Computer scientists and engineers design and implement efficient software and hardware solutions to computer-solvable problems. They are involved in the development of areas such as high-speed networks, multimedia and creative technologies, systems design and virtual reality.

The Computer Science program prepares students to enter industry in the areas of software design, development, application and maintenance. It also provides intensive study in algorithmic design and analysis, and the theory of computing, which are needed for graduate studies.

Computer engineers integrate hardware and software processes to form solutions to problems arising from complex systems such as atomic reactors, guidance systems and manufacturing systems. They design and engineer computers and computer networks.

**Programs Available**

- **Computer Science**
  - Bachelor of Science
  - 128 units
- **Computer Engineering and Computer Science**
  - Bachelor of Science
  - 132 units
- **Physics/Computer Science**
  - Bachelor of Science
  - 128 units
- **Interactive Multimedia minor**
- **Multimedia and Creative Technology minor**

See pages 59-61 for the curricula of each of the B.S. programs listed above. Information on each degree emphasis can be found below.

See pages 78-79 for information on minor programs offered by the School of Engineering.

**Physics/Computer Science Degree**

This program is intended for students with dual interests in physics and computer science who wish to complete the essential courses for both majors within their normal four year career. See the Physics and Astronomy Department section of the USC Catalogue for course requirements.

**Minor in Interactive Multimedia**

See page 78 for information on the Minor in Interactive Multimedia. Note that this minor is not open to students in the School of Engineering (these students should pursue the Multimedia and Creative Technologies Minor instead).

**Minor in Multimedia and Creative Technologies**

See page 79 for information on the Minor in Multimedia and Creative Technologies.

**Courses of Instruction**

The terms indicated are expected but are not guaranteed. For the courses offered during any given term, consult the Schedule of Classes.

**Computer Science (CSCI)**

101L Fundamentals of Computer Programming (3, FaSp) Introduction to the design of solutions to computer solvable problems. Algorithm design, solution implementation using a high-level programming language, program correctness and verification.

102L Data Structures (4, FaSp) Linear lists, strings, arrays, and orthogonal lists; graphs, trees, binary trees, multilinked structures, sorting techniques; dynamic storage allocation; applications. **Prerequisite:** CSCI 101L.

105 Introduction to Computer Science (3, Sp) Gateway to the bachelor of science in computer science and computer engineering and computer science. An introduction to the discipline of computer science. The study of the history, ethics, legal issues, and sub-disciplines of computer science using the Java language.

110 Introduction to Digital Logic (3) (Enroll in EE 101)

201L Principles of Software Development (4, FaSp) The object-oriented paradigm for programming-in-the-large (using the C++ language); UNIX tools for software development; developing window-based applications under X-windons. **Prerequisite:** CSCI 102.

271 Discrete Methods in Computer Science (4, FaSp) Models for discrete structures in computer science, including selected applications of logic, induction, recursion and graphs to program correctness, design algorithms, programming language semantics and databases. **Corequisite:** CSCI 102.

301 Theory of Computation (3, FaSp) Finite state automata, regular sets; context-free grammar, pushdown automata; Turing machines, undecidability, the halting problem, Church’s thesis, recursive functions, effective procedures. **Prerequisite:** CSCI 102 and CSCI 271.

303 Design and Analysis of Algorithms (3, FaSp) Design techniques including backtracking, dynamic programming, divide and conquer, data structure, fast Fourier transform; finite combinatorial mathematics. **Prerequisite:** CSCI 102 and CSCI 271.

351 Programming and Multimedia on the World Wide Web (3, Sp) HTML programming for creating home pages, installation and modification of Web server, writing programs that offer enhanced services, manipulation of graphics, video and sound. **Prerequisite:** CSCI 201.
357 Basic Organization of Computer Systems (3) (Enroll in EE 357)

390 Special Problems (1-4) Supervised, individual studies. No more than one registration permitted. Enrollment by petition only.

402x Operating Systems (3, FaSp)
Basic issues in concurrency, deadlock control, synchronization scheduling, memory management, protection and access control, inter-process communication, and structured design. Laboratory experiences with Unix-like operating system. Not available for graduate credit to computer science majors. Prerequisite: CSCI 201L or CSCI 455x.

410x Translation of Programming Languages (4, Fa) Concepts of assemblers, compilers, interpreters and their design; macro assemblers, Polish notation and translation techniques; operator precedence parsing, push down automata, code generation. Not available for graduate credit to computer science majors. Prerequisite: CSCI 201 or CSCI 455x.

445 Introduction to Robotics (4, Fa) Designing, building and programming mobile robots; sensors, effectors, basic control theory, control architectures, some advanced topics, illustrations of state-of-the-art. Teamwork; final project tested in a robot contest. Junior standing or higher. Prerequisite: CSCI 101L or C language programming.

450 Introduction to Computer Networks (3) (Enroll in EE 450)

454L Introduction to Systems Design Using Microprocessors (4) (Enroll in EE 454L)

455x Introduction to Programming Systems Design (4, FaSp) Intensive introduction to programming principles, discrete mathematics for computing, software design and software engineering concepts. Not available for credit to computer science majors, graduate or undergraduate. Prerequisite: departmental approval.

457x Computer Systems Organization (3) (Enroll in EE 457Lx)

458 Numerical Methods (4) (Enroll in MATH 458)

460 Introduction to Artificial Intelligence (3, FaSp) Concepts and algorithms underlying the understanding and construction of intelligent systems. Agents, problem solving, search, representation, reasoning, planning, communication, perception, robotics, neural networks. Junior standing. Prerequisite: CSCI 102L or CSCI 455x.

465 Probabilistic Methods in Computer Systems Modeling (3) (Enroll in EE 465)

477L Design and Construction of Large Software Systems (4, Sp) Programming methodologies; intra-group and inter-group communication; software life-cycle; software economics. A large software project is a central aspect of the course. Laboratory. Prerequisite: CSCI 102.

480 Computer Graphics (3, FaSp) Hardware for interactive graphic systems; picture representations; data structures for graphics; picture processing techniques; languages for graphics; survey of applications such as animation and simulation. Prerequisite: CSCI 102.

482 Introduction to Geometric Modeling (3, Sp) Role of geometry in CAD/CAM. Graphic user interfaces; motions and projections; cubes, surfaces and solids; fundamental algorithms. Applications in analysis, manufacturing, inspection and robots. Junior or senior standing. Prerequisite: CSCI 101 or departmental approval.

485 File and Database Management (3, FaSp) File input/output techniques, basic methods for file organization, file managers, principles of databases, conceptual data models, and query languages. Prerequisite: CSCI 201.

490x Directed Research (2-8, max 8) Individual research and readings. Not available for graduate credit. Prerequisite: departmental approval.

495 Senior Project (3) (Enroll in PHYS 495)

499 Special Topics (2-4, max 8) Selected topics in computer science.

Graduate Courses

501 Numerical Analysis and Computation (3)

502ab Numerical Analysis (3-3)

504ab Numerical Solutions of Ordinary and Partial Differential Equations (3)

505ab Applied Probability (3-3)

510 Software Management and Economics (3, Fa)

511 Personal Software Process (PSP) and Project (3, Sp)
520 Computer Animation and Simulation (3, Sp) 567 Machine Learning (3) 595 Advanced Compiler Design (4) 597 Seminar in Computer Science Research (1, max 2, FaSp)
533 Combinatorial Analysis and Algebra (3) 569 Integrated Intelligent Systems (3) 598 Knowledge Based Systems (3)
541 Artificial Intelligence Planning (3, Irregular) 570 Analysis of Algorithms (3, FaSp) 599 Special Topics (2-4, max 9)
542 Neural Computation with Artificial Neural Networks (3, Sp) 571 Issues of Programming Language Design (3, Fa) 620 Design and Analysis of Parallel Computation (3)
544 Natural Language Processing (3) 572 Advanced Theory of Computation (3)
545 Robotics (3, Sp) 573 Advanced Artificial Intelligence (3, Fa) 658 Diagnosis and Design of Reliable Digital Systems (3)
546 Intelligent Embedded Systems (3, Sp) 574 Computer Vision (3, Fa) 664 Neural Models for Visually Guided Behavior (3, max 9)
547 Sensing and Planning in Robotics (3, Fa) 575 Neuroinformatics (3, Sp) 674ab Advanced Topics in Computer Vision (3-3)
551 Computer Communications (3, Sp) 576 Multimedia Systems Design (3, FaSp) 694ab Topics in Computer Networks and Distributed Systems (3-3)
552 Logic Design and Switching Theory (3) 577ab Software Engineering (4-4, FaSp) 790 Research (1-12)
553 Computational Solution of Optimization Problems (3) 578 Software Architectures (3, Sp) 794abcdz Doctoral Dissertation (2-2-2-2-0)
554 Real Time Computer Systems (3) 579 Graph and Combinatorial Algorithms (3)
555 Advanced Operating Systems (3, FaSp) 580 3D Graphics and Rendering (3, Fa)
556 Introduction to Cryptography (3) 581 Logic and its Applications (3)
557 Computer Systems Architecture (3) 582 Geometric Modeling (3, Sp)
558L Internetworking and Distributed Systems Laboratory (3) 583 Computational Geometry (3)
559 Mathematical Pattern Recognition (3-3) 584 Control and Learning in Multi-Robot/Agent Systems (3, Sp)
560L Advanced Microcomputer-Based Design (3) 585 Database Systems (3, FaSp)
561 Foundations of Artificial Intelligence (3, Sp) 586 Database Systems Interoperability (3, Sp)
562 Empirical Methods in Natural Language Processing (3, 2 years, Fa) 587ab Mathematical Models of Neurons and Neural Networks (3-3)
563 Applications of Natural Language Processing (3, 2 years, Fa) 588 Specification and Design of User Interface Software (3, Fa)
564 Brain Theory and Artificial Intelligence (3, Fa) 590 Directed Research (1-12)
565 Compiler Design (4, Sp) 591ab Applied Software Engineering (3-3, 5p)
566 Neural Network Self-Organization (3, Sp) 592 Emerging Best Practices in Software Engineering (3, SpSm)
583 Autonomous Learning and Discovery Agents (3)
# Computer Science (128 units)

<table>
<thead>
<tr>
<th>Freshman (15 units)</th>
<th>Sophomore (17 units)</th>
<th>Junior (17 units)</th>
<th>Senior (14 units)</th>
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<tr>
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<td><strong>GE Cat. I</strong> (4)</td>
<td><strong>FOREIGN LANG.</strong> (4)</td>
<td><strong>FOREIGN LANG.</strong> (4)</td>
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<tr>
<td>WRIT 140 (4)</td>
<td>CSCI 102L (4)</td>
<td>FREE ELEC. (4)</td>
<td>FREE ELEC. (4)</td>
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<tr>
<td>MATH 125 (4)</td>
<td>MATH 126 (4)</td>
<td>SCIENCE COURSE (4)</td>
<td>SCIENCE COURSE (4)</td>
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<td>CSCI 101L (3)</td>
<td>CSCI 105 (3)</td>
<td>MATH 225 (4)</td>
<td>CSCI TECH. ELEC. (3)</td>
</tr>
</tbody>
</table>

**Science Courses (12 units)**
- Basic Science (see ** below)
- Basic Science (see ** below)
- Science Course (see *** below)

**Mathematics (16 units)**
- MATH 125 Calculus I
- MATH 126 Calculus II
- MATH 225 Linear Algebra & Diff. Equations

**General Education (39 units)**
- WRIT 140** Writing and Critical Reasoning
- WRIT 340 Advanced Writing
- Foreign Language
- Foreign Language
- GE Cat. I
- GE Cat. II
- GE Cat. IV******
- GE Cat. V
- GE Cat. VI

**Engineering (54 units)**
- CSCI 101L Fund. of Computer Programming
- CSCI 102L Data Structures
- CSCI 105 Intro. to Computer Science
- CSCI 201L Princ. of Software Development
- CSCI 301 Theory of Computation
- CSCI 303 Analysis and Design of Algo.
- CSCI 402 Operating Systems
- CSCI 410 Trans. of Programming Lang.
- EE 101 Introduction to Digital Logic
- EE 102L Introduction to Digital Circuits
- EE 357 Basic Org. of Computer Systems
- EE 457Lx Computer Systems Organization

**Other Courses (7 units)**
- Free Elective
- Free Elective

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**KEY:**
- **pre-requisite**
- **co-requisite**
- **concurrent enrollment**

* Math 12h or any 400-level mathematics course except MATH 450.

** Basic science requirement: PHYS 151L and 152L or CHEM 105abL or BISC 120L and 220L.

*** Any course in physics, biology or chemistry beyond the basic science requirement or in another scientific discipline. See department for approval.

**** Concurrent enrollment in a Social Issues GE is required.

****** Four upper-division computer science course not already required.
### Mathematics (24 units)
- MATH 125: Calculus I
- MATH 126: Calculus II
- MATH 225: Linear Algebra & Diff. Equations
- MATH 226: Calculus III
- MATH 407: Probability Theory
- Math Elective (see * below)

### Physics (8 units)
- PHYS 151L: Mechanics and Thermodynamics
- PHYS 152L: Electricity and Magnetism

### Science Course (4 units)
- Science Elective (see ** below)

### General Education (27 units)
- WRIT 140**: Writing and Critical Reasoning
- WRIT 340: Advanced Writing
- GE Cat. I, II, V, VI
- GE Cat. IV****

### Engineering (69-70 units)
- CSCI 101L: Fund. of Computer Programming
- CSCI 102L: Data Structures
- CSCI 105: Intro. to Computer Science
- SE 105: Intro. to Electrical Engr.
- CSCI 201L: Princ. of Software Development
- CSCI 301: Theory of Computation
- CSCI 303: Analysis and Design of Algo.
- CSCI 402x: Operating Systems
- EE 101: Introduction to Digital Logic
- EE 102L: Intro. to Digital Circuits
- EE 326Lx: Essentials of Electrical Engr.
- EE 327x: Digital Electronics
- EE 335: Basic Org. of Computer Systems
- EE 454L: Intro. to Sys. Using Microprocessors
- EE 457Lx: Computer Systems Organization
- ISE 460: Engineering Economy
- EE 459L: Senior Design Project
- CSCI 477: Design of Large Software Sys.
- Technical Elective (see ***** below)
- Technical Elective (see ***** below)
- Technical Elective (see ***** below)

### Freshman Year (15 units)
- **Mathematics (24 units)**
  - MATH 125 (4)
  - MATH 126 (4)
  - MATH 225 (4)
  - MATH 226 (4)
  - CSCI 101L (3)

### Sophomore Year (18 units)
- **Mathematics (24 units)**
  - CSCI 102L (4)
  - CSCI 201L (4)
  - PHYS 151L (4)
  - PHYS 152L (4)
  - EE 102L (2)

### Junior Year (18 units)
- **Mathematics (24 units)**
  - CSCI 271 (4)
  - EE 457Lx (3)
  - ISE 460 (3)

### Senior Year (17 units)
- **Mathematics (24 units)**
  - CSCI 303 (3)
  - EE 454L (4)

### Technical Elective (see ***** below)

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* Any 400-level mathematics course except MATH 406 or 480.
** Science elective is selected from PHYS 131L, CHEM 105aL, 115aL, or other courses approved by your advisor.
*** Concurrent enrollment in a Social Issues GE Course is required.
**** May take a Category L, L1, IV or VI GE Class.
***** See department for a list of approved technical electives and areas of specialization.