

# COMPUTER SCIENCE & ENGINEERING (CSEG)

## Faculty

**Professors:** Xiannong Meng, Luiz Felipe Perrone (Chair)

**Associate Professors:** Stephen M. Guattery, Brian R. King, Lea D. Wittie

**Assistant Professors:** Christopher L. Dancy II, Alan Marchiori, Darakhshan Mir, Neda Nasiriani, Evan M. Peck, Joshua V. Stough, Edward Talmage

**Visiting Associate Professor:** Susan Baish

**Visiting Assistant Professors:** Alexander Fuchsberger, Zachary Scherr

## Mission Statement

The mission of the computer science department at Bucknell University is to provide degree programs and courses consistent with the missions of the University, the College of Arts & Sciences, and the College of Engineering, which meet the full range of needs of the talented, primarily undergraduate student body. To do this, the department provides the following:

- A Bachelor of Science in computer science & engineering degree program in the College of Engineering for students seeking a rigorous engineering education in computer software and hardware systems with an emphasis on computer software (students interested in more of a focus on hardware should consider the computer engineering program).
- A Bachelor of Science degree program in the College of Arts & Sciences for students seeking a solid foundation in the sciences while gaining an in-depth preparation in computer science.
- A Bachelor of Arts degree program in the College of Arts & Sciences for students seeking a broad understanding of the liberal arts while gaining an in-depth preparation in computer science.
- A minor in computer science for students seeking basic competency in the discipline.
- Support for the interdisciplinary computer engineering program offered by the electrical & computer engineering department.
- Basic courses to support the general educational needs of students outside of the degree programs and minor.

The department's philosophy has the following four principles:

- Departmental programs are based on a common core curriculum that supports the breadth of the discipline.
- Computer science courses focus on principles; where appropriate, specific systems are studied to illuminate the principles.
- Courses in the core curriculum typically have a substantial faculty-directed, hands-on component in the form of a regularly scheduled laboratory.
- Departmental degree programs provide the background and experiences appropriate for entering the workplace at the entry level or a variety of graduate programs.

## Program Educational Objectives

Computer Science & Engineering degree graduates will be successful professionals in computer science or other fields, and will be recognized for qualities associated with their Bucknell education. Such qualities include critical thinking, problem solving, and effective communication. Graduates will be prepared to pursue lifelong learning, such as professional or advanced education.

## Bachelor of Science in Computer Science & Engineering

The **Bachelor of Science** in computer science & engineering curriculum requires 12 course credits in computer science as specified below (computer science electives must be at the 300 level, and no more than one credit from any combination of CSCI 376 Computer Science Honors Thesis and CSCI 378 Individual Study in Computer Science may count toward the computer science elective requirement):

### First Year

First Semester	Credits	Second Semester	Credits
ENGR 100	1	CSCI 203	1
MATH 201	1	MATH 202	1
PHYS 211	1	PHYS 212	1
W1 Course	1	Elective	1
	4		4

### Sophomore

First Semester	Credits	Second Semester	Credits
CSCI 204	1	CSCI 205	1
MATH 211	1	CSCI 206	1

200-Level Science Course <sup>1</sup>	1 MATH 222	.5
Elective	1 MATH 241 <sup>2</sup>	1
	Elective	1
	4	4.5

<b>Junior</b>		
<b>First Semester</b>	<b>Credits Second Semester</b>	<b>Credits</b>
CSCI 315	1 CSCI 240	.5
CSCI 311	1 CSCI 208	1
ECEG 101	1 One Computer Science Elective	1
MATH 226	.5 ECEG 245	1
Elective	1 Elective	1
	4.5	4.5

<b>Senior</b>		
<b>First Semester</b>	<b>Credits Second Semester</b>	<b>Credits</b>
CSCI 320	1 CSCI 476	1
CSCI 475	.5 One Computer Science Elective	1
MATH 343 or 245 <sup>3</sup>	1 Two Electives	2
Two Electives	2	
	4.5	4

Total Credits: 34

<sup>1</sup> Students may take the required lab science elective before their 200-level science course.

<sup>2</sup> Students, particularly those interested in a mathematics double major, may substitute the 1.5-credit combination of MATH 280 Logic, Sets, and Proofs, and MATH 240 Combinatorics and Graph Theory for MATH 241 Discrete Structures.

<sup>3</sup> Students who take MATH 343 will complete a minor in Mathematics.

The nine elective courses shown are distributed as follows:

- One laboratory course in the natural sciences.
- Five courses selected from any of the following: social science courses, arts & humanities courses, university courses, residential college courses, or foundation seminars. These five courses must include:
  - One course in arts & humanities
  - One course in social sciences
  - Three courses in any department or program of the University, provided the prerequisites are satisfied.

Three courses in each student's program must also fulfill the University writing requirement and one course in each student's program must also fulfill the college's global perspectives requirement.

As an alternative to the Bachelor of Science in computer science & engineering curriculum, students may wish to consider the major in computer science offered in the Bachelor of Science curriculum or in the Bachelor of Arts curriculum. See the College of Arts & Sciences Course Descriptions for Computer Science (<http://coursecatalog.bucknell.edu/collegeofartsandsciencescurricula/areasofstudy/computersciencecsci>).

## Graduates of the program are expected to demonstrate the following learning outcomes, which reflect ABET engineering and computing accreditation criteria:

### Engineering:

E-a. An ability to apply knowledge of mathematics, science, and engineering.

E-b. An ability to design and conduct experiments, as well as analyze and interpret data.

E-c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

E-d. An ability to function on multidisciplinary teams.

E-e. An ability to identify, formulate, and solve engineering problems.

E-f. An understanding of professional and ethical responsibility.

E-g. An ability to communicate effectively.

E-h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

E-i. A recognition of the need for, and an ability to engage in life-long learning.

E-j. A knowledge of contemporary issues.

E-k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## Computing:

C-a. An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.

C-b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.

C-c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.

C-d. An ability to function effectively on teams to accomplish a common goal.

C-e. An understanding of professional, ethical, legal, security and social issues and responsibilities.

C-f. An ability to communicate effectively with a range of audiences.

C-g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.

C-h. Recognition of the need for and an ability to engage in continuing professional development.

C-i. An ability to use current techniques, skills, and tools necessary for computing practice.

C-j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory at the modeling, and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

C-k. An ability to apply design and development principles in the construction of software systems of varying complexity.

## Courses

**CSCI 187. Creative Computing and Society: Computing, Creativity, and the Social Good. 1 Credit.**

**Offered Both Fall and Spring; Lecture hours:3,Other:2**

Introduces computing in the context of creativity and examining problems of social good. Students will create visual artifacts that will empower them to investigate, and draw novel insights from, data that may be social, historical, or textual in nature. Supplemented with discussions on computing's impact on society.

**CSCI 1NT. Computer Science Non-traditional Study. .25-2 Credits.**

**Offered Fall, Spring, Summer; Lecture hours:Varies**

Non-traditional study in computer science. Prerequisite: permission of the instructor.

**CSCI 203. Introduction to Computer Science I. 1 Credit.**

**Offered Either Fall or Spring; Lecture hours:3,Lab:2**

Overview of computing that explores relationships between computer organization, various programming approaches, limits to computing, and computing in society. Students solve computational problems using Python.

**CSCI 204. Introduction to Computer Science II. 1 Credit.**

**Offered Either Fall or Spring; Lecture hours:3,Lab:2**

Introduction to data structures and algorithms using an object-oriented approach. Topics include software-engineering principles, object-oriented programming, recursion, basic data structures, algorithm analysis, and team programming. Prerequisite: CSCI 203 or permission of the instructor. Corequisite: MATH 201 or equivalent.

**CSCI 205. Software Engineering and Design. 1 Credit.**

**Offered Either Fall or Spring; Lecture hours:3**

Fundamentals of software design and software engineering. Students will participate in large-scale, team-based software development project. Prerequisite: CSCI 204 or permission of the instructor.

**CSCI 206. Computer Organization and Programming. 1 Credit.**

**Offered Spring Semester Only; Lecture hours:3,Lab:3**

Concepts of software and hardware. Software: instruction set design, assembly language and assemblers. Hardware: processor organization, memory hierarchy, interfacing processors and I/O devices. Prerequisite: CSCI 204 or permission of the instructor.

**CSCI 208. Programming Language Design. 1 Credit.****Offered Spring Semester Only; Lecture hours:3,Lab:2**

Study of modern programming language paradigms (procedural, functional, logic, object-oriented). Introduction to the design and implementation of programming languages including syntax, semantics, data types and structures, control structures, run-time environments. Prerequisite: CSCI 205 or permission of the instructor.

**CSCI 240. Computers and Society. .5 Credits.****Offered Spring Semester Only; Lecture hours:2**

The place of computers in society. In-depth study of societal, ethical, and legal issues related to computing. Historical and futurists' views of computing and technology. Public perceptions of computing and the role of computer scientists as professionals. Course work includes oral and written presentations. Prerequisite: junior or senior standing.

**CSCI 245. Life, Computers, and Everything. 1 Credit.****Offered Spring Semester Only; Lecture hours:3,Other:2**

This course explores how computing technologies fit into modern life and provides opportunities for critical analysis of their societal impacts. Past, current, and future developments in computing are studied from ethical and legal perspectives. Course activities includes discussions, oral presentations, and written work. Fulfills CSCI 240 requirement for CS majors.

**CSCI 278. Computer Science Individual Study. .5-1 Credits.****Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies; Repeatable**

Independent study or project in computer science. Prerequisite: one of the following: CSCI 185, CSCI 203, CSCI 204, CSCI 205, CSCI 206, CSCI 208, CSCI 240, or permission of the instructor.

**CSCI 2NT. Computer Science Non-traditional Study. .25-2 Credits.****Offered Fall, Spring, Summer; Lecture hours:Varies**

Non-traditional study in computer science. Prerequisite: permission of the instructor.

**CSCI 305. Introduction to Database. 1 Credit.****Offered Occasionally; Lecture hours:3**

Relational database design methodologies, evaluation techniques, programming, and query languages. Introduction to database systems design, performance, and object-oriented databases. Prerequisites: CSCI 204 and junior or senior standing.

**CSCI 311. Algorithms and Data Structures. 1 Credit.****Offered Fall Semester Only; Lecture hours:3,Recitation:1**

Introduction to the algorithms and data structures used in implementing abstract data types including priority queues, dictionaries, and graphs. Includes complexity analysis of various implementations. Prerequisites: MATH 241 and CSCI 205 or permission of the instructor.

**CSCI 315. Operating Systems Design. 1 Credit.****Offered Fall Semester Only; Lecture hours:3,Lab:2**

Introduction to operating system design including processor management, scheduling, memory management, resource allocation, file systems, and concurrency. Prerequisite: CSCI 206.

**CSCI 320. Computer Architecture. 1 Credit.****Offered Fall Semester Only; Lecture hours:3,Lab:2**

Use hardware description language to describe and design digital systems. Processor design, pipelining, cache and storage systems. Instruction and thread level parallelism, speculation, branch prediction. Prerequisite: CSCI 315 or permission of the instructor.

**CSCI 321. Mobile Systems Development. 1 Credit.****Offered Occasionally; Lecture hours:3**

Covers the software design and development process of a mobile applications developer. The course uses smartphones and tablets as the programming platform. Prerequisite: CSCI 205.

**CSCI 331. Compiler Optimization. 1 Credit.****Offered Occasionally; Lecture hours:3**

Project based introduction to compiler optimization for theoretical and practical issues such as run-time, memory usage, code robustness, and security. Prerequisite: CSCI 208.

**CSCI 335. Web Information Retrieval. 1 Credit.****Offered Occasionally; Lecture hours:3**

Introduction to information retrieval. Topics include retrieval models, evaluations, text properties, indexing, query operations, user interfaces, and web search. Prerequisites: CSCI 206 and junior standing.

**CSCI 340. Mobile Computing. 1 Credit.****Offered Either Fall or Spring; Lecture hours:4**

Mobile computing ecosystem including apps, devices, wireless networks, and back-end systems. Includes at least one major project; the specific course content will vary based on projects, student interest, and current technology trends. This course typically includes a considerable amount of software development. Prerequisite: CSCI 205 or permission of instructor. Crosslisted as ECEG 430.

**CSCI 341. Theory of Computation. 1 Credit.****Offered Fall Semester Only; Lecture hours:3,Recitation:1**

Finite automata, regular sets, pushdown automata, context-free grammars. Turing machines, recursive functions and undecidability. Prerequisite: MATH 241 or MATH 280.

**CSCI 349. Introduction to Data Mining. 1 Credit.****Offered Occasionally; Lecture hours:3**

Data preprocessing, statistical modeling, basic machine learning algorithms for mining large datasets. Topics include association analysis, frequent pattern mining, classification, and clustering. Prerequisites: CSCI 311 and MATH 216 or MATH 226.

**CSCI 350. Introduction to Analysis of Algorithm. 1 Credit.****Offered Occasionally; Lecture hours:3**

Selected topics in algorithm design, analysis, and application. Possible topics include network flows, graphs, string processing, randomized algorithms, parallel algorithms, optimization, and NP-completeness. Prerequisite: CSCI 311.

**CSCI 362. Computer and Network Security. 1 Credit.****Offered Occasionally; Lecture hours:3**

Fundamental principles of computer and network security. Topics include cryptography, privacy, secure programming, authentication, assurance, intrusion detection, and practical experience on networking Linux computers. Concurrent prerequisite: must have already taken or currently taking CSCI 315.

**CSCI 363. Computer Networks. 1 Credit.****Offered Occasionally; Lecture hours:3,Lab:2**

Principles and design of networked computing systems and application programs. Topics include reliable communications medium access control, routing, transport, congestion control and networked applications. Prerequisite: CSCI 315.

**CSCI 367. Computer Graphics. 1 Credit.****Offered Occasionally; Lecture hours:3,Lab:2**

Topics in graphics hardware and software. Input devices and output displays and graphics processor architecture. Application packages, general purpose graphics packages, and algorithms. Use of color and software for two- and three-dimensional graphics. Prerequisites: junior or senior standing; CSCI 204 or permission of the instructor.

**CSCI 376. Computer Science Honors Thesis. .5-1 Credits.****Offered Fall, Spring, Summer; Lecture hours:Varies; Repeatable**

Independent work on computer science honors thesis. Prerequisite: permission of the instructor.

**CSCI 378. Individual Study in Computer Science. .5-1 Credits.****Offered Fall, Spring, Summer; Lecture hours:Varies; Repeatable**

Independent study in computer science. Recent areas include graph algorithms, computer security, distributed computing, graphics, programming languages, software engineering, web retrieval. Prerequisites: junior standing and permission of the instructor.

**CSCI 379. Topics in Computer Science. 1 Credit.****Offered Either Fall or Spring; Lecture hours:3; Repeatable**

Current topics of interest. Course may/may not require laboratory depending upon the topic. Prerequisite: permission of the instructor.

**CSCI 3NT. Computer Science Non-traditional Study. .25-4 Credits.****Offered Fall, Spring, Summer; Lecture hours:Varies,Other:3**

Non-traditional study course in computer science. Prerequisite: permission of the instructor.

**CSCI 475. Senior Design I. .5 Credits.****Offered Fall Semester Only; Lecture hours:Varies,Other:2; Repeatable**

A recognized software engineering methodology will be used with all phases of a senior design project. Written work will include a technical report about the project, a feasibility report, and a requirements specification document. Not open to students who have taken ENGR 452.

**CSCI 476. Senior Design II. 1 Credit.****Offered Spring Semester Only; Lecture hours:1.5**

Students undertake several cycles of delivery, each including a design document, product implementation, testing, and feedback. Students produce technical and user's manuals for the final version. Class presentations of designs and implementations. Includes public presentation of the final product and design process. Prerequisites: CSCI 475 and permission of the instructor.

**CSCI 479. Computer Science Design Project. 1 Credit.****Offered Fall Semester Only; Lecture hours:3**

Students in teams use software engineering methodology to design and implement a semester-long project. Written reports and oral presentations are required. Prerequisites: CSCI 205 and senior standing in the College of Arts and Sciences and permission of the instructor.