

Only grades of C or better count toward departmental requirements. At least 12 of the required 24 credits must be taken at Portland State University.

Approved CS Minor courses include any lower-division or upper-division Computer Science course. Some upper-division courses are reserved for Computer Science majors and may require permission from the instructor in order to register.

Subtotal: 24

## COMPUTER SCIENCE - HONORS TRACK

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The honors degree in computer science requires the writing of an honors thesis. Details about the program can be found on the computer science website at [www.pdx.edu/computer-science/honors-track](http://www.pdx.edu/computer-science/honors-track).

## BIOMEDICAL INFORMATICS PROGRAM

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Portland State University and Oregon Health & Science University offer an accelerated, collaborative degree program in biomedical informatics. Designed for high achieving freshmen, this program combines courses from both schools to award a B.S. in computer science and Master of Biomedical Informatics at the end of five years. Details about the program can be found on the computer science website at [www.pdx.edu/computer-science/biomedical-informatics](http://www.pdx.edu/computer-science/biomedical-informatics).

## Graduate Programs

## ADMISSIONS REQUIREMENTS

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To be considered for admission to the graduate program in computer science, the student must have a four-year baccalaureate degree from an accredited institution. Prospective graduate students are not required to have a bachelor's degree in Computer Science, but they must make up the background needed for graduate study before applying for admission. The Grad Prep program described at <https://www.pdx.edu/computer-science/grad-prep> may be helpful in developing knowledge of the core curriculum of an undergraduate computer science degree.

A cumulative undergraduate GPA of at least 3.00 is required. See the CS graduate admissions webpage for the admission and application requirements: <https://www.pdx.edu/computer-science/graduate-admission>.

Students may apply to the Ph.D. program with or without having already obtained an M.S. in computer science.

## COMPUTER SCIENCE M.S.

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The Master's program in computer science is designed to prepare students for advanced careers in the computer

industry, to create a research environment in computer science, and to prepare students for graduate work at the Ph.D. level.

See University Master's degree requirements. The Master's program in computer science consists of two options. The first option involves the completion of an approved program of 45 credits. The second option requires the completion of an approved program of 45 credits, which includes 6 to 9 credits of thesis. In both options, the coursework includes core courses in theory and programming practice, plus a 9-credit concentration in one of the tracks described below. For the thesis option, successful completion of a final oral examination covering the thesis is required. For more information, visit: <https://www.pdx.edu/computer-science/master>.

## CORE COURSE REQUIREMENT

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### One theory course from:

CS 581	Theory of Computation	3
CS 584	Algorithm Design and Analysis	3
CS 578	Programming Language Semantics	3

Subtotal: 3

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### One programming practice course from:

CS 558	Programming Languages	3
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Or any 500-level course designated by the department as a "Programming Intensive" course, as indicated by the "P" suffix in the corresponding 400-level course number.

Subtotal: 3

## ELECTIVES

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Students must take enough electives to complete 45 total credits for the Master's degree. Electives can be any 500-level CS course and may include up to 6 credits of CS 505 (Reading and Conference) and CS 506 (Special Projects). CS 501 Research, CS 502 Independent Study, CS 504 Internship, and CS 509 Practicum credits cannot be applied. A limited number of credits taken outside Computer Science can count towards the elective requirements, with advisor approval. A minimum of 30 credits must be taken in Computer Science at Portland State University. Given this, students may use a combined total of 15 pre-admission, transfer, and non-CS credits toward their Master's degree with advisor approval. One additional credit beyond the 15 credit limit can be used provided none of the courses are a 1-credit course.

- Pre-admission credits (taken before the term of formal admission) can include both transfer and PSU credits. Pre-admission credits taken at PSU are requested via a DARS exception submitted to the Graduate School. This request should be made soon after admission to the graduate program.

- Transfer credits refer to credits taken from another institution other than PSU. To request approval of transfer credits, complete and submit the GO-21M form (Proposed Transfer Credit) to the CS Graduate Advisor. Students should submit the GO-21 form during the first term of enrollment in the program, so there is sufficient time to complete any additional coursework that may be necessary. Any transfer credits must be approved before graduation paperwork can be processed. OHSU joint campus credits are considered transfer credits and are transferred via a different process. For more information, visit: [www.pdx.edu/gradschool/joint-campus-registration](http://www.pdx.edu/gradschool/joint-campus-registration).
- Non-CS credits taken outside of Computer Science, such as ECE or Math, can count towards elective requirements once approved. Students should obtain advisor approval in advance to avoid the risk of taking a course that will not be approved. To request approval, submit a plan of study with the courses listed to the Graduate Advisor. Non-CS courses must be graduate level. All ETM courses are eligible to transfer but students are limited to using only one for the CS degree requirements.

Subtotal: 30

## TRACK REQUIREMENT

Take three courses from one of the following tracks:

### Databases

Covers concepts, languages, implementation and application of database management systems. Other topics that have been offered in the track include formal foundations of databases, databases for cloud and cluster environments, and data stream systems.

CS 586	Introduction to Database Management Systems	3
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And two courses from the following\*:

CS 530	Internet, Web, & Cloud Systems	3
CS 587	Database Management Systems Implementation	3
CS 588	Cloud and Cluster Data Management	3
CS 589	Blockchain Development & Security	3

\*Or any approved CS 510 course in Databases.

### Languages and Programming

Focuses on the design, implementation, and use of programming languages. It includes exposure to a variety of programming paradigms, experience using programming languages to express the essential abstractions of a problem domain, courses on programming language implementation, and the study of

formal methods for specifying and reasoning about programs and programming languages.

CS 558	Programming Languages	3
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Two courses from the following\*:

CS 515	Parallel Programming	3
CS 520	Object-Oriented Programming & Design	3
CS 553	Design Patterns	3
CS 557	Functional Programming	3
CS 578	Programming Language Semantics	3

\*Or any approved CS 510 course in Languages and Programming.

### Security

Focuses on protecting computing systems and user data from unauthorized access and use. Topics include cryptography, network and host-based access control, vulnerability analysis, penetration testing, and reverse engineering.

CS 591	Introduction to Computer Security	3
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Two courses from the following\*:

CS 530	Internet, Web, & Cloud Systems	3
CS 576	Computer Security Research Seminar	3
CS 585	Cryptography	3
CS 592	Malware Reverse Engineering	3
CS 593	Digital Forensics	3
CS 595	Web and Cloud Security	3
CS 596	Network Security	3

\*Or any approved CS 510 course in Security.

### Software Engineering

Studies the principles, processes, techniques, and tools for building software systems. Topics include software requirement, design, development, validation, and maintenance.

CS 554	Software Engineering	3
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Two courses from the following\*:

CS 530	Internet, Web, & Cloud Systems	3
CS 552	Building Software Systems with Components	3
CS 553	Design Patterns	3
CS 555	Software Specification and Verification	3
CS 556	Software Implementation and Testing	3

CS 561	Open Source Software Development Laboratory	3
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\*Or any approved CS 510 course in Software Engineering.

### Systems and Networking

Studies the design and implementation of operating systems, wired and wireless computer networks including high performance computer systems, data centers, cloud computing architectures, distributed systems, fault tolerance, concurrency, systems programming, and theoretical topics related to these areas.

CS 533	Concepts of Operating Systems	3
CS 594	Internetworking Protocols	3

One course from the following\*:

CS 515	Parallel Programming	3
CS 530	Internet, Web, & Cloud Systems	3
CS 531	Introduction to Performance Measurement, Modeling and Analysis	3
CS 535	Accelerated Computing	3
CS 538	Computer Architecture	3
CS 572	Operating System Internals	3
CS 590	Introduction to Multimedia Computing and Networking	3
CS 598	Introduction to Wireless Network Protocols	3
ECE 586	Computer Architecture	4

\*Or any approved CS 510 course in Systems and Networking.

### Artificial Intelligence and Machine Learning

Covers modern algorithms underlying intelligent and learning systems. Examples of topics covered in this track include knowledge representation, planning, reasoning, combinatorial and adversarial search methods, natural language processing, computer vision, statistical machine learning, and evolutionary and reinforcement learning.

CS 541	Artificial Intelligence	3
CS 545	Machine Learning	3

One course from the following\*:

CS 542	Advanced Artificial Intelligence: Combinatorial Games	3
CS 543	Advanced Artificial Intelligence: Combinatorial Search	3
CS 546	Advanced Topics in Machine Learning	3
CS 570	Machine Learning Seminar	1
Stat 671	Statistical Learning I	3
Stat 672	Statistical Learning II	3
Stat 673	Statistical Learning III	3

\*Or any approved CS 510 course in Artificial Intelligence or Machine Learning.

Subtotal: 9

**Total Credit Hours: 45**

### Cumulative Graduate GPA

Students must have a graduate GPA of 3.0 or above in all graduate level coursework taken at PSU to graduate from a master's degree, doctoral degree, or graduate certificate program at PSU.

### Degree Program GPA

Students must have a GPA of 3.0 or above in all courses being used to meet the degree requirements. All graded courses must be passed with a grade of B- or better. Core requirements must be passed with a grade of B or better. All courses taken Pass/No Pass must be passed. Students must have the minimum number of credits needed for their degree before they can graduate.

### Application for Graduation

Students must apply for graduation no later than the first Friday of the term in which they wish to graduate. Information about applying for graduation can be found at: <https://www.pdx.edu/gradschool/applying-for-graduation>.

## COMPUTER SCIENCE PH.D.

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The doctoral degree program in Computer Science is designed to prepare students for advanced research or university teaching in the field.

See University doctoral degree requirements. The student must complete an approved program of 90 graduate credits, including 18 credits of core courses and 27 credits of dissertation research. To be admitted to Ph.D. candidacy, a student must pass the Research Proficiency Examination (RPE) and must present an acceptable dissertation proposal. The dissertation comprises original research work, which is expected to be of a quality meriting publication in a refereed journal or conference. For more information, visit: [www.pdx.edu/computer-science/doctor-philosophy-phd](http://www.pdx.edu/computer-science/doctor-philosophy-phd).

## CYBERSECURITY GRADUATE CERTIFICATE

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The cybersecurity certificate program requires admission as a graduate student, similar to admission to the Master's program, in the Computer Science department. The program requires 21 total credits of graduate classes. There are two core classes for a total of 6 credits. In addition, five elective classes must be taken for the needed additional 15 credits. In summary, seven total graduate classes must be taken; two are core and five are electives.

**Required Core Courses**

CS 591	Introduction to Computer Security	3
CS 595	Web and Cloud Security	3
Subtotal: 6		

**Five of the following courses\*:**

CS 554	Software Engineering	3
CS 555	Software Specification and Verification	3
CS 556	Software Implementation and Testing	3
CS 576	Computer Security Research Seminar	3
CS 585	Cryptography	3
CS 592	Malware Reverse Engineering	3
CS 593	Digital Forensics	3
CS 594	Internetworking Protocols	3
CS 596	Network Security	3

\*Or any CS 510 course in Security.

Subtotal: 15

**Total Credit Hours: 21**

**Electrical and Computer Engineering**

1900 SW Fourth Ave., Suite 160

503-725-3806

[www.pdx.edu/electrical-computer-engineering/](http://www.pdx.edu/electrical-computer-engineering/)

- B.S.—Computer Engineering
- B.S.—Electrical Engineering
- Minor in Electrical Engineering
- M.S.—Electrical and Computer Engineering
- Ph.D.—Electrical and Computer Engineering

**Mission, Vision & Values****Mission**

We prepare students for successful engineering careers and lifelong learning, and we conduct research that creates new technologies and engineering knowledge.

**Vision**

Our vision is to be a source of premier electrical and computer engineering talent and high-impact research. This means our graduates are successful, our research is recognized worldwide, and we are the intellectual center for our discipline in the Portland region.

**Values**

We value

- The success of our graduates
- Contributions to research and knowledge creation
- High intellectual and ethical standards
- High quality education for traditional and nontraditional students
- A diverse student population
- Our contribution to the Oregon economy
- Lifelong learning
- Technical and professional relationships with the engineering community

**Undergraduate programs**

The Department of Electrical and Computer Engineering offers programs in electrical and computer engineering. Cooperative educational arrangements with Portland-area industries, government agencies, and engineering consulting offices are available to qualified students. Qualified freshmen are encouraged to participate in the University Honors Program. Qualified upper-division students should consider the Electrical and Computer Engineering departmental honors track as described below.

The Electrical Engineering and Computer Engineering programs are accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org>, under the General Criteria and the Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Program Criteria.

**DEGREE MAPS AND LEARNING OUTCOMES**

To view the degree maps and expected learning outcomes for Electrical and Computer Engineering's undergraduate degrees, go to [www.pdx.edu/academic-programs/a-z](http://www.pdx.edu/academic-programs/a-z).

**PROGRAM EDUCATIONAL OBJECTIVES**

The electrical and computer engineering programs prepare our graduates for the following program educational objectives:

1. Graduates are expected to be employed as electrical or computer engineers or in related fields that benefit from an electrical and computer engineering education.
2. Graduates are expected to advance in their profession and engage in the professional community.
3. Graduates are expected to continue to learn and adapt in a world of constantly changing environment and technology.

**ADMISSION REQUIREMENTS**