

COMPUTER SCIENCE, B.S. (ABINGTON)

Begin Campus: Any Penn State Campus

End Campus: Abington

Program Description

Computer Science is the study of computers and their theoretical and practical applications. This program is designed to prepare students for employment as computer scientists in engineering, scientific, industrial, and business environments as software developers, programmers, and systems analysts. While most students will enter the job market directly upon graduation, graduate school in computer science or related areas is also an option. Selection of electives can be tailored for students pursuing this path.

The Computer Science major provides a solid foundation in the areas of systems programming, algorithm design, and engineering large software systems using state-of-the-art methodologies and will provide students with the knowledge needed to design, develop, and analyze software solutions for a variety of computational problems.

Students may expect to: develop a solid foundation in mathematical studies relevant to computer science; master skills in computer science; enjoy possibilities for internships and part-time employment with local companies; and become problem solvers. These goals are consistent with the goals outlined by the Association of Computing Machinery (ACM).

What is Computer Science?

Computer science is the study of computational methods, including their principles and foundations, their efficient implementation, their analyses, and their practical application in wide-ranging areas. It includes the foundations of software development, computational problem solving, the principles of system software, and the fundamental principles and limits of computing. It is much more than just programming. It includes the mathematical foundations that support analyzing, evaluating, and proving the correctness of computational solutions. It includes specializations such as artificial intelligence, machine learning, cybersecurity, data mining, high-performance computing, computer networks, computer graphics, computer vision, quantum computing, and others. It is continually evolving with the development of new and faster forms of computation and with the identification of new problems that require computational solutions.

You Might Like This Program If...

- You have an interest or aptitude in math.
- You enjoy solving problems and you are good at analytical thinking.
- You are interested in finding more efficient solutions to problems. Remember, computer science is more than just programming.

Entrance to Major

Entry to the Computer Science major requires that the student has earned a C or better in the following courses: MATH 140, MATH 141, CMPSC 121, and CMPSC 122.

A 2.00 or higher cumulative grade-point average is required.

Degree Requirements

For the Bachelor of Science degree in Computer Science, a minimum of 120 credits is required:

| Requirement | Credits |
|----------------------------|---------|
| General Education | 45 |
| Requirements for the Major | 88 |

13 of the 45 credits for General Education are included in Requirements for the Major. This includes: 3 credits of GWS courses, 6 credits of GQ courses, and 4 credits in GN courses.

FIRST-YEAR SEMINAR: Incoming first-year students are required to complete a course with the suffix S, T, or X, or the PSU abbreviation.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (<http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/>) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

University Degree Requirements

First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44>).

| Code | Title | Credits |
|---|--|---------|
| Prescribed Courses | | |
| CMPSC 221 | Object Oriented Programming with Web-Based Applications ¹ | 3 |
| CMPSC 312 | Computer Organization and Architecture ¹ | 3 |
| CMPSC 430 | Database Design ¹ | 3 |
| CMPSC 460 | Principles of Programming Languages ¹ | 3 |
| CMPSC 462 | Data Structures ¹ | 3 |
| CMPSC 463 | Design and Analysis of Algorithms ¹ | 3 |
| CMPSC 469 | Formal Languages with Applications ¹ | 3 |
| CMPSC 470 | Compiler Construction ¹ | 3 |
| CMPSC 472 | Operating System Concepts ¹ | 3 |
| CMPSC 487W | Software Engineering and Design ¹ | 3 |
| CMPSC 488 | Computer Science Project ¹ | 3 |
| ENGL 202C | Effective Writing: Technical Writing | 3 |
| MATH 220 | Matrices | 2 |
| PHYS 211 | General Physics: Mechanics | 4 |
| <i>Prescribed Courses: Require a grade of C or better</i> | | |
| CMPSC 121 | Introduction to Programming Techniques | 3 |
| CMPSC 122 | Intermediate Programming | 3 |
| CMPSC 360 | Discrete Mathematics for Computer Science ¹ | 3 |

| | | |
|----------|------------------------------------|---|
| MATH 140 | Calculus With Analytic Geometry I | 4 |
| MATH 141 | Calculus with Analytic Geometry II | 4 |

Additional Courses

| | | |
|---|------------------------|----|
| Select one of the following: | | 3 |
| MATH 318 | Elementary Probability | |
| STAT 301 | Statistical Analysis I | |
| STAT 318 | Elementary Probability | |
| Select 15 credits of the following (9 of which must have a CMPSC prefix): | | 15 |

| | | |
|-----------|---|--|
| CMPSC 313 | Assembly Language Programming | |
| CMPSC 412 | Data Structures Lab | |
| CMPSC 413 | Algorithms Lab | |
| CMPSC 426 | Object-oriented Design | |
| CMPSC 438 | Computer Network Architecture and Programming | |
| CMPSC 441 | Artificial Intelligence | |
| CMPSC 444 | Secure Programming | |
| CMPSC 455 | Introduction to Numerical Analysis I | |
| CMPSC 457 | Computer Graphics Algorithms | |
| CMPSC 475 | Applications Programming | |
| CMPSC 496 | Independent Studies | |
| CMPSC 497 | Special Topics | |
| MATH 401 | Introduction to Analysis I | |
| MATH 411 | Ordinary Differential Equations | |
| MATH 412 | Fourier Series and Partial Differential Equations | |
| MATH 425 | Introduction to Operations Research | |
| MATH 430 | Linear Algebra and Discrete Models I | |
| MATH 435 | Basic Abstract Algebra | |
| MATH 449 | Applied Ordinary Differential Equations | |
| MATH 450 | Mathematical Modeling | |
| MATH 455 | Introduction to Numerical Analysis I | |
| MATH 465 | Number Theory | |
| MATH 468 | Mathematical Coding Theory | |
| MATH 496 | Independent Studies | |
| MATH 497 | Special Topics | |

Supporting Courses and Related Areas

| | |
|--|---|
| Select 6 credits of 300-400 level courses in consultation with an academic adviser and in support of the student's interests | 6 |
| Select 5 credits of 100-400 level courses | 5 |

¹ Requires a grade point average of 2.5 or higher.

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary

academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

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Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2021-22 academic year. To access previous years' suggested academic plans, please visit the archive (<https://bulletins.psu.edu/undergraduate/archive/>) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

Computer Science, B.S. at Abington Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

| Fall | Credits | Spring | Credits |
|------------------------------------|-------------|------------------------------|-----------|
| ENGL 15 or 30H (GWS) [†] | 3 | CAS 100 (GWS) [‡] | 3 |
| MATH 140 (GQ) ^{*‡#} | 4 | MATH 141 (GQ) ^{*‡#} | 4 |
| Humanities (GH) | 3 | Arts (GA) | 3 |
| Social and Behavioral Science (GS) | 3 | CMPSC 121 (GQ) ^{*#} | 3 |
| Health and Physical Activity (GHW) | 1.5 | PHYS 211 (GN) [†] | 4 |
| | 14.5 | | 17 |

Second Year

| Fall | Credits | Spring | Credits |
|--|---------|-------------------------------------|---------|
| Arts (GA) | 3 | Natural Sciences (GN) | 2-3 |
| Humanities (GN) | 3 | Social and Behavioral Sciences (GS) | 3 |
| Natural Sciences (GN) (PHYS 212 recommended) ¹ | 3-4 | MATH 220 | 2 |
| CMPSC 122 ^{*#} | 3 | CMPSC 312 ² | 3 |
| CMPSC 360 ^{*2} | 3 | CMPSC 221 ² | 3 |

| | Health and Physical Activity (GHW) | Credits |
|---|------------------------------------|---|
| | | 1.5 |
| | 15-16 | 14.5-15.5 |
| Third Year | | |
| Fall | Credits | Spring |
| CMPSC 462 ² | 3 | CMPSC 430 ² |
| MATH 318 or STAT 318 | 3 | CMPSC 463 ² |
| ENGL 202C (GWS) [‡] | 3 | CMPSC 469 ² |
| Technical Elective (Select 3 Credits) | 3 | Technical Elective (Select 3 Credits) |
| Supporting Courses: Select 5 credits of 100-400 level courses in consultation with an academic adviser ³ | 5 | Supporting Courses: Select 3 credits of 300-400 level courses in consultation with an academic adviser ³ |
| | 17 | 15 |
| Fourth Year | | |
| Fall | Credits | Spring |
| CMPSC 470 ² | 3 | CMPSC 460 ² |
| CMPSC 472 ² | 3 | CMPSC 488 ² |
| CMPSC 487W ² | 3 | Technical Elective (Select 3 Credits) |
| Technical Elective (Select 6 Credits) | 6 | Supporting Courses: Select 3 credits of 300-400 level courses in consultation with an academic adviser ³ |
| | 15 | 12 |

Total Credits 120-122

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

¹ Natural Sciences (GN), recommended courses
• PHYS 212 General Physics: Electricity and Magnetism

² Students must earn a 2.5 or higher grade point average in the following courses: CMPSC 221, CMPSC 312, CMPSC 360, CMPSC 430, CMPSC 460, CMPSC 462, CMPSC 463, CMPSC 469, CMPSC 470, CMPSC 472, CMPSC 487W, and CMPSC 488.

³ 6 credits from courses at 300-400 level and 5 credits from courses at 100-400 level are to be chosen in consultation with the adviser and with program approval.

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

Program Notes:

1. General Education & Entrance to Major Requirements (55 credits)
 - a. English (9 credits)
 - i. ENGL 15 or ENGL 30H (GWS)
 - ii. ENGL 202C (GWS)
 - iii. CAS 100 (GWS)
 - b. Mathematics (10 credits)
 - i. MATH 140 (GS)
 - ii. MATH 141 (GS)
 - iii. MATH 220 (GS)
 - c. Computer Science (6 credits)
 - i. CMPSC 121 (GQ)
 - ii. CMPSC 122
 - d. Natural Sciences
 - i. PHYS 211 (GN)
 - ii. Additional 5 credits of any courses with a GN suffix (PHYS 212 recommended)
 - e. Arts
 - i. 6 credits of any courses with a GA suffix
 - f. Humanities
 - i. 6 credits of any courses with a GH suffix
 - g. Social & Behavioral Sciences
 - i. 6 credits of any courses with a GS suffix
 - h. Health & Physical Activities
 - i. 3 credits of any courses with a GHW suffix
2. Core Requirements (65 credits)
 - a. Required Computer Science Courses - Students must earn a 2.5 or higher-grade point average in the Required Computer Science Courses (36 credits):
 - i. CMPSC 221
 - ii. CMPSC 312
 - iii. CMPSC 360
 - iv. CMPSC 430
 - v. CMPSC 460
 - vi. CMPSC 462
 - vii. CMPSC 463
 - viii. CMPSC 469
 - ix. CMPSC 470
 - x. CMPSC 472
 - xi. CMPSC 487W
 - xii. CMPSC 488
 - b. Required Mathematics Courses - Select one course from the following (3 credits):
 - i. STAT 301
 - ii. STAT 318
 - iii. MATH 318
3. Additional Computer Science/Math Courses (15 credits)
 - a. Select at least 15 credits from the following. Other courses are to be chosen in consultation with the advisor and with program

approval. **At least 9 of these additional computer science/math course credits must be from courses with a CMPSC prefix.**

- i. CMPSC 313
 - ii. CMPSC 412
 - iii. CMPSC 413
 - iv. CMPSC 414
 - v. CMPSC 421
 - vi. CMPSC 426
 - vii. CMPSC 438
 - viii. CMPSC 441
 - ix. CMPSC 444
 - x. CMPSC 455
 - xi. CMPSC 457
 - xii. CMPSC 475
 - xiii. CMPSC 496
 - xiv. CMPSC 497
 - xv. MATH 401
 - xvi. MATH 411
 - xvii. MATH 412
 - xviii. MATH 425
 - xix. MATH 430
 - xx. MATH 435
 - xxi. MATH 449
 - xxii. MATH 450
 - xxiii. MATH 455
 - xxiv. MATH 465
 - xxv. MATH 468
 - xxvi. MATH 485
 - xxvii. MATH 496
 - xxviii. MATH 497
4. Additional Electives / Supporting Courses (11 credits)
 - a. 6 credits from courses at 300-400 level and 5 credits from courses at 100-400 level are to be chosen in consultation with the advisor and with program approval.

Career Paths

Computer Science jobs are expected to be among the top three fastest growing occupations and one of the top 20 in the number of new jobs created. According to the U.S. Bureau of Labor Statistics, employment opportunities for Computer Science graduates are projected to grow 11 percent from 2019 to 2029, faster than the average for all occupations. Computer Science students are encouraged to incorporate internships into their academic program. Internships can provide valuable hands-on experience that will benefit graduates during their job search. Previous students have completed successful internships with state government, Google, Amazon, Facebook, Microsoft, IBM, UNISYS, and other businesses.

Careers

This program is designed to prepare students for employment as computer scientists in engineering, scientific, industrial, and business environments as software developers, programmers, and systems analysts. Over the last few years, Penn State Harrisburg Computer Science graduates have obtained positions with companies such as Blue Cross/Blue Shield, Google, Boeing, Microsoft, Intel, IBM, Oracle, General

Dynamics, Northrop and Grumman, GEOS, Hershey Medical Center, Woolworth, Rite Aid, and EDS.

Opportunities for Graduate Studies

The program provides a sound background for students who plan to pursue graduate studies in computer science, including Penn State's Master of Science in Computer Science program. Selection of electives can be tailored for students pursuing this path.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (<https://harrisburg.psu.edu/science-engineering-technology/computer-science-and-mathematics/master-science-computer-science/>)

Professional Resources

- Association for Computer Machinery (ACM) (<https://www.acm.org/>)
- IEEE (<https://www.ieee.org/>)

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