. Identify common security vulnerabilities and select appropriate mitigation techniques for these vulnerabilities.
2. Assess novel security-related topics and how they relate to previously seen material.
3. Convincingly communicate with broad audiences about privacy and security related topics.
4. Identify the ethical considerations related to various security policies and tools.

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 Requirement (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
CPE 2300	Introduction to Computer Systems	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/CPE 4553	Introduction to Operating Systems	3
General Curriculum in Computer Science or Concentration		
(See General Curriculum in Computer Science and list of Concentrations below)		23
SUPPORT COURSES		
Select from the following: (5A & 5C) ¹		4
CHEM 1120	Fundamentals of Chemical Structure and Properties	
PHYS 1141	General Physics I	
MATH 1151	Linear Algebra	3
Select from the following: (2) ¹		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) ¹	3
STAT 3210	Engineering Statistics (Upper-Division 2/5) ¹	3
WGQS 3350	Gender, Race, Culture, Science, and Technology	4
or WGQS 3351	Gender, Race, Class, Nation: Critical Computing and Engineering Studies	
Life Science Support Elective		
Select from the following: (5B) ¹		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	
GENERAL EDUCATION (GE)		
(See GE program requirements below)		27
FREE ELECTIVES		
Free Electives		0
Total Units		120

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

Concentrations

General Curriculum in Computer Science

Code	Title	Units
REQUIRED COURSES		
Senior Project		
Select from the following: ¹		2-8
CSC 4160 & CSC 4161	Software Engineering Capstone I and Senior Project - Software Engineering Capstone II	
CSC 4260 & CSC 4261	Interdisciplinary Privacy and Security Capstone I and Senior Project - Privacy and Security Capstone II	
CSC 4460	Senior Project	
CSC 4461	Senior Project - Research	
DATA 4460	Senior Project - Data Science Capstone	
ENGR 4460 & ENGR 4461	Interdisciplinary Senior Project I and Interdisciplinary Senior Project II	
ENGR 4463 & ENGR 4464	Interdisciplinary Entrepreneurial Senior Project I and Interdisciplinary Entrepreneurial Senior Project II	
Technical Electives		
Select from the following: ^{1, 2, 3}		9-16
CSC 3113	Teaching Computing	
CSC 3203	Cryptography Engineering and Applications	
CSC 3250	Introduction to Privacy: Policy and Technology	
CSC 3445	Theory of Computation	
CSC 3660	Introduction to Databases	
CSC 3662	Introduction to Non-Relational Database Systems	
CSC 3665	Introduction to Database Management 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 4160 & CSC 4161	Software Engineering Capstone I and Senior Project - Software Engineering Capstone II	
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 4260 & CSC 4261	Interdisciplinary Privacy and Security Capstone I and 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 4554	Implementation of Operating Systems
CSC 4570	Special Advanced Topics in Computer Systems
CSC/DATA 4610	Fundamentals of Machine Learning
CSC/DATA 4620	Foundations and Applications of Deep Learning
CSC 4665	Database Management Systems Organization
CSC 4667	Deep Learning
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 4820	Natural Language Processing
CSC 4880	Artificial Intelligence
CSC 4881	Semantic Computing
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 5666	Advanced Machine Learning
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 5820	Computational Linguistics
CSC 5870	Special Advanced Topics in Artificial Intelligence
CSC 5880	Artificial Intelligence
CSC 5887	Advanced Deep Learning
CPE 2301	Introduction to HDL and Digital Design Laboratory
CPE 3160	Microcontrollers and Embedded Applications
CPE 3300	Computer Architecture
CPE 4140	Robotic Systems Integration
CPE 4160	Autonomous Mobile Robotics
CPE 4180	Advanced Microcontrollers and Embedded Applications
CPE 4190	Applied Parallel Computing
CPE 4220	Network Security
CPE 4250	Wireless Security
CPE 4280	Introduction to Hardware Security
CPE 4300	Advanced Computer Architecture
CPE 4390	Introduction to Real-Time Operating Systems
CPE 4420	High-Performance Embedded Systems
CPE 4455	Design of Fault-Tolerant Systems
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 5300	Computer Microarchitecture
CPE 5420	Advanced High-Performance Embedded Systems
CPE 5564	Research Topics in Computer Networks
CPE 5660	Computer Systems
DATA 3301	Introduction to Data Science

DATA 3302	Data Visualization
DATA 4401	Data Science Process and Ethics
DATA 4632	Graph Mining
DATA 4720	Data Science Seminar
ENGR 2995	Vertically Integrated Project Experience I
ENGR 4460 & ENGR 4461	Interdisciplinary Senior Project I and Interdisciplinary Senior Project II
ENGR 4463 & ENGR 4464	Interdisciplinary Entrepreneurial Senior Project I and Interdisciplinary Entrepreneurial Senior Project II
ENGR 4995	Vertically Integrated Project Experience II

Approved External Electives

Select from the following: ^{1, 2, 3} 5-6

AERO 2220	Aerospace Engineering Dynamics
AERO 4450	Introduction to Aerospace Systems Engineering
ART 1102	2D Design
ART 1103	3D Design
ART 1104	4D Design
ART 1141	Design Thinking and Methods
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art
ART 4433	The Art of Mixed Reality
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 3323	Ornithology
BIO 3351	Principles of Genetics
BMED 2310	Introduction to Electrical Design in Biomedical Engineering
BMED 2311	Introduction to Electrical Design in Biomedical Engineering Lab
BOT 3313	Plant Taxonomy
BUS 2212	Financial Accounting for Nonbusiness Majors
BUS 3302	International and Cross Cultural Management
BUS 3310	Introduction to Entrepreneurship
CHEM 1120	Fundamentals of Chemical Structure and Properties
CHEM 1122	Fundamentals of Chemical Reactivity
COMS 2213	Organizational Communication
COMS 2226	Applied Argumentation
COMS 2250	Building Advocacy Skills
COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4404	Video Games and Society
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience

DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
DATA/STAT 3820	Intermediate Statistical Computing with R
EE 2115	Circuits & Electronics for Non-Majors
EE 2115L	Circuits & Electronics Laboratory for Non-Majors
EE 2201	Electric Circuits for Non-Majors
EE 2211	Electric Circuit Analysis I
EE 2241	Electric Circuit Analysis Laboratory I
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 2211	Introduction to Mechanics
ENGR 2212	Introduction to Engineering Dynamics
ENGR 2234	Introduction to Design Thinking
ENGR 3302	The Learn By Doing Lab Teaching Practicum
ENVE 3323	Engineering for the Environment
ENVE 3324	Introduction to Air Pollution
GEOL 2240	Physical Geology
GEOL 2241	Physical Geology Laboratory
GEOL 3330	Principles of Stratigraphy
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping
IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 1223	Process Improvement Fundamentals
IME 2212	Introduction to Enterprise Analytics and Database Systems
IME 2243	Intermediate Design and Manufacturing
IME 2315	Financial Decision Making for Engineers
IME 3303	Project Organization and Management
IME 3326	Statistical Decision-Making and Quality Control
IME 3327	Test Design and Analysis in Manufacturing Engineering
IME 4403	Software Product Management
IME 4408	Systems Engineering
IME 4421	Engineering Management
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
ISLA 3340	Media Arts and Technologies: Storytelling
ISLA 3341	Media Arts and Technologies: Cinematic Process
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
MATH 2263	Calculus III
MATH 2341	Linear Analysis
MATH 2343	Differential Equations
MATH 2621	Introduction to Mathematical Optimization
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 3680	Typesetting with LaTeX
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
ME 2210	Engineering Statics
ME 2212	Engineering Dynamics
MSCI 1111	The Oceans
MSCI 1112	The Oceans Laboratory
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics
PHIL 3341	Professional Ethics
PHIL 4412	Epistemology
PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
PHYS 1141	General Physics I
PHYS 1143	General Physics II
PHYS 2211	General Physics III: Modern Physics
PSY 3302	Organizational Behavior
PSY 3350	Teamwork
PSY 3357	Cognition
STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 3540	Statistical Methods for Study Design and Analysis
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

Total Units
23

¹ A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection of senior project, technical electives, and approved external 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 Courses used to satisfy any other Major, Support, or General Education requirement are not allowed to count toward this electives requirement. Credit/No Credit grading is not allowed.

Artificial Intelligence and Machine Learning

Code	Title	Units
REQUIRED COURSES		
CSC 4460	Senior Project	2
or CSC 4461	Senior Project - Research	
Select from the following:		4
CSC/DATA 4610	Fundamentals of Machine Learning	
CSC 4667	Deep Learning	
CSC 4820	Natural Language Processing	
CSC 4880	Artificial Intelligence	
DATA 3301	Introduction to Data Science	4
MATH 2621	Introduction to Mathematical Optimization ¹	3
Concentration Electives		
Select from the following: ^{2, 3}		7-8
CSC/DATA 4610	Fundamentals of Machine Learning	
CSC/DATA 4620	Foundations and Applications of Deep Learning	
CSC 4667	Deep Learning	
CSC 4820	Natural Language Processing	
CSC 4880	Artificial Intelligence	
CSC 4881	Semantic Computing	
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 5571	Special Advanced Laboratory	
CSC 5572	Special Advanced Activity	
CSC 5666	Advanced Machine Learning	
CSC 5820	Computational Linguistics	
CSC 5870	Special Advanced Topics in Artificial Intelligence	
CSC 5880	Artificial Intelligence	
CSC 5887	Advanced Deep Learning	
External Electives		
Select from the following: ^{2, 3}		2-3
ART 1102	2D Design	
ART 1103	3D Design	
ART 1104	4D Design	
ART 1141	Design Thinking and Methods	
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art	
ART 4433	The Art of Mixed Reality	
ASTR 3301	Stars and Planetary Systems	
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	
BUS 2212	Financial Accounting for Nonbusiness Majors	
BUS 3302	International and Cross Cultural Management	
COMS 2213	Organizational Communication	
COMS 2226	Applied Argumentation	
COMS 2250	Building Advocacy Skills	

COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4404	Video Games and Society
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience
DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 3302	The Learn By Doing Lab Teaching Practicum
GEOL 2240	Physical Geology
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping
IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 2315	Financial Decision Making for Engineers
IME 4403	Software Product Management
IME 4408	Systems Engineering
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
MATH 2263	Calculus III
MATH 2343	Differential Equations
MATH 3051	Combinatorics I
MATH 3055	Graph Theory
MATH 3111	Number Theory
MATH 3511	Euclidean Geometry
MATH 3622	Mathematics of Data Science
MATH 3680	Typesetting with LaTeX
MATH 3681	Mathematical Programming
MATH 4911	Game Theory
MCRO 3301	Wine Microbiology
MCRO 3342	Public Health Microbiology
ME 2210	Engineering Statics
MSCI 1111	The Oceans
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics

PHIL 3341	Professional Ethics
PHIL 4412	Epistemology
PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 4750	Bayesian Reasoning and Methods
STAT 4770	Survival Analysis Methods
STAT 4790	Applied Multivariate Statistics

Total Units
23

- ¹ If MATH 1262 was taken in the core requirements, then MATH 2263 needs to be taken from the External Electives to satisfy the prerequisites for MATH 2621.
- ² A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection of concentration electives and external electives.
- ³ A combined maximum of 6 units may be taken from CSC 4495, CSC 4891, CSC 4892, and CSC 4893; of which up to a combined 4 units may be taken from CSC 4495 and CSC 4891.

Data Engineering

Code	Title	Units
REQUIRED COURSES		
CSC 3665	Introduction to Database Management Systems	4
CSC 4460	Senior Project	2
or CSC 4461	Senior Project - Research	
CSC 4665	Database Management Systems Organization	4
DATA 3301	Introduction to Data Science	4
Select from the following: ^{1, 2}		3-4
CSC 3250	Introduction to Privacy: Policy and Technology	
CSC 3662	Introduction to Non-Relational Database Systems	
CSC 4310	Compiler Construction	
CSC/DATA 4610	Fundamentals of Machine Learning	
CSC 4667	Deep Learning	
CSC 4691	Seminars in Data Engineering	
CSC 4692	Research Experience in Data Engineering	
CSC 4693	Projects in Data Engineering	
CSC 4820	Natural Language Processing	
CSC 4880	Artificial Intelligence	
CSC 4888	Computer Vision	
CSC 5660	Advanced Database Management Systems	
External Electives		
Select from the following: ^{1, 2}		5-6
ART 1102	2D Design	
ART 1103	3D Design	
ART 1104	4D Design	
ART 1141	Design Thinking and Methods	
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art	
ART 4433	The Art of Mixed Reality	
ASTR 3301	Stars and Planetary Systems	
ASTR 3302	Galaxies and Cosmology	
BIO 1113	Biology of Sex	
BIO 1114	Plant Diversity and Ecology	

BIO 1150	Life: History and Diversity
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 3323	Ornithology
BIO 3351	Principles of Genetics
BMED 2310	Introduction to Electrical Design in Biomedical Engineering
BMED 2311	Introduction to Electrical Design in Biomedical Engineering Lab
BOT 3313	Plant Taxonomy
BUS 2212	Financial Accounting for Nonbusiness Majors
BUS 3302	International and Cross Cultural Management
BUS 3310	Introduction to Entrepreneurship
CHEM 1120	Fundamentals of Chemical Structure and Properties
CHEM 1122	Fundamentals of Chemical Reactivity
COMS 2213	Organizational Communication
COMS 2226	Applied Argumentation
COMS 2250	Building Advocacy Skills
COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4404	Video Games and Society
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience
DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
DATA/STAT 3820	Intermediate Statistical Computing with R
EE 2115	Circuits & Electronics for Non-Majors
EE 2115L	Circuits & Electronics Laboratory for Non-Majors
EE 2201	Electric Circuits for Non-Majors
EE 2211	Electric Circuit Analysis I
EE 2241	Electric Circuit Analysis Laboratory I
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 2211	Introduction to Mechanics
ENGR 2212	Introduction to Engineering Dynamics
ENGR 2234	Introduction to Design Thinking
ENGR 3302	The Learn By Doing Lab Teaching Practicum
GEOL 2240	Physical Geology
GEOL 2241	Physical Geology Laboratory
GEOL 3330	Principles of Stratigraphy
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping

IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 1223	Process Improvement Fundamentals
IME 2212	Introduction to Enterprise Analytics and Database Systems
IME 2243	Intermediate Design and Manufacturing
IME 2315	Financial Decision Making for Engineers
IME 3303	Project Organization and Management
IME 3326	Statistical Decision-Making and Quality Control
IME 3327	Test Design and Analysis in Manufacturing Engineering
IME 4403	Software Product Management
IME 4408	Systems Engineering
IME 4421	Engineering Management
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
ISLA 3340	Media Arts and Technologies: Storytelling
ISLA 3341	Media Arts and Technologies: Cinematic Process
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
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 3680	Typesetting with LaTeX
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
ME 2210	Engineering Statics
ME 2212	Engineering Dynamics
MSCI 1111	The Oceans
MSCI 1112	The Oceans Laboratory
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics
PHIL 3341	Professional Ethics
PHIL 4412	Epistemology

PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
PHYS 1141	General Physics I
PHYS 1143	General Physics II
PHYS 2211	General Physics III: Modern Physics
PSY 3302	Organizational Behavior
PSY 3350	Teamwork
PSY 3357	Cognition
STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 3540	Statistical Methods for Study Design and Analysis
STAT 4610	Probability Theory
STAT 4750	Bayesian Reasoning and Methods
STAT 4770	Survival Analysis Methods
STAT 4790	Applied Multivariate Statistics

Total Units **23**

¹ A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection in the notated requirement and technical electives.

² A combined maximum of 6 units may be taken from CSC 4495, CSC 4691, CSC 4692, and CSC 4693; of which up to a combined 4 units may be taken from CSC 4495 and CSC 4691.

Game Development

Code	Title	Units
REQUIRED COURSES		
CSC 3710	Game Design and Development	4
CSC 3780	Game Engineering and Critical Analysis	4
CSC 4460	Senior Project	2
or CSC 4461	Senior Project - Research	
COMS 4404	Video Games and Society	3
Computer Science Electives		
Select from the following: ^{1, 2}		7-8
CSC 3760	Introduction to Mixed Reality	
CSC 4036	Mobile Application Development	
CSC 4037	Web Development	
CSC 4184	User-Centered UI/UX Design	
CSC 4186	Human-Computer Interaction	
CSC 4471	Special Advanced Laboratory	
CSC 4472	Special Advanced Activity	
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 4991	Seminars in Game Development	
CSC 4992	Research Experience in Game Development	
CSC 4993	Projects in Game Development	

CSC 5571	Special Advanced Laboratory
CSC 5572	Special Advanced Activity
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
CSC 5880	Artificial Intelligence
External Electives	
Select from the following: ^{1, 2}	
ART 1102	2D Design
ART 1103	3D Design
ART 1104	4D Design
ART 1141	Design Thinking and Methods
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art
ART 4433	The Art of Mixed Reality
ASTR 3301	Stars and Planetary Systems
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
BUS 2212	Financial Accounting for Nonbusiness Majors
BUS 3302	International and Cross Cultural Management
COMS 2213	Organizational Communication
COMS 2226	Applied Argumentation
COMS 2250	Building Advocacy Skills
COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience
DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 3302	The Learn By Doing Lab Teaching Practicum
GEOL 2240	Physical Geology
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping
IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 2315	Financial Decision Making for Engineers

IME 4403	Software Product Management
IME 4408	Systems Engineering
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
MATH 2263	Calculus III
MATH 2343	Differential Equations
MATH 3051	Combinatorics I
MATH 3055	Graph Theory
MATH 3111	Number Theory
MATH 3511	Euclidean Geometry
MATH 3622	Mathematics of Data Science
MATH 3680	Typesetting with LaTeX
MATH 3681	Mathematical Programming
MATH 4911	Game Theory
MCRO 3301	Wine Microbiology
MCRO 3342	Public Health Microbiology
ME 2210	Engineering Statics
MSCI 1111	The Oceans
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics
PHIL 3341	Professional Ethics
PHIL 4412	Epistemology
PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 4750	Bayesian Reasoning and Methods
STAT 4770	Survival Analysis Methods
STAT 4790	Applied Multivariate Statistics

Total Units
23

¹ A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection of computer science electives and external electives.

² A combined maximum of 6 units may be taken from CSC 4495, CSC 4791, CSC 4792, CSC 4793, CSC 4991, CSC 4992, and CSC 4993; of which up to a combined 4 units may be taken from CSC 4495, CSC 4791, and CSC 4991.

Graphics

Code	Title	Units
REQUIRED COURSES		
CSC 4460 or CSC 4461	Senior Project Senior Project - Research	2
CSC 4710	Introduction to Computer Graphics	3
Graphics Electives		
Select from the following:		6

CSC 4471	Special Advanced Laboratory
CSC 4472	Special Advanced Activity
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

Concentration Electives

Select from the following: ^{1, 2}

6-7

ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art
ART 4433	The Art of Mixed Reality
CSC 3710	Game Design and Development
CSC 3760	Introduction to Mixed Reality
CSC 3780	Game Engineering and Critical Analysis
CSC 4471	Special Advanced Laboratory
CSC 4472	Special Advanced Activity
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 4991	Seminars in Game Development
CSC 4992	Research Experience in Game Development
CSC 4993	Projects in Game Development
CSC 5571	Special Advanced Laboratory
CSC 5572	Special Advanced Activity
CSC 5710	Computer Graphics
CSC 5740	Advanced Compute Shaders in Computer Graphics
CSC 5770	Special Advanced Topics in Computer Graphics
ENGR 2995	Vertically Integrated Project Experience I
ENGR 4995	Vertically Integrated Project Experience II

External Electives

Select from the following: ^{1, 2}

5-6

ART 1102	2D Design
ART 1103	3D Design
ART 1104	4D Design
ART 1141	Design Thinking and Methods
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art
ART 4433	The Art of Mixed Reality
ASTR 3301	Stars and Planetary Systems
ASTR 3302	Galaxies and Cosmology
BIO 1113	Biology of Sex
BIO 1114	Plant Diversity and Ecology
BIO 1150	Life: History and Diversity
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 3323	Ornithology

BIO 3351	Principles of Genetics
BMED 2310	Introduction to Electrical Design in Biomedical Engineering
BMED 2311	Introduction to Electrical Design in Biomedical Engineering Lab
BOT 3313	Plant Taxonomy
BUS 2212	Financial Accounting for Nonbusiness Majors
BUS 3302	International and Cross Cultural Management
BUS 3310	Introduction to Entrepreneurship
CHEM 1120	Fundamentals of Chemical Structure and Properties
CHEM 1122	Fundamentals of Chemical Reactivity
COMS 2213	Organizational Communication
COMS 2226	Applied Argumentation
COMS 2250	Building Advocacy Skills
COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4404	Video Games and Society
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience
DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
DATA/STAT 3820	Intermediate Statistical Computing with R
EE 2115	Circuits & Electronics for Non-Majors
EE 2115L	Circuits & Electronics Laboratory for Non-Majors
EE 2201	Electric Circuits for Non-Majors
EE 2211	Electric Circuit Analysis I
EE 2241	Electric Circuit Analysis Laboratory I
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 2211	Introduction to Mechanics
ENGR 2212	Introduction to Engineering Dynamics
ENGR 2234	Introduction to Design Thinking
ENGR 3302	The Learn By Doing Lab Teaching Practicum
GEOL 2240	Physical Geology
GEOL 2241	Physical Geology Laboratory
GEOL 3330	Principles of Stratigraphy
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping
IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 1223	Process Improvement Fundamentals
IME 2212	Introduction to Enterprise Analytics and Database Systems
IME 2243	Intermediate Design and Manufacturing
IME 2315	Financial Decision Making for Engineers
IME 3303	Project Organization and Management

IME 3326	Statistical Decision-Making and Quality Control
IME 3327	Test Design and Analysis in Manufacturing Engineering
IME 4403	Software Product Management
IME 4408	Systems Engineering
IME 4421	Engineering Management
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
ISLA 3340	Media Arts and Technologies: Storytelling
ISLA 3341	Media Arts and Technologies: Cinematic Process
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
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 3680	Typesetting with LaTeX
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
ME 2210	Engineering Statics
ME 2212	Engineering Dynamics
MSCI 1111	The Oceans
MSCI 1112	The Oceans Laboratory
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics
PHIL 3341	Professional Ethics
PHIL 4412	Epistemology
PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
PHYS 1141	General Physics I
PHYS 1143	General Physics II
PHYS 2211	General Physics III: Modern Physics
PSY 3302	Organizational Behavior
PSY 3350	Teamwork
PSY 3357	Cognition

STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 3540	Statistical Methods for Study Design and Analysis
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

Total Units
23

¹ A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection of concentration electives and external electives.

² A combined maximum of 6 units may be taken from CSC 4495, CSC 4791, CSC 4792, CSC 4793, CSC 4991, CSC 4992, CSC 4993, ENGR 2995, and ENGR 4995; of which up to a combined 4 units may be taken from CSC 4495, CSC 4791, and CSC 4991.

Privacy and Security

Code	Title	Units
REQUIRED COURSES		
CSC 3250	Introduction to Privacy: Policy and Technology	3
CSC 4260	Interdisciplinary Privacy and Security Capstone I	3
CSC 4261	Senior Project - Privacy and Security Capstone II	3
Concentration Electives		
Select from the following: ^{1, 2, 3}		8-9
CSC 3203	Cryptography Engineering and Applications	
CSC 4210	Software Security	
CSC 4212	Malware Design and Analysis	
CSC 4214	Binary Exploitation: Tools and Techniques	
CSC 4230	Web and Cloud Security	
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 4471	Special Advanced Laboratory	
CSC 4472	Special Advanced Activity	
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 5571	Special Advanced Laboratory	
CSC 5572	Special Advanced Activity	
CPE 2301 & CPE 3300	Introduction to HDL and Digital Design Laboratory and Computer Architecture	
CPE 4220	Network Security	
CPE 4250	Wireless Security	
CPE 4280	Introduction to Hardware Security	
CPE 4464	Introduction to Computer Networks	
ENGR 2995	Vertically Integrated Project Experience I	
ENGR 4995	Vertically Integrated Project Experience II	

Mathematics Electives

Select from the following: 3

MATH 2263	Calculus III
MATH 3051	Combinatorics I
MATH 3055	Graph Theory
MATH 3111	Number Theory
MATH 4911	Game Theory

External Electives

Select from the following: ^{1, 2} 2-3

ART 1102	2D Design
ART 1103	3D Design
ART 1104	4D Design
ART 1141	Design Thinking and Methods
ART 3332	Three-dimensional Design and Modeling for Animation and Interactive Art
ART 4433	The Art of Mixed Reality
ASTR 3301	Stars and Planetary Systems
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
BUS 2212	Financial Accounting for Nonbusiness Majors
BUS 3302	International and Cross Cultural Management
COMS 2213	Organizational Communication
COMS 2226	Applied Argumentation
COMS 2250	Building Advocacy Skills
COMS 3301	Business and Professional Communication
COMS 3302	Advanced Public Speaking
COMS 3395	Science Communication
COMS 4402	Rhetorics of Science, Technology, and Medicine
COMS 4404	Video Games and Society
COMS 4421	Gender and Communication
COMS 4430	The Dark Side of Interpersonal Communication
COMS 4435	Rhetoric and Social Change
CSC 4495	Cooperative Education Experience
DATA/STAT 1810	Introduction to Statistical Computing with R
DATA/STAT 3800	Introduction to Statistical Computing with SAS and SQL
ENGL 3387	Fiction Writing
ENGL 3390	The Linguistic Structure of Modern English
ENGR 3302	The Learn By Doing Lab Teaching Practicum
GEOL 2240	Physical Geology
GRC 4290	User Experience Research Methods
HLTH 2281	Health Ambassadors
HLTH 2297	Medical Terminology
HLTH 3337	Early Fieldwork Experience
IME 1140	Technical Graphics Communication for Design and Manufacturing
IME 1141	Introduction to Metal Casting and Prototyping
IME 1142	Materials Joining
IME 1143	Introduction to Design and Manufacturing
IME 1156	Introduction to Modern Electronics Manufacturing
IME 2315	Financial Decision Making for Engineers

IME 4403	Software Product Management
IME 4435	Reliability for Design and Testing
IME 4456	Sensing Systems and the Industrial Internet of Things
KINE 1181	Responding to Emergencies: Comprehensive First Aid, CPR, AED
KINE 2266	Sport and Performance Psychology
MATE 1220	Principles of Materials Engineering for Non-Majors
MATH 2263	Calculus III
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 3680	Typesetting with LaTeX
MATH 3681	Mathematical Programming
MATH 4531	Differential Geometry
MATH 4911	Game Theory
MCRO 3301	Wine Microbiology
MCRO 3342	Public Health Microbiology
ME 2210	Engineering Statics
MSCI 1111	The Oceans
PHIL 2241	Symbolic Logic
PHIL 3321	Philosophy of Science
PHIL 3322	Philosophy of Technology
PHIL 3327	Robot Ethics
PHIL 3328	Technologies and Ethics of Warfare
PHIL 3331	Ethics
PHIL 3341	Professional Ethics
PHIL 4412	Epistemology
PHIL 4422	Philosophy of Mind
PHIL 4423	Philosophy of Language
STAT 1510	Statistics I
STAT 2610	Introduction to Probability and Simulation
STAT 3430	Applied Regression Analysis
STAT 3520	Statistics II
STAT 4750	Bayesian Reasoning and Methods
STAT 4770	Survival Analysis Methods
STAT 4790	Applied Multivariate Statistics

Total Units
23

- ¹ A minimum of 23 units is required to complete the concentration. Unit selection for requirements will vary based on students' selection of concentration electives and external electives.
- ² A combined maximum of 6 units may be taken from CSC 4495, CSC 4291, CSC 4292, CSC 4293, ENGR 2995, and ENGR 4995; of which up to a combined 4 units may be taken from CSC 4495 and CSC 4291.
- ³ Topic courses require department approval. Please contact department for a list of approved topics.

General Education (GE) Requirements

- 43 units required, 16 of which are specified in Major and/or Support.
- If any of the remaining 27 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
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		27
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¹ Required in Major or Support; also satisfies General Education (GE) requirement.

Coming soon