COMPUTER SCIENCE, B.S. (CAPITAL)

Begin Campus: Any Penn State Campus

End Campus: Harrisburg

Program Description

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, artificial intelligence, and engineering large software systems using state-of-the-art methodologies and programming languages.

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.

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 General Option requires that the student has earned a C or better in the following courses:

- MATH 140
- MATH 141
- CMPSC 121 or CMPSC 131
- CMPSC 122 or CMPSC 132.

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

Entry to the Computer Science Data Science Option requires that the student has earned a C or better in the following courses:

- MATH 140
- MATH 141
- CMPSC 131
- CMPSC 132

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 of 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.

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 (https://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Common Requirements for the Major (All Options)

Code	Title	Credits
Prescribed Courses		
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 472	Operating System Concepts [1]	3
CMPSC 487W	Software Engineering and Design [1]	3
CMPSC 488	Computer Science Project [1]	3
MATH 220	Matrices	2
PHYS 211	General Physics: Mechanics	4
Prescribed Courses: Require a grade of C or better		
CMPSC 330	Advanced Programming in C++	3
CMPSC 360	Discrete Mathematics for Computer Science [1]	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
Additional Courses		
STAT/MATH 318 or STAT/MATH 414	Elementary Probability Introduction to Probability Theory	3

Requirements for the Option

Select an option	35

[1] Students must earn a 2.5 or higher grade point average in the following courses:
- For the General Option: 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
- For the Data Science Option: DS 220, CMPSC 312, CMPSC 360, CMPSC 430, CMPSC 445, CMPSC 446, CMPSC 460, CMPSC 462, CMPSC 463, CMPSC 469, CMPSC 472, CMPSC 487W, and CMPSC 488

Requirements for the Option
Data Science Option (35 credits)
Available at the following campuses: Abington, Harrisburg

Code	Title	Credits
Prescribed Courses		
CMPSC 441	Artificial Intelligence	3
CMPSC 445	Applied Machine Learning in Data Science [1]	3
CMPSC 446	Data Mining [1]	3
DS 220	Data Management for Data Sciences [1]	3
STAT 401	Experimental Methods	3
STAT 462	Applied Regression Analysis	3
Prescribed Courses: Require a grade of C or better		
CMPSC 131	Programming and Computation I: Fundamentals	3
CMPSC 132	Programming and Computation II: Data Structures	3
Additional Courses		
Select at least 6 credits from the following:		6
CMPSC 313	Assembly Language Programming	
CMPSC 412	Data Structures Lab	
CMPSC 413	Algorithms Lab	
CMPSC 414	Contest Programming	
CMPSC 421	Net-centric Computing	
CMPSC 438	Computer Network Architecture and Programming	
CMPSC 444	Secure Programming	
CMPSC/MATH 455	Introduction to Numerical Analysis I	
CMPSC 457	Computer Graphics Algorithms	
CMPSC 470	Compiler Construction	
CMPSC 475	Applications Programming	
CMPSC 496	Independent Studies	
CMPSC 497	Special Topics	
MATH 401	Introduction to Analysis I	
MATH 410	Complex Analysis for Mathematics and Engineering	
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 448	Mathematics of Finance	
MATH 465	Number Theory	
MATH 468	Mathematical Coding Theory	
MATH 485	Graph Theory	
MATH 496	Independent Studies	
MATH 497	Special Topics	
STAT/MATH 415	Introduction to Mathematical Statistics	
STAT 463	Applied Time Series Analysis	
Supporting Courses and Related Areas		
Select 5 credits of unrestricted electives at 100-400 level		5

General Option (35 credits)
Available at the following campuses: Abington, Harrisburg

Code	Title	Credits
Prescribed Courses		
CMPSC 221	Object Oriented Programming with Web-Based Applications [1]	3
CMPSC 470	Compiler Construction [1]	3
Additional Courses		
Select 9 credits from the following:		9
CMPSC 313	Assembly Language Programming	
CMPSC 412	Data Structures Lab	
CMPSC 413	Algorithms Lab	
CMPSC 414	Contest Programming	
CMPSC 421	Net-centric Computing	
CMPSC 438	Computer Network Architecture and Programming	
CMPSC 441	Artificial Intelligence	
CMPSC 444	Secure Programming	
CMPSC 445	Applied Machine Learning in Data Science	
CMPSC 446	Data Mining	
CMPSC/MATH 455	Introduction to Numerical Analysis I	
CMPSC 457	Computer Graphics Algorithms	
CMPSC 475	Applications Programming	
CMPSC 496	Independent Studies	
CMPSC 497	Special Topics	
MATH 425	Introduction to Operations Research	
MATH 485	Graph Theory	
Select 6 credits from the following:		6
CMPSC 313	Assembly Language Programming	
CMPSC 412	Data Structures Lab	
CMPSC 413	Algorithms Lab	
CMPSC 414	Contest Programming	
CMPSC 421	Net-centric Computing	

CMPSC 438	Computer Network Architecture and Programming	
CMPSC 441	Artificial Intelligence	
CMPSC 444	Secure Programming	
CMPSC 445	Applied Machine Learning in Data Science	
CMPSC 446	Data Mining	
CMPSC/MATH 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 410	Complex Analysis for Mathematics and Engineering	
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 448	Mathematics of Finance	
MATH 465	Number Theory	
MATH 468	Mathematical Coding Theory	
MATH 485	Graph Theory	
MATH 496	Independent Studies	
MATH 497	Special Topics	
STAT 401	Experimental Methods	
STAT/MATH 415	Introduction to Mathematical Statistics	
STAT 462	Applied Regression Analysis	
STAT 463	Applied Time Series Analysis	
Additional Courses: Require a grade of C or better		
CMPSC 121	Introduction to Programming Techniques	3
or CMPSC 131	Programming and Computation I: Fundamentals	
CMPSC 122	Intermediate Programming	3
or CMPSC 132	Programming and Computation II: Data Structures	
Supporting Courses and Related Areas		
Select 3 credits of unrestricted electives at 300-400 level		3
Select 5 credits of unrestricted electives at 100-400 level		5

[1] Students must earn a 2.5 or higher grade point average in the following courses:
- For the General Option: 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
- For the Data Science Option: DS 220, CMPSC 312, CMPSC 360, CMPSC 430, CMPSC 445, CMPSC 446, CMPSC 460, CMPSC 462, CMPSC 463, CMPSC 469, CMPSC 472, CMPSC 487W, and CMPSC 488

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 (https://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 and Inter-Domain courses do not meet this requirement.)
- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.)
- **Arts (GA):** 3 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 3 credits
- **Social and Behavioral Sciences (GS):** 3 credits
- **Natural Sciences (GN):** 3 credits

Integrative Studies
- **Inter-Domain Courses (Inter-Domain):** 6 credits

Exploration
- **GN,** may be completed with Inter-Domain courses: 3 credits
- **GA, GH, GN, GS, Inter-Domain courses.** This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher**:** 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 (https://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.

Integrated B.S. in Computer Science and M.S. in Computer Science

Available at the following campuses: Harrisburg

Requirements for the Integrated B.S. in Computer Science and M.S. in Computer Science can be found in the Graduate Bulletin (https://bulletins.psu.edu/graduate/programs/majors/computer-science/#integratedundergradgradprogramstext).

Program Learning Objectives

- **Know Algorithmic Problem Solving and Analysis:** Formulate and solve problems using appropriate data structures and algorithmic techniques; analyze the efficiency and correctness of the algorithms.
- **Know Computer Hardware and Operating Systems:** Analyze the effects of computer hardware and operating systems design on the efficiency and correctness of software systems.
- **Know Programming Language Paradigms:** Express algorithms clearly and correctly in a variety of programming languages
- **Know Theoretical Foundations of Computer Science:** Explain and use the theoretical foundations of computer science effectively
- **Use Software Engineering Skills:** Design and implement large software systems through a strong foundation in the software development lifecycle, effective communication, and team work

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/)

Harrisburg

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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 2023-24 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 contains suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

General Option: Computer Science, B.S. at Harrisburg 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
CMPSC 121 or 131[*#]	3	CMPSC 122 or 132[*#]	3
MATH 140[*#†]	4	MATH 141[*#†]	4
ENGL 15, 15S, 30T, or ESL 15[‡]	3	PHYS 211[†]	4
General Education Course	3	CAS 100A or 100S[‡]	3
General Education Course (GHW)	1.5	General Education Course	3
	14.5		**17**

Second Year

Fall	Credits	Spring	Credits
CMPSC 221	3	CMPSC 330[*]	3
MATH 220	2	CMPSC 360[*]	3
General Education Course (PHYS 212 recommended)	3-4	ENGL 202C[‡]	3
General Education Course	3	General Education Course	2-3
General Education Course	3	General Education Course	3
		General Education Course (GHW)	1.5
	14-15		**15.5-16.5**

Third Year

Fall	Credits	Spring	Credits
CMPSC 312	3	CMPSC 430	3
MATH/STAT 318 or STAT 414	3	CMPSC 462	3
General Education Course	3	CMPSC 469	3
CMPSC/MATH/STAT elective chosen from department list[1]	3	CMPSC/MATH/STAT elective chosen from department list[1]	3
100-400 level elective	3	300-400 level elective	3
	15		**15**

Fourth Year

Fall	Credits	Spring	Credits
CMPSC 463	3	CMPSC 460	3
CMPSC 472	3	CMPSC 470	3
CMPSC 487W	3	CMPSC 488	3
CMPSC/MATH/STAT electives chosen from department list[1]	6	CMPSC/MATH/STAT elective chosen from department list[1]	3
		Open Electives 100-400 level	0-2
	15		**12-14**

Total Credits 118-122

* 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] 9 credits should be in CMPSC.
[2] Students must earn a 2.5 or higher grade point average in the following courses: CMPSC 221, 312, 330, 360, 430, 460, 462, 463, 469, 470, 472, 487W, and 488.
[3] Students in the Computer Science (COMP_BS) major are required to complete 21 of the 27 credits of 400-level prescribed courses for the major, including the senior capstone course, at Penn State Harrisburg. This is in compliance with Faculty Senate Policy 83-80.5.
[4] CMPSC/MATH/STAT electives should be chosen from the following lists:
  • CMPSC 313, 412, 413, 438, 441, 444, 445, 446 455, 457, 475, 496, 497
  • MATH 401, 411, 412, 425, 430, 431, 435, 445, 449, 450, 455, 465, 468, 496, 497
  • STAT 401, 415, 462, 463

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

Data science Option: Computer Science, B.S. at Harrisburg 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
CMPSC 131*#	3	CMPSC 132*#	3
MATH 140*#†	4	MATH 141*#†	4
ENGL 15, 15S, 30T, or ESL 15‡	3	PHYS 211†	4
General Education Course	3	CAS 100A or 100S‡	3
General Education Course (GHW)	1.5	General Education Course	3
	14.5		**17**

Second Year

Fall	Credits	Spring	Credits
CMPSC 221	3	CMPSC 360*	3
MATH 220	2	STAT 401	3
General Education Course (PHYS 212 recommended)	3-4	ENGL 202C‡	3
General Education Course	3	General Education Course	3
General Education Course	3	General Education Course	2-3
		General Education Course (GHW)	1.5
	14-15		**15.5-16.5**

Third Year

Fall	Credits	Spring	Credits
CMPSC 312	3	CMPSC 430	3
CMPSC 330*	3	CMPSC 445	3
CMPSC 441	3	CMPSC 462	3
MATH/STAT 318 or STAT 414	3	CMPSC 469	3
General Education Course	3	100-400 level elective	3
	15		**15**

Fourth Year

Fall	Credits	Spring	Credits
CMPSC 463	3	CMPSC 446	3
CMPSC 472	3	CMPSC 460	3
CMPSC 487W	3	CMPSC 488	3
STAT 462	3	CMPSC/MATH/STAT elective chosen from department list	3
CMPSC/MATH/STAT elective chosen from department list	3	Open Electives 100-400 level	0-2
	15		**12-14**

Total Credits 118-122

* 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] Students must earn a 2.5 or higher grade point average in the following courses: DS 220, CMPSC 312, 330, 360, 430, 441, 460, 445, 446, 462, 463, 469, 472, 487W, and 488.

[2] Students in the Computer Science (COMP_BS) major are required to complete 27 of the 33 credits of 400-level prescribed courses for the major, including the senior capstone course, at Penn State Harrisburg. This is in compliance with Faculty Senate Policy 83-80.5.

[3] CMPSC/MATH/STAT electives should be chosen from the following lists:
- CMPSC 313, 412, 413, 438, 444, 455, 457, 470, 475, 496, 497
- MATH 401, 411, 412, 425, 430, 431, 435, 445, 449, 450, 455, 465, 468, 496, 497
- STAT 415, 463

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

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-ms/)

Professional Resources

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

Contact

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