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 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:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>88</td>
</tr>
</tbody>
</table>

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

Code | Title                                                | Credits |
-----|------------------------------------------------------|---------|
CMPSC 221 | Object Oriented Programming with Web-Based Applications | 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       |
MATH/STAT 318 | Elementary Probability                              | 3       |
PHYS 211 | General Physics: Mechanics                           | 4       |

Prescribed Courses: Require a grade of C or better

Code | Title                                                        | Credits |
-----|--------------------------------------------------------------|---------|
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 9 credits from the following:

Code | Title                                                      | Credits |
-----|------------------------------------------------------------|---------|
CMPSC 313 | Assembly Language Programming                              |         |
CMPSC 412 | Data Structures Lab                                        |         |
CMPSC 413 | Algorithms Lab                                             |         |
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/MATH 455 | Introduction to Numerical Analysis I                      |         |
CMPSC 457 | Computer Graphics Algorithms                               |         |
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.)
- 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.

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

*Avaliable 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/#integratedundergradgradprogramtext).

**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**

*Thang Bui, Ph.D.*

Program Chair

Olmsted Building, W255a
Middletown, PA 17057
717-948-6088

**Abington**

*Vinayak Elangovan*  
Assistant Professor

Rydal Executive Plaza, 320
Abington, PA 19001
215-881-7852

**Suggested Academic Plan**

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2022-23 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).

**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

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>ENGL 15 or 30H‡</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 140*§</td>
<td>4</td>
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<td>General Education Course</td>
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<td>General Education Course</td>
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**Total Credits:** 14.5

### Second Year

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<thead>
<tr>
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<tr>
<td>Fall</td>
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<tr>
<td></td>
<td>General Education Course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education Course</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>CMPSC 122*§</td>
<td>3</td>
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<tr>
<td></td>
<td>Supporting Course, 100-400 level course in consultation with adviser</td>
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</table>

**Total Credits:** 15-16

### Third Year

<table>
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<tr>
<th>Semester</th>
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<tbody>
<tr>
<td>Fall</td>
<td>CMPSC 312</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 318 or STAT 318</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CMPSC 360*</td>
<td>3</td>
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<tr>
<td></td>
<td>Additional Computer Science/Math Course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Supporting Courses, 300-400 level course in consultation with adviser</td>
<td>3</td>
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</table>

**Total Credits:** 15

### Fourth Year

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<th>Semester</th>
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<tr>
<td>Fall</td>
<td>CMPSC 463</td>
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<tr>
<td></td>
<td>CMPSC 472</td>
<td>3</td>
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</tbody>
</table>

**Total Credits:** 15
Computer Science, B.S. (Capital)

**CMPSC 487W** 3  
**Additional Computer Science/Math Course** 3  
Supporting Course, 100-400 level course in consultation with adviser 2-3  

**Total Credits 120-123**

* 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, 312, 360, 430, 460, 462, 463, 469, 470, 472, 487W, and 488. None of the classes in this list can be taken using the Satisfactory/Unsatisfactory grading system.

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.

**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:**

Additional Computer Science/Math Courses:

- CMPSC 313 - Assembly Language Programming (3)  
- CMPSC 412 - Data Structures Lab (1.5)  
- CMPSC 413 - Algorithms Lab (1.5)  
- CMPSC 414 - Contest Programming (1)  
- CMPSC 421 - Net-centric Computing (3)  
- CMPSC 438 - Computer Network Architecture and Programming (3)  
- CMPSC 441 - Artificial Intelligence (3)  
- CMPSC 444 - Secure Programming (3)  
- CMPSC 445 - Applied Machine Learning in Data Science (3)  
- CMPSC 455 - Introduction to Numerical Analysis I (3)  
- CMPSC 457 - Computer Graphics Algorithms I (3)  
- CMPSC 475 - Applications Programming (3)  
- CMPSC 496 - Independent Studies (1-18)  
- CMPSC 497 - Special Topics (1-9)  
- MATH 401 - Introduction to Analysis I (3)  
- MATH 411 - Ordinary Differential Equations (3)  
- MATH 412 - Fourier Series and Partial Differential Equations (3)  
- MATH 425 - Introduction to Operations Research (3)  
- MATH 430 - Linear Algebra and Discrete Models I (3)  
- MATH 435 - Basic Abstract Algebra (3)  
- MATH 445 - Mathematical Statistics and Applications (3)  
- MATH 449 - Applied Ordinary Differential Equations (3)  
- MATH 450 - Mathematical Modeling (3)  
- MATH 455 - Introduction to Numerical Analysis I (3)  
- MATH 465 - Number Theory (3)  
- MATH 468 - Mathematical Coding Theory (3)  
- MATH 496 - Independent Studies (1-18)  
- MATH 497 - Special Topics (1-9)
Computer Science, B.S. at Commonwealth Campuses

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.

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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tr>
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<td>CAS 100†</td>
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<td>MATH 140**</td>
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<td>General Education Course</td>
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<td>General Education Course</td>
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<td>CMPSC 121**</td>
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### Second Year

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<td>CMPSC 122**</td>
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<td>CMPSC 221</td>
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<th>Spring</th>
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<tbody>
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<td>CMPSC 312</td>
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<td>CMPSC 430</td>
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<td>MATH 318 or STAT 318</td>
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<td>CMPSC 462</td>
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<td>CMPSC 360†</td>
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<td>CMPSC 469</td>
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<td>CMPSC 460</td>
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<td>CMPSC 472</td>
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<td><strong>14-15</strong></td>
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Total Credits 120-123

* 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

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1 Natural Sciences (GN), recommended courses
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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/)

Contact
Harrisburg
SCHOOL OF SCIENCE, ENGINEERING, AND TECHNOLOGY
Olmsted Building, W255
Middletown, PA 17057
717-948-6081
jmb84@psu.edu

https://harrisburg.psu.edu/science-engineering-technology/computer-science-and-mathematics/bachelor-science-computer-science

Abington
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