

MINORS

- **Communication:** 20 semester hours, including COMA 101(190) or 120; four credits of two-credit Elective Skills classes; plus 12 semester hours from 300- or 400-level communication courses selected in consultation with advisor.
- **Theatre:** 20 semester hours, including THEA 160, 250, 255 and 270, plus four semester hours in upper-division electives selected in consultation with advisor.
- **Dance Performance:** 20 semester hours, including DANC 170, 222, 240, 462; THEA 230, 235, 355; Electives (four semester hours) from: PHED 223, 225, 362 or THEA 225, 491 or MUSI 120. Some DANC courses are cross-listed with the Department of Movement Studies and Wellness Education.
- **Publishing and Printing Arts:** Cross-listed with the Department of English. See the description of the minor under Publishing and Printing Arts.
- **Specialized Business Minor in Marketing for Communication and Theatre Majors:** 19 semester hours, including BUSA 201, 305, 308, 364; and six hours from BUSA 363, 365, or 387.

BACHELOR OF ARTS IN EDUCATION

See Department of Instructional Development and Leadership, see page 65.

To view **Communication (COMA)** courses, see the PLU Directory of Approved Courses beginning on page 164.

To view **Keystones, Internships and Capstones** courses, go to School of Arts & Communication (SOAC), in the PLU Directory of Approved Courses, page 213.

To view **Sign Language** courses, go to the PLU Directory of Approved Courses, page 213.

To view **Theatre** courses, go to the PLU Directory of Approved Courses, page 219.

Computer Science and Computer Engineering

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Computer Science

Computer science deals with the theory, design, and application of computing systems and the study of the storing and manipulation of information. The program at Pacific Lutheran University provides a broad base core of fundamental material that stresses analysis and design experiences with substantial laboratory work, including software development. In addition, students are exposed to a variety of programming languages and systems. Students can choose from a number of upper-division courses, which insure a depth of knowledge and

an understanding of current developments in the field. The Bachelor of Science degree program in computer science has been accredited by the Computing Accreditation Commission of ABET.

Computer Engineering

Computer engineering is an engineering specialty that has grown out of rapidly evolving micro- and mini-computer technology. The curriculum consists of essential and advanced elements from computer science and electrical engineering, developing both hardware and software expertise. Electives permit concentration in areas such as integrated circuit design, robotics, microprocessor applications, computer design, computer security, application software development, and artificial intelligence.

In keeping with the university's mission to prepare students for a life of service, there are four major goals of the Computer Science and Computer Engineering programs.

Goal I: To provide a solid education in computer science and computer engineering in a liberal arts setting that prepares the student for graduate study or entrance into a profession in computing technology.

Goal II: To foster an aptitude and desire for life-long learning.

Goal III: To provide courses and personnel that view computer science and computer engineering as part of the human endeavor, that is, to see computer science and computer engineering in relation to more general intellectual development and to the needs of society.

Goal IV: To help students develop the ability and mental precision necessary to analyze, think critically, consider alternatives, and finally to be creative in their field of study.

In other words, we want to turn out students who will not only contribute to the field but also succeed in life. These goals are reflected in our program objectives, which are designed to produce graduates who, as practicing engineers and computer scientists, are able to:

- contribute to their field of study,
- apply sound design methodology and tools to solve problems,
- respect their role in society, and
- expand their knowledge after graduation.

We call these our CARE objectives. For a complete description of the CSCE Goals, Objectives, and Outcomes visit the department web site www.cs.plu.edu.

Faculty: Wolff, Chair; Blaha, Easwaran, Hauser, Kakar, Murphy, Spillman.

BEGINNING CLASSES IN COMPUTER SCIENCE AND COMPUTER ENGINEERING (CSCE)

There are several beginning-level classes in computer science designed for students with various needs:

- **CSCE 115: Solve it with the Computer**
Especially for students with little or no background in computer science who wish an introduction to the use of the computer for problem solving. This course also satisfies the Mathematical Reasoning requirement.
- **CSCE 120: Computerized Information Systems**
Especially appropriate for business majors and other students wishing an introduction to the computer and applications of software packages.
- **CSCE 144: Introduction to Computer Science**
For students majoring in computer science, computer engineering, mathematics, and most science majors, as well as others wishing a strong experience in computer programming.
- **CSCE 270: Data Structures**
This is the second course in the major. With departmental approval, students with a strong programming background may receive advanced placement into this course.

Facilities

The Computer Science and Computer Engineering Department is located in the Morken Center for Learning and Technology, a \$21 million facility that opened in February 2006. The state-of-the-art facility has more than seven miles of conduit running through the concrete floors to power advanced computing technologies. The building provides computer science students with exciting new facilities for learning and close collaboration with professors. The Morken building includes a computer lab for software development, an electronics lab for computer engineering and robotics, a Linux lab, the Wiegand Multimedia Lab, smart classrooms with recessed computers for each student, private student work areas, and dedicated student workrooms for capstone projects. There is wireless network access throughout the building and CSCE students have accounts on the department's Solaris server.

COMPUTER SCIENCE AND COMPUTER ENGINEERING MAJORS

Students majoring in computer science may choose to earn either a Bachelor of Arts degree in Computer Science or a Bachelor of Science degree in either Computer Science or Computer Engineering.

The Bachelor of Arts program is the minimum preparation suitable for further professional study and is often combined with extensive study or a second major in an allied field.

The Bachelor of Science degrees are strong, scientific degrees that contain additional courses in computer science, mathematics, and science and serve both students going directly into employment on graduation and those going into graduate programs.

Students should take CSCE 144, 270 and MATH 151, 152 early in their program.

Restrictions for all three majors

- A minimum grade of C is required in all courses (including supporting courses) counted for a major.
- Only one CSCE topics course (either 400, 410, x87, x88, or x89) can be used as an elective for a major.
- For the B.A. degree, at least 12 upper-division hours must be completed at PLU.
- For the B.S. degrees, at least 16 upper-division hours must be completed at PLU.

BACHELOR OF ARTS MAJOR IN COMPUTER SCIENCE 28 semester hours in CSCE, plus 12 semester hours in mathematics

- CSCE 144, 270; 346 or 380; and 499.
- The remaining hours are from computer science and engineering courses numbered above CSCE 319 (except CSCE 345 and 449)
- Up to four hours may be substituted from Math 341 or 356
- **Required supporting:** Math 151, 152, and 245.

BACHELOR OF SCIENCE MAJOR IN COMPUTER SCIENCE

44 semester hours in CSCE, plus 30 semester hours of supporting courses in mathematics and science.

- 44 semester hours of computer science must include CSCE 144, 270, 320, 343, 346, 371, 380, 499
- 12 additional credits of approved elective courses, one of which must be from CSCE 367, 386, or 444.
- Elective courses submitted for approval are to be selected from the computer science courses numbered above CSCE 319 (except 345 and 449), or hours from MATH 356 not counted toward the 30 hours of required supporting courses
- The 30 hours of supporting courses in mathematics and science must include:
 - MATH 151, 152, 245, 341.
 - A minimum of 12 semester hours of approved science courses, which includes a year's sequence of a laboratory science. PHYS 153, 154 with 163, 164 are preferred. CHEM 115, 116 and either 320 or 331, BIOL 161, 162, GEOS 101, 102, or 103; and 201 are acceptable.
 - Approved sciences courses are: any BIOL, except 111; any CHEM, except 104, 105, 210; any Geosciences; any Physics; CSCE 345.
 - The remaining hours, if any, may be chosen from any Mathematics course numbered above 329 (except 446) or any approved science course.

BACHELOR OF SCIENCE MAJOR IN COMPUTER ENGINEERING

44 semester hours in CSCE, plus 42 semester hours of supporting courses in mathematics and science.

- CSCE 131, 144, 245, 270, 345, 346, 380, 480, 499
- MATH 151, 152, 245, 253, 341; 331 or 356
- PHYS 153, 154, 163, 164
- CHEM 115

- **At least four semester hours chosen from:**
PHYS 240, 333, 334, 336, or CHEM 341
- Ten additional semester hours from any upper-division Computer Science and Computer Engineering courses numbered above CSCE 319 (except CSCE 449).

MINORS

Restrictions on all three minors: Computer Science, Information Science and Electrical Engineering:

At least eight upper-division semester hours must be completed at PLU.

- **Minor in Computer Science**
20 semester hours, including
 - CSCE 144, 270
 - Eight additional hours of upper-division computer science courses numbered above CSCE 319 (except CSCE 345 and 499).
 - **Required supporting:** MATH 151, 128 or equivalent
- **Minor in Information Science**
21 semester hours including
 - CSCE 144 and 367
 - Business 202
 - At least four additional hours from CSCE courses numbered above 250 (except CSCE 345 and 449)
 - At least six additional hours selected from BUSA 320, 375, 376, 378, or 478.
- **Minor in Electrical Engineering**
44 semester hours including
 - CSCE 131, 144, 245, 345, and 346
 - Required supporting:
CHEM 115; MATH 151, 152, and MATH 245 or 253
PHYS 153, 154, 163, 164

To view Computer Science and Computer Engineering (CSCE) courses, go to the PLU Directory of Approved Courses beginning on page 167.

Dance

For curriculum information, see Department of Communication and Theatre, page 46.

To view Dance (DANC) courses, go to the PLU Directory of Approved Courses beginning on page 170.

Economics

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“By virtue of exchange, one person’s property is beneficial to all others.” — Frederic Bastiat

Economics is the study of how people establish social arrangements for producing and distributing goods and services to sustain and enhance human life. Its main objective is to

determine an efficient use of limited economic resources so that people receive the maximum benefit at the lowest cost.

The economics discipline embraces a body of techniques and conceptual tools that are useful for understanding and analyzing our complex economic system.

Faculty: St. Clair, Chair; Hunnicutt, Peterson, Reiman, Travis, Wang, Wurm.

BACHELOR OF ARTS MAJOR

Minimum of 40 semester hours

- **Required Courses for all Economic Majors:**

ECON 101 or 111, 102, 301, 302, 499

Four semester hours selected from:

STAT 231 or MATH 341

- **Additional Required Courses for General Major:**
Twelve semester hours of electives in Economics

One course selected from:

ECON 344, BUSA 202 or 302, MATH 348 or up to four semester hours in Computer Science

A grade point average of 2.50 in all classes included in the 40 semester hours toward the major.

With departmental approval, ECON 111 may be substituted for ECON 101 for purposes of major and minor requirements.

ECON 499 meets the senior seminar/project requirement. For students planning graduate work in economics or business, additional math preparation will be necessary. For specific courses, consult your major advisor.

CONCENTRATIONS

The Economics Department offers the following concentrations:

- **Domestic Economic Analysis**
Minimum 51 semester hours

As well as the required courses for the major listed above, the following courses are required for this concentration:

ECON 495, POLS 345 and 346

Twelve semester hours chosen from:

ECON 321, 322, 323, 325, 327

One course selected from:

ECON 344, BUSA 202 or 302, MATH 348, or CSCE 120

- **International Economic Analysis**
Minimum 51 semester hours

As well as the required courses for the major listed above, the following courses are required for this concentration:

ECON 495, POLS 331 and POLS 347

Twelve semester hours chosen from:

ECON 311, 313, 315, 331, 333, 335, 338

Plus one course selected from

ECON 344, BUSA 202 or 302, MATH 348, or CSCE 120

COMA 491, 492, 493: Independent Studies

Investigations or research in area of special interest not covered by regular courses; open to qualified junior or senior students. A student should not begin registration for independent study until the specific area for investigation has been approved by a departmental sponsor. (1-4)

COMA 543: Conflict and Negotiation

This course examines the sources and development of conflict and develops negotiation as a tool for managing conflict situations. Emphasis is on understanding conflict interactions and reaching agreement through negotiation. (3)

To view **Keystones, Internships and Capstones** courses, go to *School of Arts & Communication (SOAC)*, in the *PLU Directory of Approved Courses*, page 213.

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Computer Science and Computer Engineering (CSCE)

A grade of C or higher is strongly recommended in all CSCE prerequisite courses

Term	Courses
Fall	120, 131, 144, 245, 270, 343, 346, 371, 386, 499A
J-Term	120, 400
Spring	120, 131, 144, 270, 320, 345, 367, 380, 480, 499B
Alternate Years	115, 340, 372, 391, 400, 410, 412, 436, 438, 444, 446, 449

CSCE 115: Solve It With the Computer – MR, NS

Teaches how computer use can be combined with mathematical reasoning to solve problems. Spreadsheet package and other computer tools to solve problems from elementary statistics, financial transactions, and other areas where mathematics and data are used in every day life. **Prerequisite:** Fulfillment of the PLU entrance requirement in mathematics. (4)

CSCE 120: Computerized Information Systems – NS

Introduction to computers including net-centric computing, computer ethics, operating systems, spreadsheets, graphics, and related topics. Includes a computer laboratory component. **Prerequisite:** MATH 128 or MATH 140 or equivalent. (4)

CSCE 131: Introduction to Engineering – NS

An introduction to the engineering profession and development of basic skills important to the profession, including problem solving, engineering design, graphics, use of computers, computer programming, engineering economics, and ethics in engineering. **Prerequisite:** Completion of college-preparatory mathematics. (2)

CSCE 144: Introduction to Computer Science – NS

An introduction to computer science including problem solving, algorithm design, object-oriented programming, numerical and non-numerical applications, and use of data files. Ethical and social impacts of computing. **Prerequisite:** Four years of high school mathematics or MATH 140 or equivalent. (4)

CSCE 190 FI: Privacy and Technology - F, NS

This course will explore the impact of technology on privacy. The goal is to provide students with insight into the importance of privacy in their daily lives and how to protect that privacy as it comes under attack from new technology. It will explore these issues from several different perspectives including a look at the history of privacy, the development of laws related to privacy, methods used to protect privacy, and developments in technology that threaten privacy. In the process students will study concepts from mathematics, computer science, history, political science, English, and military science. (4)

CSCE 199: Directed Reading

Supervised study of topics selected to meet the individual's needs or interests, primarily for students awarded advanced placement in computer science. Admission only by department invitation. (1-2)

CSCE 245: Electrical Circuits

Introduction to the fundamental concepts of DC and AC circuits analysis including Kirchoff's Laws, circuit theorems, first and second order circuits, and frequency response. Laboratory work is an integral part of the course. **Prerequisite:** MATH 151; PHYS 154 or consent of the instructor. (4)

CSCE 270: Data Structures

Study of object-oriented programming techniques and fundamental data structure abstractions and implementations including list, stack, queue, and trees with applications to sorting, searching, and data storage. **Prerequisite:** CSCE 144. (4)

CSCE 320: Software Engineering

An engineering approach to the development of large software packages. Topics include software requirements definition, object-oriented design and programming, specifications, and software testing. Consideration of societal and ethical issues surrounding software engineering. Major small group project. **Prerequisites:** CSCE 270, MATH 245. (4)

CSCE 330: Introduction to Artificial Intelligence

An introduction to concepts of artificial intelligence (AI), including expert systems, natural language processing, image understanding, and problem solving techniques. Consideration of the ethical and social dilemmas posed by AI. The programming languages LISP and PROLOG will be taught and used in several projects. **Prerequisite:** CSCE 270. (4)

CSCE 340: Formal Languages

Study of formal models of computation (finite automata, pushdown automata, and Turing machines). Study of formal language concepts such as regular expressions and grammars. There will be a significant programming component where students implement and test algorithms. **Prerequisite:** CSCE 270. (4)

CSCE 343: Programming Language Concepts

A study and comparison of features found in different computer languages. Imperative object-oriented, functional, and declarative languages will be studied. Programs written in several of the languages. Includes a computer laboratory component. **Prerequisite:** CSCE 270. (4)

CSCE 345: Analog Electronics

An introduction to analog integrated circuit design techniques, including single and multistage amplifiers, frequency response and feedback methods. Laboratory work is part of the course. **Prerequisite:** CSCE 245 (4)

CSCE 346: Digital Electronics

Analysis of digital design techniques, including coverage of combinational logic, flip flops, registers, counters, and timing circuits. The hardware description language VHDL will be taught and used in several projects. Includes a computer laboratory component. **Prerequisite:** CSCE 144. (4)

CSCE 348: Modeling and Simulation

An introduction to the fundamental concepts of mathematical modeling and computer simulation. The course will cover

building and validating abstract models and simulating them using simulation languages. **Prerequisite:** CSCE 144. Recommended: CSCE 270 and MATH 341. (4)

CSCE 367: Database Management

An introduction to the fundamental concepts necessary for design, use, and implementation of database systems. The entity-relationship and relational models are studied in detail. Individual, organization, and societal concerns related to accuracy and privacy of data. Major small group project. **Prerequisite:** CSCE 144 Recommended: CSCE 270. (4)

CSCE 371: Design and Analysis of Algorithms

Elementary data structures reviewed for efficiency under different conditions. Analysis of problems associated with searching and sorting. This course will also include analysis of advanced data structures including Hash Tables, and Height-balanced trees. It will include the study of algorithms for graph theory, heuristic search, and other topics selected by the instructor. There will be a significant programming component where students will implement and test algorithms. **Prerequisite:** CSCE 270, MATH 245. (4)

CSCE 380: Assembly Language and Computer Organization

Fundamentals of assembly language and computer organization. Topics include data and instruction formats, addressing, linking, macro definition, interrupt processing, computer architecture, and interface between assembly language and high-level programming languages. **Prerequisite:** CSCE 270. Strongly recommended: CSCE 346. (4)

CSCE 385: Computer Architecture

An introduction to the structure and operation of large computer systems. Topics include data representation, memory structure, I/O processing, multiprocessing systems such as parallel, pipeline, and stack machines. Examples of the architecture of several large systems are analyzed. **Prerequisite:** CSCE 380, MATH 245. (2)

CSCE 386: Computer Networks

An introduction to computer networks and computer communication protocols from the physical layer through the transport layer. Topics include connection oriented and connectionless networks, error detection and correction, LANs, sockets, and routing. Application layer topics can include HTTP, DNS, and email. **Prerequisite:** CSCE 270. Recommended: CSCE 346, MATH 341. (4)

CSCE 391: Problem Solving and Programming Seminar

Designed to improve advanced problem solving and programming skills, including advanced data structures. A goal of the course is participation in the regional ACM programming competition. Pass/Fail only. Students may take this course more than once. **Prerequisite:** CSCE 270 or consent of instructor. (1)

CSCE 400: Topics in Computer Science

Selected topic from the list below or topic of current interest in the discipline. Frequent topics are: Computer Security, Parallel

Computing, Graphical User Interface Programming, Parallel Processing Topologies, Genetic Algorithms, and Neural Networks. (1–4)

CSCE 410: Topics in Computer Engineering

Selected topic from the list below or topic of current interest in the discipline. Frequent topics are: Computer Security, Parallel Computing, Graphical User Interface Programming, Parallel Processing Topologies, Genetic Algorithms, and Neural Networks. (1–4)

CSCE 412: Computer Graphics

A study of the techniques and theory used to generate computer graphics. Both two- and three-dimensional representations will be covered. Course work includes several programming assignments plus a project. **Prerequisites:** CSCE 270, MATH 331. (4)

CSCE 436: Pattern Recognition

The use of the computer to recognize patterns in data. Topics include data mining, cluster analysis algorithms, learning algorithms, and pattern processing. Issues associated with making decisions from data analyzed by machines and the societal and privacy implications and ethical concerns involved in those kinds of decisions. Includes a major small group project. **Prerequisites:** CSCE 270, MATH 245. (4)

CSCE 438: Expert Systems

The development of AI systems that operate at the level of a human expert. Students will explore the structure of expert systems and use an expert system development tool. **Prerequisite:** CSCE 330 or consent of instructor. (4)

CSCE 444: Operating Systems

An introduction to computer operating systems including process scheduling, memory management, and file systems. Major small group project. **Prerequisite:** CSCE 380, MATH 245. Recommended CSCE 343. (4)

CSCE 446: VLSI Design

An introduction to the design of very large-scale integrated systems using computer-aided design methods. **Prerequisite:** CSCE 346. (2)

CSCE 449: Computer Science in the Secondary School

Methods and materials in secondary school computer science teaching. LOGO, PILOT, etc., may be considered. Does not count toward a major in computer science. **Prerequisite:** CSCE 144. (2)

CSCE 455: Compilers

An introduction to the organization, specification, and analysis of programming languages, including scanning, parsing, object code, run-time machine structures and optimization. **Prerequisites:** CSCE 380, MATH 245. (2)

CSCE 480: Microprocessors

Study of microprocessors and their use in microcomputer systems. Includes a computer laboratory component. **Prerequisites:** CSCE 346, 380. (4)

CSCE 495: Computer Science Research

Involvement in an ongoing research project in computer science under the supervision of a faculty member. **Prerequisite:** Consent of instructor. (1–4)

CSCE 499A and 499B: Capstone: Seminar – SR

Written and oral presentation of a project in a topic of interest by the student under the supervision of a faculty member. Students normally work in small groups (two to three students). Includes discussion of the skills needed for good research and technical communication of that research and a study of the social implications of computing. Completion of this course satisfies the core requirement for a senior capstone seminar/project. The capstone is a two semester sequence beginning in the fall semester; May graduates should start the course in the fall of their senior year and December graduates should begin the course in the fall of their junior year. There are two-semester hours given each term for a total of four-semester hours. Requirements and prerequisites depend on the major and degree. B.S. in Computer Science: Students design and implement a significant software program. **Prerequisite:** CSCE 320. B.S. in Computer Engineering: Students design and implement a significant hardware component. **Prerequisite:** CSCE 270, 345, 346. B.A. in Computer Science: Same as the B.S. in Computer Science or write a research paper. **Prerequisite:** CSCE 270. (2, 2)

