COMPUTER SCIENCE, B.S. (CAPITAL)

Begin Campus: Any Penn State Campus
End Campus: Harrisburg

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>
</tr>
</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 (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)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 312</td>
<td>Computer Organization and Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 430</td>
<td>Database Design</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 460</td>
<td>Principles of Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 462</td>
<td>Data Structures</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 463</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 469</td>
<td>Formal Languages with Applications</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 472</td>
<td>Operating System Concepts</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 487W</td>
<td>Software Engineering and Design</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 488</td>
<td>Computer Science Project</td>
<td>3</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Matrices</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics: Mechanics</td>
<td>4</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

CMPS 330 | Advanced Programming in C++              | 3       |
CMPS 360 | Discrete Mathematics for Computer Science| 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

CMPS 313 | Assembly Language Programming            | 3       |
CMPS 412 | Data Structures Lab                      |         |
CMPS 413 | Algorithms Lab                           |         |
CMPS 414 | Contest Programming                      |         |
CMPS 421 | Net-centric Computing                    |         |
CMPS 438 | Computer Network Architecture and Programming | 3  |
CMPS 444 | Secure Programming                       |         |
CMPS/MATH 455 | Introduction to Numerical Analysis |     |
CMPS 457 | Computer Graphics Algorithms             |         |
CMPS 470 | Compiler Construction                    |         |
CMPS 475 | Applications Programming                 |         |
CMPS 496 | Independent Studies                      |         |
CMPS 497 | Special Topics                           |         |
MATH 401 | Introduction to Analysis I               |         |
MATH 410 | Complex Analysis for Mathematics and Engineering | 3 |
MATH 411 | Ordinary Differential Equations          |         |
MATH 412 | Fourier Series and Partial Differential Equations | 3 |
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                             |         |

1 Students must earn a 2.5 or higher grade point average in the following courses:
   - For the General Option: CMPS 221, CMPS 312, CMPS 360, CMPS 430, CMPS 460, CMPS 462, CMPS 463, CMPS 469, CMPS 470, CMPS 472, CMPS 487W, and CMPS 488
   - For the Data Science Option: DS 220, CMPS 312, CMPS 360, CMPS 430, CMPS 445, CMPS 446, CMPS 460, CMPS 462, CMPS 463, CMPS 469, CMPS 472, CMPS 487W, and CMPS 488

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 411</td>
<td>Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 445</td>
<td>Applied Machine Learning in Data Science</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 446</td>
<td>Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>DS 220</td>
<td>Data Management for Data Sciences</td>
<td>3</td>
</tr>
<tr>
<td>STAT 401</td>
<td>Experimental Methods</td>
<td></td>
</tr>
<tr>
<td>STAT 462</td>
<td>Applied Regression Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

CMPS 131 | Programming and Computation I: Fundamentals | 3  |
CMPS 132 | Programming and Computation II: Data Structures | 3  |

Additional Courses
Select at least 6 credits from the following:

CMPS 313 | Assembly Language Programming            | 3       |
CMPS 412 | Data Structures Lab                      |         |
CMPS 413 | Algorithms Lab                           |         |
CMPS 414 | Contest Programming                      |         |
CMPS 421 | Net-centric Computing                    |         |
CMPS 438 | Computer Network Architecture and Programming | 3  |
CMPS 444 | Secure Programming                       |         |
CMPS/MATH 455 | Introduction to Numerical Analysis |     |
CMPS 457 | Computer Graphics Algorithms             |         |
CMPS 470 | Compiler Construction                    |         |
CMPS 475 | Applications Programming                 |         |
CMPS 496 | Independent Studies                      |         |
CMPS 497 | Special Topics                           |         |
MATH 401 | Introduction to Analysis I               |         |
MATH 410 | Complex Analysis for Mathematics and Engineering | 3 |
MATH 411 | Ordinary Differential Equations          |         |
MATH 412 | Fourier Series and Partial Differential Equations | 3 |
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 | Introduction to Mathematical Statistics 415
STAT 463 | Applied Time Series Analysis

Supporting Courses and Related Areas

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

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 221</td>
<td>Object Oriented Programming with Web-Based Applications</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 470</td>
<td>Compiler Construction</td>
<td>3</td>
</tr>
</tbody>
</table>

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 | Introduction to Numerical Analysis I               | 455     |
- CMPSC 457 | Computer Graphics Algorithms                       |
- CMPSC 475 | Applications Programming                           |
- CMPSC 496 | Independent Studies                                |
- CMPSC 497 | Special Topics                                     |
- MATH 401  | Introduction to Analysis                           |
- 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 | Introduction to Mathematical Statistics             | 415     |
- 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.