

**California State University, Fullerton**  
**Computer Science, M.S.**  
(30 UNITS)

The Master of Science in Computer Science program emphasizes the study of advanced computational theory and practice to prepare students for successful careers in computer science. Graduates will understand the principles and practices in both classical and emerging domains of computer science, such as AI, data science, software engineering, cyber security, commercial application development, scientific computing and more. They will be well-positioned to seek rewarding careers in all areas of business, government, education and industry, and for pursuing Ph.D. studies.

**Admission to Graduate Standing - Conditionally Classified**

Students must meet the CSU requirements for admission to a master's degree program. Please consult the Graduate Admissions section in this catalog for complete information. In addition, to qualify for admission with conditionally classified standing, applicants must meet the following departmental requirements:

- Minimum GPA of 2.5 for applicants graduated from domestic (U.S.) institutions with undergraduate degrees in engineering or computer science
- Minimum GPA of 2.5 for applicants graduated from ABET-accredited international institutions with undergraduate degrees in engineering or computer science
- Minimum GPA of 3.0 for applicants graduated from domestic (U.S.) institutions with undergraduate degrees other than engineering or computer science
- Minimum GPA of 3.0 for applicants with undergraduate degrees from non-ABET-accredited international institutions Students without an undergraduate degree in computer science must have completed at least one course in computer programming with a grade of at least "B-" within the past 2 years.

**Classified Graduate Standing**

Prior to admission to classified graduate standing in Computer Science, each student, with the aid of the Graduate Adviser, shall prepare and submit for approval a formal study plan consisting of 400-level and graduate coursework. Achieving this status requires all of the following before completing more than 13 units of study plan courses:

1. For students without a bachelor's degree in computer science, satisfactory completion of the following courses or their equivalents. These courses may also have prerequisites, and students without preparation in a closely related degree may have additional work to complete:  
CPSC 121  
The object-oriented programming paradigm: classes, member functions, interfaces, inheritance, polymorphism, and exceptions. Design practices including encapsulation, decoupling, and documentation. Pointers/references and memory management. Recursion. (2 hours lecture, 2 hours activity) Prerequisite: CPSC 120(Introduction to

Programming (3)) or passing score on Computer Science Placement Exam.

Undergraduate Course not available for Graduate Credit

CPSC 131 (Data Structures (3)) Prerequisite: CPSC 121 or sufficient score on the Computer Science Placement Exam.

CPSC 240 (Computer Organization and Assembly Language (3) ) Prerequisites: CPSC 131

CPSC 323 (File Structures and Databases (3)) Prerequisites: CPSC 131

CPSC 335 (Algorithm Engineering (3)) Prerequisites: CPSC 131, MATH 270B

CPSC 351 (Operating Systems Concepts (3)) Prerequisites: CPSC 131

CPSC 362 (Foundations of Software Engineering(3)) Prerequisites: CPSC 131

MATH 270A (Mathematical Structures I(3))

MATH 270B (Mathematical Structures II(3))

MATH 338 (MATH 338 - Statistics Applied to Natural Sciences (4)(4)) Prerequisites:

MATH 250A(Calculus 1 (4)), MATH 250B(Calculus 2 (4)) .

2. For all students, approval of a formal study plan (see description below) by the Computer Science Graduate Adviser and the Associate Vice President, Academic Programs (or designee).

### **Degree Requirements**

At least 15 of the total units shall represent courses offered by the Department of Computer Science. Courses offered by other disciplines, not listed here, and related to the student's objectives in Computer Science may be approved by petition to the Department of Computer Science.

### **Required Courses (6 units)**

- **CPSC 589 - Seminar in Computer Science (3)**

Research methods in computer science. Student presentations covering current topics, research advances, updating of concepts and verifications of principles of computer science. (Examples: large-scale parallelism, Internet security, design for user interfaces, computers in instruction). May be repeated once for credit. One 400-level course in Computer Science and satisfaction of graduate writing requirements recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- **CPSC 597 - Project (3) \* (3)**

Conduct a computer science research or development project proposed in the selected topic, complete it, write a final project report, and present the results in partial fulfillment of the requirements for the master's degree. Classified graduate standing and approval of the computer science graduate adviser are required to enroll. Prerequisite: CPSC 589. Graduate-level One or more sections may be offered in any online format. Department Consent Required

- **CPSC 598 - Thesis (3) \***

Requires approval of the Computer Science graduate adviser. Prerequisites: CPSC 589; Computer Science or Computer Engineering graduate standing. Graduate-level Department Consent Required

**Note:**

\* A "C" (2.0) or better will satisfy the graduate writing requirement.

**Required Electives (9 units)**

Select one course (3 units) from three of the four categories below. Taking two or more courses in the same category will result in only the first course counting toward the required electives.

**Computer Applications (3 units)**

- **CPSC 531 - Advanced Database Management (3)**

Implementation techniques for query analysis, data allocation, concurrency control, data structures and distributed databases. New database models and recent developments in database technology. Student projects directed to specific design problems. CPSC 431 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- **CPSC 566 - Advanced Computer Graphics (3)**

Three-dimensional: reflection models, shading techniques, rendering process, parametric representation, ray tracing, radiosity, texture, anti-aliasing, animation, color science. CPSC 484 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- **CPSC 583 - Expert Systems Design Theory (3)**

Knowledge representation and search strategies for expert systems; logic programming; expert system tools. Project. CPSC 481 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- **CPSC 585 - Artificial Neural Networks (3)**

Principles of neural networks; neural networks paradigms, software implementations, applications, comparison with statistical methods, use of fuzzy logic; project. CPSC 481 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

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**Computer Systems (3 units)**

- **CPSC 551 - Operating Systems Design (3)**

Design and evaluation techniques for controlling automatic resource allocation, providing efficient programming environments and appropriate user access to the system, and sharing the problem solving facilities. CPSC 351 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- CPSC 552 - Cyber Forensics (3)

Introduction to principles and practices of cyber forensics. Topics include: developing an investigative capability; legal and IT requirements; forensic tools; incident response; live forensic investigations; seizure of digital information; operating system boot processes; and investigation of network traffic. CPSC 456 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- CPSC 558 - Advanced Computer Networking (3)

System-oriented view of computer network design, protocol implementation, networking, high-speed networking, network management, computer network performance issues. CPSC 471 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

## **Software Engineering**

- CPSC 541 - Systems and Software Standards and Requirements (3)

SESC framework and the IEEE Software Engineering Standards. Establishing the following standards: Software Life Cycle Processes, Work Product Standards, Process Standards, Requirement Analysis and Management and System Integration. Introduces CMMI framework; discuss number of practical lessons. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

- CPSC 542 - Software Verification and Validation (3)

Theory and practice of software verification and validation (V&V), including software integrity levels, minimum V&V tasks, walkthroughs, inspections and clean room. Topics include: white-box and black-box testing, boundary value analysis, equivalence class partitioning, unit testing, functional testing and test plans. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 543 - Software Maintenance (3)

Theory and practice of maintaining large-scale software. Maintenance framework, process, measures, and process management. Topics include fundamentals of software change and its implications, maintenance process models, reusability for maintenance, reverse engineering, maintenance testing, software configuration management and tools in maintenance. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 544 - Advanced Software Process (3)

Advanced guidance for defining and improving the software development process. Concepts of software maturity framework, principles of process improvement and software process assessment. Current topics such as CMMI and SCAMPI. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 545 - Software Design and Architecture (3)

Advanced software design and architecture principles focusing a software engineering approach to the development process. Topics include architecture business cycle, quality attributes, attribute-driven design method, architectural styles, design patterns, software product lines and component-based design. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 546 - Modern Software Management (3)

Modern project management methodologies and techniques. Software development process. Planning, estimating, organizing, directing, monitoring, controlling software projects and managing risks. Other related software management issues, such as infrastructure, quality software development, project and product metrics and external factors. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 547 - Software Measurement (3)

Current software measurement practices. Topics include: establishing an effective software metrics program; measuring software product, project and process; applying Statistical Process Control and other statistical techniques. High maturity concepts defined in CMMI model will be discussed. Stresses a practitioner-based approach. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

- CPSC 548 - Professional, Ethical and Legal Issues for Software Engineers (3)

Professional, legal and ethical issues pertaining to software engineering. Topics include professional codes of ethics, intellectual property laws, computer privacy and human-computer interaction. Relevant regulatory documents and their applications. CPSC 362 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level One or more sections may be offered in any online format.

### **Theoretical Computer Science (3 units)**

- CPSC 535 - Advanced Algorithms (3)

Design and analysis of sophisticated algorithms and data structures. Lower, tight and pseudo-polynomial bounds. Randomization, approximation and special-purpose data structures. Algorithmic frameworks, such as maximum flow and linear programming. CPSC 335 recommended. Prerequisite: Computer Science or Computer Engineering graduate standing. Graduate-level

### **Electives (15 units)**

Maximum 9 units at the 400-level

CPSC 411 - Mobile Device Application Programming (3)

CPSC 431 - Database and Applications (3)

CPSC 439 - Theory of Computation (3)

CPSC 440 - Computer System Architecture (3)

CPSC 449 - Web Back-End Engineering (3)

CPSC 452 - Cryptography (3)

CPSC 454 - Cloud Computing and Security (3)

CPSC 455 - Web Security (3)

CPSC 456 - Network Security Fundamentals (3)

CPSC 458 - Malware Analysis (3)

CPSC 459 - Blockchain Technologies (3)

CPSC 462 - Software Design (3)

CPSC 463 - Software Testing (3)

CPSC 464 - Software Architecture (3)

CPSC 466 - Software Process (3)

CPSC 474 - Parallel and Distributed Computing (3)

CPSC 479 - Introduction to High Performance Computing (3)

CPSC 483 - Introduction to Machine Learning (3)

CPSC 484 - Principles of Computer Graphics (3)

CPSC 485 - Computational Bioinformatics (3)

CPSC 486 - Game Programming (3)

CPSC 489 - Game Development Project (3)

CPSC 499 - Independent Study (1-3)

EGGN 495 - Professional Practice (1-3)

Graduate Student Advisement The graduate program adviser provides overall supervision of the graduate program. The individual student chooses an adviser for the thesis or project from the Computer Science Department's full-time faculty on the basis of the student's particular interests and objectives.

**Total (30 units)**