

COMPUTER SCIENCE & ENGINEERING (CSEG)

Faculty

Professors: Xiannong Meng, Luiz Felipe Perrone (Chair)

Associate Professors: Susan Baish, Christopher L. Dancy II, Brian R. King, Alan Marchiori, Evan M. Peck, Lea D. Wittie

Assistant Professors: Alexander Fuchsberger, Samuel C. Gutekunst, Darakhshan Mir, Anne Spencer Ross, Joshua V. Stough, Edward Talmage

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		1 Elective	1
	4		4

Sophomore

First Semester	Credits	Second Semester	Credits
CSCI 201		.5 CSCI 202	.5
CSCI 204		1 CSCI 205	1
MATH 227		1 CSCI 206	1
200-Level Science Course ²		1 MATH 241 ³	1

Elective		1 Elective	1
		4.5	4.5
Junior			
First Semester	Credits	Second Semester	Credits
CSCI 315		1 CSCI 240	.5
CSCI 311		1 CSCI 308	1
ECEG 101		1 ECEG 240	1
Elective		1 One Computer Science Elective	1
		Elective	1
		4	4.5
Senior			
First Semester	Credits	Second Semester	Credits
CSCI 320		1 CSCI 476	1
CSCI 475		.5 One Computer Science Elective	1
MATH 343 or 245 ⁴		1 Two Electives	2
Two Electives		2	
		4.5	4

Total Credits: 34

- ¹ Three courses in each student's program must fulfill the University writing requirement that includes a **W1 course taken in the first semester** and two subsequent W2 courses.
- ² Students may take the required lab science elective before their 200-level science course.
- ³ Students who placed out of MATH 201 and/or MATH 202 may want to consider a mathematics double major. Students pursuing this double major may substitute the 1.5-credit combination of MATH 280 and MATH 240 for MATH 241.
- ⁴ 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:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Computing:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

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 201. Computer Science Seminar. .5 Credits.**Offered Fall Semester Only; Lecture hours:1.5**

A variety of Computer Science related topics presented by faculty, alumni, student speakers, and other relevant guests. Presentations and discussions on the frontier of the discipline, professional development, ethics and societal issues, and other topics relevant to the profession. Prerequisite: open to sophomores. Others by permission of the instructor.

CSCI 202. Research Methods. .5 Credits.**Offered Spring Semester Only; Lecture hours:1.5**

An introduction to research methodology in Computer Science, involving reading scientific literature, developing presentation skills, and learning to use various software packages. Prerequisites: open to first years and sophomores. Others by permission of the instructor.

CSCI 203. Introduction to Computer Science. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:2**

Overview of computer science in which students learn the python programming language in order to explore the capabilities, limits, and social impact of computing. Application areas include image manipulation, data manipulation and visualization, introductions to predictive models, and ethical programming practices. Not open to students who have taken ANOP 203.

CSCI 204. Data Structures & Algorithms. 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 (BCEN students ECEG 247) 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. 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 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**

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.

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 202, CSCI 203, CSCI 204, CSCI 205, CSCI 206, CSCI 240, CSCI 308, 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 308. 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. Not open to students who have taken CSCI 208.

CSCI 311. Design & Analysis of Algorithms. 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 or (MATH 240 and MATH 280) and CSCI 204, 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**

Explores two important topics in computer architecture today: memory hierarchy and parallelism in all its forms. Students will use a hardware description language to implement concepts including pipelining, cache, and branch prediction. Prerequisite: CSCI 206 or ECEG 247 or permission of the instructor. Crosslisted as ECEG 443 and ECEG 643.

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 308.

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 or MATH 227).

CSCI 356. Machine Learning and Intelligent Systems. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:2**

Introduction to artificial intelligence (AI) and machine learning (ML). The course includes the study of AI and ML theoretical principles and the use of these technologies in the creation of software applications. MATH 211 and Python coding experience recommended. Prerequisite: MATH 202 or permission of the instructor. Crosslisted as ECEG 478 and ECEG 678.

CSCI 357. AI & Cognitive Science. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

Theories and methods in artificial intelligence and cognitive science. Topics will be a mix of historically important and foundational perspectives, including statistical (e.g., connectionist), and symbolic frameworks. Prerequisites: CSCI 204, open to juniors and seniors or permission of the instructor.

CSCI 358. Human Computer Interaction. 1 Credit.**Offered Occasionally; Lecture hours:3**

In this interdisciplinary course, we will study research at the intersection of people and computing. Through a variety of prototypes that we'll build (3D user interfaces, visual design, data communication, intelligent user interfaces, etc), we will deliberately practice processes that result in useful, usable and maybe even inspirational computer interfaces.

CSCI 359. Fairness, Privacy, & Transparency When Learning From Data. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

The course enables students to audit and analyze data-centric systems and processes that are used to make decisions about people's lives and understand the bias, fairness, privacy, and transparency implications of these systems. We will read, discuss, and implement ideas from recently published research articles in this upcoming area.

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 365. Image Processing & Analysis. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:1**

Imaging is everywhere! In this course, we will cover broadly the acquisition, processing, and analysis of digital images, covering topics ranging from the human visual system, to image and video compression algorithms, to pattern recognition and machine learning within the context of automatic image understanding.

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.