Computer Science (CSE)

Major and Minor in Computer Science

Department of Computer Science, College of Engineering and Applied Sciences

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Minors of particular interest to students majoring in Computer Science: Business Management (BUS)

Department Information - Computer Science (CSE)

Computer science is the study of computer systems, including the architecture of computers, development of computer software, information processing, computer applications, algorithmic problem-solving, and the mathematical foundations of the discipline.

The Computer Science major provides professional education in computer science to prepare the student for graduate study or for a career in the computing field. Students learn concepts and skills needed for designing, programming, and applying computer systems while also learning the theoretical and mathematical foundations of computer science. They have sufficient freedom in the program to pursue other academic interests in the liberal arts, sciences, and engineering to complement their study of computer science. The Computer Science program is accredited by the Computing Accreditation Commission of ABET, [http://www.abet.org](http://www.abet.org).

Many students prepare for their professional careers through internships at local companies. Computer science graduates are recruited heavily, and career opportunities include developing software systems for a diverse range of applications such as: user interfaces; networks; databases; forecasting; web technologies; and medical, communications, satellite, and embedded systems. Many are employed in the telecommunication and financial industries, and some are self-employed as heads of software consulting companies.

The Department of Computer Science offers two undergraduate majors: Computer Science and Information Systems. Requirements and courses for the latter appear under the program title in the alphabetical listings of Approved Majors, Minors, and Programs. The two programs of study share a number of courses, particularly in the first two years, so that it is possible to follow a program that permits a student to select either major by the start of the junior year. The Department also offers a minor in computer science, a joint B.S./M.S. program, and an honors program.

Program Educational Objectives

The graduates of the computer science program will, within 3-5 years after graduation:

- Establish themselves as practicing professionals or engage in advanced study and
- Advance professionally through organized training or self-learning.

Student Outcomes

The students will demonstrate the following:

- An ability to apply knowledge of computing and mathematics appropriate to the program’s student outcomes and to the discipline;
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
- An ability to design, implement, and evaluate, a computer-based system, process, component or program to meet desired needs;
- An ability to function effectively on teams to accomplish a common goal;
- An understanding of professional, ethical, legal, security and social issues and responsibilities.
- An ability to communicate effectively with a range of audiences;
- An ability to analyze the local and global impact of computing on individuals, organizations, and society;
- Recognition of the need for and an ability to engage in continuing professional development;
- An ability to use current techniques, skills, and tools necessary for computing practice;
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;
- An ability to apply design and development principles in the construction of software systems of varying complexity.
Computing Facilities

Computing facilities for undergraduates are maintained by both the University Computing Center and the Department of Computer Science. For a description of the computing services provided by the University Computing Center, see the Student Services section of this Bulletin.

The Department of Computer Science provides additional laboratories to support undergraduate instruction and research. The laboratory facilities are regularly upgraded to keep pace with advances in technology. Current computing facilities include the Computer Science Undergraduate Computing Laboratory; the Programming Techniques Teaching Laboratory with facilities for classroom instruction; the Computer Associates Transactions Laboratory, used primarily for upper-level courses on databases, transaction processes, and Web applications; the Computer Science Advanced Programming Laboratory, also donated by Computer Associates, Inc., which provides computing support for upper-level courses on such topics as operating systems and user interfaces; and the Computer Science Multimedia Laboratory, used for courses on multimedia design. Most of the laboratories are connected to the Internet via the campus network and are easily accessible by students from campus residences or from off-campus via modem.

The Departmental research laboratories are available to undergraduate students working on supervised projects with computer science faculty.

Requirements for the Major and Minor in Computer Science (CSE)

Enrolling in CSE Courses

To enroll in CSE courses, students must:

Have completed all prerequisites with a grade of C or higher. (Pass/No Credit grades are not acceptable to meet prerequisites.) For transfer students, official transfer credit evaluations must have been completed.

Failure to satisfy the prerequisites or to attend the first class may result in deregistration. The Pass/No Credit option is not available for CSE courses.

Acceptance into the Computer Science Major

Qualified freshman and transfer students who have indicated their interest in the major on their applications may be admitted directly as a degree major or as a pre-major. Pre-majors are placed into the Area of Interest (AOI) program and to be eligible for the degree, they must be admitted to and declare the major. The requirements and application process for matriculation are detailed below. Students admitted to other programs within the College of Engineering and Applied Science (CEAS) follow the same admissions process as students in the AOI program. Students in programs outside of CEAS (non-CEAS students) and double major applicants may apply for admission to the degree program following a separate process, outlined below.

Area of Interest and Other CEAS Students (excluding double major applicants)

Applications for major admission from AOI and other CEAS students are reviewed twice per year and must be received by January 5 for Spring admission and June 5 for Fall admission. Students who submit their application on time will be admitted if they meet the following requirements:

• Completed at least ten credits of required technical CSE courses, including CSE 114 and CSE 215,
• Receive grades of B- or higher in required technical CSE courses and a grade point average of 3.20 or higher in these courses (Transfer students who have completed equivalent courses at another school with grades of B- or higher need not retake these courses, but should keep in mind that grades do not transfer and grade point averages are calculated on the basis of courses completed at Stony Brook),
• Repeated at most one of these courses,
• Earned a cumulative grade point average of 3.00 or higher, and
• Completed course evaluations for all transferred courses that are to be used to meet requirements of the major (only courses transferred before matriculation can be used for CSE major admission purposes).

Students must complete these requirements no later than one year after they enroll in the first course that applies towards major entry. Students must apply for admission by the application deadline immediately following completion of the above requirements, but no later than the one year limit. Admission of AOI students and other CEAS students who apply late will follow the process of Non-CEAS Students and Double Major Applicants below.

Non-CEAS Students and Double Major Applicants

Applications for major admission from non-CEAS students and double major applicants are reviewed twice per year and must be received by January 5 for Spring admission and June 5 for Fall admission. Students who do not meet the requirements for AOI admission above will not be considered. Fulfilling the requirements does not guarantee acceptance. Admission is competitive and contingent upon program capacity.

Requirements for the Major

The major in Computer Science leads to the Bachelor of Science degree. Completion of the major requires approximately 80 credits. At least 24 credits from items 1 to 3 below, and at least 18 credits from items 2 and 3, must be completed at Stony Brook.

1. Required Introductory Courses

• CSE 114 Introduction to Object-Oriented Programming
• CSE 214 Data Structures
• CSE 215 Foundations of Computer Science or CSE 150 Foundations of Computer Science: Honors
• CSE 216 Programming Abstractions
• CSE 220 Systems Fundamentals I

Note: Students in the CSE Honors Program may substitute CSE 160, CSE 161 and CSE 260, CSE 261 Computer Science A, B: Honors with labs for CSE 114, 214 and 216.

2. Required Advanced Courses
• CSE 303 Introduction to the Theory of Computation or CSE 350 Theory of Computation: Honors
• CSE 310 Computer Networks
• CSE 316 Fundamentals of Software Development
• CSE 320 Systems Fundamentals II
• CSE 373 Analysis of Algorithms or CSE 385 Analysis of Algorithms: Honors
• CSE 416 Software Engineering

3. Computer Science Electives
Four upper-division CSE electives. Technical electives do not include teaching practica (CSE 475), the senior honors project (CSE 495, 496), and courses designated as non-technical in the course description (such as CSE 301).

4. AMS 151, AMS 161 Applied Calculus I, II
Note: The following alternate calculus course sequences may be substituted for AMS 151, AMS 161 in major requirements or prerequisites:
MAT 125, MAT 126, MAT 127, or MAT 131, MAT 132, or MAT 141, MAT 142 or MAT 171. Equivalency for MAT courses achieved through the Mathematics Placement Examination is accepted to meet MAT course requirements.

5. One of the following:
• MAT 211 Introduction to Linear Algebra
• AMS 210 Applied Linear Algebra
• AMS 326 Numerical Analysis

6. Both of the following:
• AMS 301 Finite Mathematical Structures
• AMS 310 Survey of Probability and Statistics or AMS 311 Probability Theory

7. At least one of the following natural science lecture/laboratory combinations:
BIO 201/204 or BIO 202/204 or BIO 203/204 or CHE 131/133 or CHE 152/154 or PHY 126/133 or PHY 127/133 or PHY 131/133 or PHY 141/133

8. Additional natural science courses selected from above and the following list:
AST 203, AST 205, CHE 132, CHE 321, CHE 322, CHE 331, CHE 332, GEO 102, GEO 103, GEO 112, GEO 113, GEO 122, PHY 125, PHY 132, PHY 134, PHY 142, PHY 251, PHY 252
Note: The courses selected in 7 and 8 must carry at least 9 credits.

9. Professional Ethics
• CSE 312 Legal, Social, and Ethical Issues in Information Systems

10. Upper-Division Writing Requirement: CSE 300 Technical Communications

All degree candidates must demonstrate technical writing skills at a level that would be acceptable in an industrial setting. To satisfy the requirement, students must pass CSE 300, a course that requires the completion of various writing assignments, including at least one significant technical paper.

Note: All students are encouraged to discuss their program with an undergraduate advisor. In Requirement 2 above, CSE/ESE double majors may substitute ESE 440, ESE 441 Electrical Engineering Design I, II for CSE 416 Software Engineering provided that the design project contains a significant software component. Approval of the Department of Computer Science is required.

Grading
All courses taken to satisfy Requirements 1 through 10 must be taken for a letter grade. The courses in Requirements 1-6, 9, and 10 must be passed with a letter grade of C or higher. The grade point average for the courses in Requirements 7 and 8 must be at least 2.00. A grade of C or higher is also required in prerequisite courses listed for all CSE courses.

Specialization in Artificial Intelligence and Data Science
The specialization in artificial intelligence and data science emphasizes modern approaches for building intelligent systems using machine learning. It requires four courses selected from the list below. The four courses must include at least two core courses. Students may declare their participation in the specialization after completing two core courses. All courses must be completed with a grade of C or higher.
1. Core Courses

1. CSE 351 Introduction to Data Science
2. CSE 352 Artificial Intelligence
3. CSE 353 Machine Learning
4. CSE 357 Statistical Methods for Data Science

2. Electives

- CSE 323 Human-Computer Interaction
- CSE 327 Fundamentals of Computer Vision
- CSE 332 Introduction to Visualization
- CSE 337 Scripting Languages
- CSE 354 Natural Language Processing
- CSE 371 Logic
- CSE 378 Introduction to Robotics
- CSE 390-394 Special Topics in Computer Science*
- CSE 487 Research in Computer Science*

*Special topic or research project must be in artificial intelligence or data science.

Specialization in Human-Computer Interaction

The specialization in human-computer interaction emphasizes both the psychology aspects of effective human-computer interactions and the technical design and implementation of systems for those interactions. It requires four core course, two electives, and a project. Students may declare their participation in the specialization after completing the courses in 1a and 1b. All courses must be completed with a grade of C or higher.

1. Core Courses

   a. CSE 323 Human-Computer Interaction
   b. PSY 260 Survey of Cognition and Perception
   c. CSE 328 Fundamentals of Computer Graphics or CSE 332 Introduction to Visualization
   d. CSE 333 User Interface Development or PSY 384 Research Lab: Human Factors

2. Two electives from the following, including at least one CSE course:

   - CSE 327 Fundamentals of Computer Vision
   - CSE 328 Fundamentals of Computer Graphics
   - CSE 332 Introduction to Visualization
   - CSE 333 User Interface Development
   - CSE 334 Introduction to Multimedia Systems
   - CSE 336 Internet Programming
   - CSE 352 Artificial Intelligence
   - CSE 364 Advanced Multimedia Techniques
   - CSE 366 Introduction to Virtual Reality
   - CSE 378 Introduction to Robotics
   - CSE 390-394 Special Topics in Computer Science*
   - PSY 366 Human Problem Solving
   - PSY 368 Sensation and Perception
   - PSY 369 Special Topics in Cognition and Perception
   - PSY 384 Research Lab: Human Factor

*Special topic must be in human-computer interaction.

3. Project

Completion of CSE 487 Research in Computer Science or CSE 488 Internship in Computer Science or CSE 495/CSE 496 Senior Honors Research Project I, II, on a topic in human-computer interaction. The project may not be applied towards the requirements of another specialization.

Specialization in Game Programming

The specialization in game programming prepares students for a career as either a professional game developer or researcher. Game graphics and multiplayer network programming techniques are stressed. The specialization also emphasizes original game development, game design methodology, and team projects and presentations. It requires four core courses, two electives, and a project. Students may declare their participation in the specialization after completing two core courses. All courses must be completed with a grade of C or higher.

1. Core Courses
COMPUTER SCIENCE (CSE)

a. CSE 306 Operating Systems
b. CSE 328 Fundamentals of Computer Graphics
c. CSE 380 Computer Game Programming
d. CSE 381 Advanced Game Programming

2. Two electives from the following:
   CSE 327 Fundamentals of Computer Vision
   CSE 331 Computer Security Fundamentals
   CSE 332 Introduction to Visualization
   CSE 334 Introduction to Multimedia Systems
   CSE 352 Artificial Intelligence
   CSE 353 Machine Learning
   CSE 355 Computational Geometry
   CSE 364 Advanced Multimedia Techniques
   CSE 365 Advanced Programming in UNIX/C
   CSE 378 Introduction to Robotics

3. Project

Completion of CSE 487 Research in Computer Science or CSE 488 Internship in Computer Science or CSE 495/CSE 496 Senior Honors Research Project I, II, on a topic in game programming. The project may not be applied towards the requirements of another specialization.

Note: Students specializing in Game Programming are encouraged to complete the natural science sequence in physics, see part seven (7) of the Requirements for the Major in Computer Science.

Specialization in Computer Security

The specialization in Computer Security prepares students for a career as a security engineer, threat analyst, or security researcher. The courses under this specialization are taught by the computer science faculty affiliated with the National Security Institute. The specialization covers the fundamentals of security, while also exposing the student to some of the latest developments. It requires four core courses, two electives, and a project. Students may declare their participation in the specialization after completing the courses in 1a and 1b. All courses must be completed with a grade of C or higher.

1. Core Courses
   a. CSE 310 Computer Networks or CSE 346 Computer Communications
   b. CSE 306 Operating Systems or CSE 376 Advanced Systems Programming in UNIX/C
   c. CSE 331 Computer Security Fundamentals
   d. CSE 360 Software Security, CSE 361 Web Security, CSE 362 Mobile Security, or CSE 363 Offensive Security

2. Two electives from the following:
   CSE 305 Principles of Database Systems
   CSE 306 Operating Systems
   CSE 315 Database Transaction Processing Systems
   CSE 336 Internet Programming
   CSE 375 Concurrency
   CSE 376 Advanced Systems Programming in UNIX/C

3. Project

Completion of either CSE 487 Research in Computer Science or CSE 495, CSE 496 Senior Honors Research Projects I, II, on a topic in computer security. The project may not be applied towards the requirements of another specialization.

Specialization in Systems Software Development

The specialization in systems software development prepares students for a career in software applications development or systems software development. It requires four core courses, two electives, and a project. Students may declare their participation in the specialization after completing the courses in 1a and 1b. All courses must be completed with a grade of C or higher.

1. Core Courses
   a. CSE 310 Computer Networks or CSE 346 Computer Communications
   b. CSE 306 Operating Systems or CSE 376 Advanced Systems Programming in Unix/C
   c. CSE 331 Computer Security Fundamentals
   d. CSE 311 Systems Administration or CSE 337 Scripting Languages

2. Two electives from the following:
   CSE 304 Compiler Design
COMPUTER SCIENCE (CSE)  

CSE 305 Principles of Database Systems  
CSE 306 Operating Systems  
CSE 311 Systems Administration  
CSE 336 Internet Programming  
CSE 337 Scripting Languages  
CSE 370 Wireless and Mobile Networking  
CSE 376 Advanced Systems Programming in UNIX/C  
Special topics courses in systems software development  

3. Project  
Completion of CSE 487 Research in Computer Science or CSE 488 Internship in Computer Science or CSE 495/CSE 496 Senior Honors Research Project I, II, on a topic in systems software development. The project may not be applied towards the requirements of another specialization.  

The Honors Program  
The Honors Program in Computer Science, a highly selective academic program within the major in Computer Science, offers a specially designed curriculum to a limited number of exceptional students. The program is open to freshmen and to continuing students. To be admitted as a freshman, students must demonstrate overall academic excellence by achieving a combined SAT score of at least 1430 on the critical reading and math components of the SAT (with a score of 700 or higher in math), an unweighted high school average of 93 or higher (on a 100 point scale), and high grade averages in mathematics and the natural sciences. Continuing Computer Science majors who have completed at least two CSE courses and have maintained a cumulative grade point average of 3.50 and an average of 3.50 in CSE courses may apply for admission to the honors program in the sophomore or junior year. Students whose GPA drops below the Honors requirements may be asked to leave the program.  

Honors course offerings include introductory course sequences in programming and in the foundations of computing, advanced courses on selected topics that reflect active research areas within the Department, and a two-semester senior honors project. Students will be able to take at least one honors course during most of the semesters in a four-year program of study. Honors program students must complete the regular requirements of the Computer Science major. Final conferral of honors is contingent upon successful completion of all required courses in the Computer Science major, the two-semester honors project, a minimum of three honors courses in addition to the project, and a grade point average of at least 3.50, both cumulative and in CSE courses. Graduate courses may be counted as honors courses with prior approval of the department. The teaching practicum CSE 475 may be substituted for one of the honors courses. Other suitable advanced undergraduate courses may be counted as honors courses with prior approval of the department. The requirement of three honors courses can be relaxed to one course for students with at least a 3.75 grade point average, both overall and for CSE courses.  

Honors students in good standing at the end of the junior year will, on application, be recommended for admission to the five-year joint B.S./M.S. program in Computer Science. B.S./M.S. applicants who successfully complete the honors program may be considered for a graduate student assistantship. (It is recommended that these students complete an undergraduate teaching practicum in the junior or senior year.)  

Requirements for the Minor  
The minor in Computer Science is open to all students not majoring in either Computer Science or Information Systems or minoring in Information Systems. To declare the minor in Computer Science, students must complete CSE 114 and either CSE 214 or CSE 215 with grades of C or higher. Priority is given to students with a grade point average of 3.00 or higher, both overall and in CSE courses. Transfer students who have completed equivalent courses at another school with grades of C or higher need not retake these courses, but should keep in mind that grades do not transfer and grade point averages are calculated on the basis of courses completed at Stony Brook. Admission is competitive and contingent upon program capacity.  

The minor requires seven CSE courses totaling 22 to 24 credits as outlined below. Students who have declared the minor should see a Computer Science Undergraduate Advisor to discuss a suitable selection of Computer Science electives.  

1. CSE 114 Introduction to Object Oriented Programming  
2. CSE 214 Data Structures  
3. CSE 216 Programming Abstractions or CSE 220 Systems Fundamentals I  
4. Four additional courses that are part of the CSE major, including three upper division CSE courses totaling at least nine credits (but excluding CSE 300, CSE 312, CSE 475, CSE 487, CSE 488). Note: CSE 301 can not be used as a technical elective for the minor.  
Note: Each of these courses must be passed with a letter grade of C or higher.  

Joint B.S./M.S. Program  
Computer Science majors may apply for admission to a special program that leads to a Bachelor of Science degree at the end of the fourth year and a Master of Science degree at the end of the fifth year. Students usually apply to the program in their junior year.  

Students must satisfy the respective requirements of both the B.S. degree and the M.S. degree, but the main advantage of the program is that nine credits may be simultaneously applied to both the undergraduate and graduate requirements. The M.S. degree can therefore be earned in less time than that required by the traditional course of study.  

For more details about the B.S./M.S. program, see the undergraduate or graduate program director in the Department of Computer Science.
Sample Course Sequence for the Major in Computer Science
A course planning guide for this major may be found here. The major course planning guides are not part of the official Undergraduate Bulletin, and are only updated periodically for use as an advising tool. The Undergraduate Bulletin supersedes any errors or omissions in the major course planning guides.

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Notes:
- SBC refers to the following (five) categories: HUM, SBS, ARTS, USA, GLO
- Students may satisfy the Pursue Deeper Understanding category of the SBC by completing CSE 316 and CSE 416.
CSE

Computer Science

CSE 101: Computer Science Principles
Introduces central ideas of computing and computer science, instills practices of algorithmic and computational thinking, and engages students in the creative aspects of the field. Also introduces appropriate computing technology as a means for solving computational problems and exploring creative endeavors. Includes weekly computer programming assignments, but assumes no previous programming experience.

Prerequisite: Level 3 or higher on the mathematics placement examination

SBC: TECH

3 credits

CSE 102: Introduction to Web Design and Programming
An introduction to the design of Web pages, specifically the development of browser and device independent HTML, with an emphasis on the XHTML standards. Includes the use of style sheets (CSS) and tools for page layout and verification. HTML is presented as a mark-up language, exploring the rules of HTML elements and attributes. Students learn the separation of page viewing information from the HTML through CSS style sheets as well as the use of block layout without using HTML tables. Addresses HTML display properties including text, color, image, and graphic elements as well as approaches to HTML validation and techniques.

Advisory Prerequisite: CSE 101 or basic computer skills

SBC: TECH

3 credits

CSE 110: Introduction to Computer Science
An introduction to fundamentals of computer science. Topics covered include algorithmic design, problem-solving techniques for computer programming, fundamentals of digital logic and computer organization, the role of the operating system, introductory programming methodology including variables, assignment statements, control statements and subroutines (methods), programming paradigms, the compilation process, theoretical limits of computation, social and ethical issues. Intended for students who have not taken any college-level computer science course containing programming assignments in a high-level programming language.

Prerequisite: Level 3 or higher on the mathematics placement examination

SBC: TECH

3 credits

CSE 114: Introduction to Object-Oriented Programming
An introduction to procedural and object-oriented programming methodology. Topics include program structure, conditional and iterative programming, procedures, arrays and records, object classes, encapsulation, information hiding, inheritance, polymorphism, file I/O, and exceptions. Includes required laboratory. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: Level 4 or higher on the math placement exam

Advisory Prerequisite: CSE 101 or ISE 108

SBC: TECH

4 credits

CSE 130: Introduction to Programming in C
Introduces programming concepts using the C language. Variables, data types, and expressions. Conditional and iterative statements, functions, and structures. Pointers, arrays, and strings. Scope of variables and program organization. Includes programming projects of an interdisciplinary nature. Suitable as an introductory programming course for non-CSE majors.

Prerequisite: Level 3 or higher on the mathematics placement examination

3 credits

CSE 150: Foundations of Computer Science: Honors
Introduction to the logical and mathematical foundations of computer science for computer science honors students. Topics include functions, relations, and sets; recursion and functional programming; basic logic; and mathematical induction and other proof techniques.

Prerequisite: one MAT course that satisfies D.E.C. C or QPS or score of level 4 on the math placement exam; admission to the Computer Science Honors Program or the Honors College or WISE.

4 credits

CSE 160: Computer Science A: Honors
First part of a two-semester sequence, CSE 160 and CSE 260. An introduction to procedural and object-oriented programming methodology and basic data structures. Topics include program structure, conditional and iterative programming, procedures, arrays, object classes, encapsulation, information hiding, inheritance, polymorphism, file I/O, exceptions and simple data structures, such as lists, queues and stacks.

Prerequisite: Computer Science Honors Program or University Scholar or permission of instructor

Corequisite: CSE 161

SBC: TECH

3 credits

CSE 161: Laboratory for Computer Science A: Honors
Must be taken concurrently with lecture component, CSE 160; a common grade for both courses will be assigned. Laboratory sessions will focus on development of pragmatic programming skills and use of programming environments and tools in a supervised setting.

Corequisite: CSE 160

1 credit

CSE 190: Special Topics in Practice and Applications of Computer Science
A lecture course on a current topic in the practice and application of computer science. May be repeated as the topic changes.

SBC: TECH

3 credits

CSE 191: Special Topics in Practice and Applications for Computer Science
A lecture course on a current topic in the practice and application of computer science. May be repeated as the topic changes.

SBC: TECH

3 credits

CSE 192: Special Topics in Practice and Applications for Computer Science
A lecture course on a current topic in the practice and application of computer science. May be repeated as the topic changes.

SBC: TECH

3 credits

CSE 214: Data Structures
An extension of programming methodology to data storage and manipulation on complex data sets. Topics include: programming and applications of data structures; stacks, queues, lists, binary trees, heaps, priority queues, balanced trees and graphs. Recursive programming is heavily utilized. Fundamental
arithmetic, control path design, and pipelining.

CSE 215: Foundations of Computer Science
Introduction to the logical and mathematical foundations of computer science. Topics include functions, relations, and sets; recursion; elementary logic; and mathematical induction and other proof techniques.
Prerequisite: AMS 151 or MAT 125 or MAT 131
3 credits

CSE 216: Programming Abstractions
Intermediate-level programming language concepts and paradigms, including functional programming, object-orientation, basics of type systems, event-driven programming, program and data abstractions, and modularity. Includes weekly recitations, which provide students with experience in the practice of programming in a variety of high-level languages such as Java, Scala, Haskell, Python or Javascript.
Prerequisites: C or higher in CSE 214; CSE major
4 credits

CSE 219: Computer Science III
Development of the basic concepts and techniques learned in CSE 114 Computer Science I and CSE 214 Computer Science II into practical programming skills that include a systematic approach to program design, coding, testing, and debugging. Application of these skills to the construction of robust programs of 1000 to 2000 lines of source code. Use of programming environments and tools to aid in the software development process.
Prerequisite: C or higher in CSE 214 and CSE major or ECE major
4 credits

CSE 220: Systems Fundamentals I
This course will introduce assembly language programming and essential concepts of computer organization and architecture. The focus of this course is on the computer organization of a computer system, including the processor architecture and the memory system. In particular, we will discuss the internal representation of information, performance evaluation methodology, instruction set architectures and implementation techniques for computer arithmetic, control path design, and pipelining.
Prerequisites: C or higher: CSE 214 or 260 and CSE major
3 credits

CSE 230: Intermediate Programming in C and C++
Intermediate programming concepts using the C language in a UNIX environment. Files, systems calls, stream I/O, the C preprocessor, bitwise operations, the use of makefiles, advanced formatting of input and output, conversions. Introduction to object-oriented programming using C++; classes, objects, inheritance, aggregation, and overloading. Suitable for all majors.
Prerequisite: CSE 130 or CSE 220 or ESE 124 or ESG 111 or BME 120 or MEC 102
3 credits

CSE 260: Computer Science B: Honors
Second part of a two-semester sequence, CSE 160 and CSE 260. Applies object-oriented programming methodology to data storage and manipulation on complex data sets, such as, binary trees, heaps, priority queues, balanced trees and graphs. Recursive programming is heavily utilized. Fundamental sorting and searching algorithms are examined along with informal efficiency comparisons. Intermediate-level programming language concepts and paradigms, including functional programming, basics of type systems, event-driven programming, program and data abstractions, and modularity.
Prerequisite: CSE 160 or CSE 220 or ESE 124 or ESG 111 or BME 120 or MEC 102
3 credits

CSE 261: Laboratory for Computer Science B: Honors
Must be taken concurrently with lecture component, CSE 260; a common grade for both courses will be assigned. Weekly laboratories provide students with experience in the practice of programming in a variety of high-level languages such as Java, Scala, Haskell, Python or Javascript.
Corequisite: CSE 260
1 credit

CSE 300: Technical Communications
Principles of professional technical communications for Computer Science and Information Systems majors. Topics include writing business communications, user manuals, press releases, literature reviews, and research abstracts. Persuasive oral communications and effective presentation techniques, to address a range of audiences, will also be covered. This course satisfies the upper-division writing requirement for CSE and ISE majors.
Prerequisites: WRT 102, CSE or ISE major, U3 or U4 standing
SBC: SPK, WRTD
3 credits

CSE 301: History of Computing
A study of the history of computational devices from the early ages through the end of the 20th century. Topics include needs for computation in ancient times, development of computational models and devices through the 1800’s and early 1900’s, World War II and the development of the first modern computer, and early uses in business. Creation of programming languages and the microchip. Societal changes in computer usage due to the microcomputer, emergence of the Internet, the World Wide Web, and mobile computing. Legal and social impacts of modern computing. Cannot be used as a technical elective for the CSE major or minor. This course is offered as both CSE 301 and ISE 301.
Prerequisite: U2 standing or higher
Advisory Prerequisite: one course in computing
DEC: H
SBC: STAS
3 credits

CSE 303: Introduction to the Theory of Computation
An introduction to the abstract notions encountered in machine computation. Topics include finite automata, regular expressions, and formal languages, with emphasis on regular and context-free grammars. Questions relating to what can and cannot be done by machines are covered by considering various models of computation, including Turing machines, recursive functions, and universal machines.
Prerequisites: C or higher: CSE 214 and 215 and CSE major
3 credits

CSE 304: Compiler Design
Topics studied include formal description of programming languages, lexical analysis, syntax analysis, symbol tables and memory allocation, code generation, and interpreters. Students undertake a semester project that includes the design and implementation of a compiler for a language chosen by the instructor.
Prerequisites: C or higher: CSE 216 or CSE 219 or CSE 260; CSE 220
Advisory Prerequisites: CSE 303 or CSE 350
CSE 305: Principles of Database Systems
The design of database management systems to obtain consistency, integrity, and availability of data. Conceptual models and schemas of data: relational, hierarchical, and network. Students undertake a semester project that includes the design and implementation of a database system.
Prerequisites: C or higher: CSE 216 or CSE 219 or CSE 260; CSE major.
3 credits

CSE 306: Operating Systems
Students are introduced to the structure of modern operating systems. Topics include virtual memory, resource allocation strategies, concurrency, and protection. The design and implementation of a simple operating system are performed.
Prerequisites: C or higher: CSE 216 or CSE 219 or CSE 260; CSE 320 or ESE 380; CSE Major or ECE major.
3 credits

CSE 307: Principles of Programming Languages
Presents examples of important programming languages and paradigms such as LISP, ALGOL, ADA, ML, Prolog, and C++. Students write sample programs in some of the languages studied. The languages are used to illustrate programming language constructs such as binding, binding times, data types and implementation, operations (assignment data-type creation, pattern matching), data control, storage management, parameter passing, and operating environment. The suitability of these various languages for particular programming tasks is also covered.
Prerequisites: C or higher: CSE 216 or CSE 219 or CSE 260; CSE 220; CSE major.
3 credits

CSE 308: Software Engineering
Introduces the basic concepts and modern tools and techniques of software engineering. Emphasizes the development of reliable and maintainable software via system requirements and specifications, software design methodologies including object-oriented design, implementation, integration, and testing; software project management; life-cycle documentation; software maintenance; and consideration of human factor issues.
Prerequisites: C or higher: CSE 219 or CSE 260; CSE 320; CSE 305 or CSE 306; U4 standing; CSE major.
3 credits

CSE 310: Computer Networks
Prerequisites: C or higher: CSE 214 or 260; CSE 220 or ISE 218; CSE major or ISE major. Advisory Pre- or Corequisite: AMS 310
3 credits

CSE 311: Systems Administration
This course covers practical techniques to manage information systems, also known as IT Systems Administration. Students will learn how to install computers for assorted hardware and software platforms (Windows, Unix/Linux, OS-X). Install networking equipment and configure it. Install server software on several systems (e.g. web, database, mail) and configure it. Secure the network, hosts, and services, and apply system patches. Set up redundant computing services, virtual machines/services, and hardware so that services can survive some hardware/software failures. Evaluate the performance, reliability, and security of the overall system. This course is offered as both CSE 311 and ISE 311.
Prerequisites: CSE 214 or CSE 230 or CSE 260 or ISE 208; ISE or CSE major.
3 credits

CSE 312: Legal, Social, and Ethical Issues in Information Systems
This course deals with the impact of computers on us as individuals and on our society. Rapid changes in computing technology and in our use of that technology have changed the way we work, play, and interact with other people. These changes have created a flood of new social and legal issues that demand critical examination. For example, technologies such as Gmail, Facebook, MySpace, along with music sharing sites and wikis create new social, ethical, and legal issues. This course is offered as both CSE 312 and ISE 312.
Prerequisites: U3 or U4 standing, one D.E.C. E or SNW course
SBC: CER, ESI, STAS
3 credits

CSE 316: Fundamentals of Software Development
Introduction to systematic design, development and testing of software systems, including event-driven and Web programming, information management, software design and development fundamentals, and the application of these skills to the construction of large robust programs. Includes weekly assignments and projects, which provide students with experience in the practice of design and programming.
Prerequisites: C or higher in CSE 216 or CSE 260; CSE major.
3 credits

CSE 320: Systems Fundamentals II
This course will introduce C programming and essential concepts of operating systems, compilers, concurrency, and performance analysis, focused around several cross-cutting examples, such as memory management, error handling, and threaded programming.
Prerequisite: C or higher: CSE 220 and CSE major.
3 credits

CSE 323: Human-Computer Interaction
A survey course designed to introduce students to Human-Computer Interaction and prepare them for further study in the specialized topics of their choice. Students will have the opportunity to delve deeper in the course through a course project, and through a two-three week special topic selected at the instructor’s discretion. Course is cross-listed as CSE 323, EST 323 and ISE 323.
Prerequisites: CSE 214 or CSE 230 or CSE 260 or ISE 208
3 credits

CSE 325: Computers and Sculpture
This multidisciplinary class surveys how computer science and computer technology are used in sculpture. Case studies with slides, videos, and software demonstrations illustrate a range of approaches of sculptors incorporating computers in their creative process. Various state-of-the art fabrication technologies are studied (with site visits if available on campus). Mathematical foundations are emphasized so students can recognize them when analyzing sculpture and choose the right tool when designing. In the weekly laboratory, these ideas are reinforced with projects using a range of available software and inexpensive construction materials, e.g., paper, cardboard, and foamcore.
Prerequisite: CSE 110 or CSE 101 or CSE 114
3 credits

CSE 327: Fundamentals of Computer Vision
Introduces fundamental concepts, algorithms, and techniques in visual information processing. Covers image formation, binary image processing, image features, model fitting, optics, illumination, texture, motion, segmentation, and object recognition.
Prerequisites: CSE 214 or CSE 230 or CSE 260; AMS 210 or MAT 211; CSE or ISE major
3 credits

CSE 328: Fundamentals of Computer Graphics
An introduction to computer graphics including graphics application programming; data structures for graphics; representing and specifying color; fundamental hardware and software concepts for calligraphic and raster displays; two-dimensional, geometric transformations; introduction to three-dimensional graphics; graphics standards; and input devices, interaction handling, and user-computer interface.
Prerequisites: C or higher: CSE 216 or CSE 219 or CSE 260; CSE 220; CSE major
3 credits

CSE 331: Computer Security Fundamentals
Introduces the basic concepts and terminology of computer security. Covers basic security topics such as cryptography, operating systems security, network security, and language-based security.
Prerequisite: CSE 220; CSE major
Advisory pre-or corequisite: CSE 320
3 credits

CSE 332: Introduction to Visualization
This course is an introduction to both the foundations and applications of visualization and visual analytics, for the purpose of understanding complex data in science, medicine, business, finance, and many others. It will begin with the basics - visual perception, cognition, human-computer interaction, the sense-making process, data mining, computer graphics, and information visualization. It will then move to discuss how these elementary techniques are coupled into an effective visual analytics pipeline that allows humans to interactively think with data and gain insight. Students will get hands-on experience via several programming projects, using popular public-domain statistics and visualization libraries and APIs. This course is offered as both CSE 332 and ISE 332.

Prerequisites: CSE 214 or CSE 260; MAT 211 or AMS 210; AMS 310; CSE or ISE major
3 credits

CSE 333: User Interface Development
Survey of user interface systems, with emphasis on responsive and adaptive strategies to accommodate cross-platform deployment across multiple devices such as desktops and mobile devices. Demonstration of the use of tool kits for designing user interfaces. Additional topics include human factors, design standards, and visual languages. Students participate in a project involving the design and implementation of user interface systems. This course is offered as both CSE 333 and ISE 333.
Prerequisite: CSE 214 or CSE 260; CSE or ISE major
3 credits

CSE 334: Introduction to Multimedia Systems
Survey of technologies available for user interfaces. Discussion of hypertext; voice, music, and video together with tools and models for capturing, editing, presenting, and combining them. Capabilities and characteristics of a range of peripheral devices including devices based on posture, gesture, head movement, and touch. Case studies of academic and commercial multimedia systems including virtual reality systems. Students participate in laboratory exercises and build a multimedia project. This course is offered as both CSE 334 and ISE 334.
Prerequisite: U2, U3 or U4 standing; CSE or ISE major
3 credits

CSE 336: Internet Programming
Introduces the design and development of software for Internet commerce. Topics include extended markup language, servlets, cookies, sessions, Internet media types, Web protocols, digital signatures, certificates, encryption, and the wireless Internet.
Prerequisites: C or higher in CSE 216 or CSE 219 or CSE 260; CSE major
3 credits

CSE 337: Scripting Languages
Scripting languages are widely used in the IT industry. Programming with scripting languages, also known as scripting, has several advantages compared to programming with other types of languages in that scripts facilitate rapid program development; can automate high-level jobs or tasks very effectively; and can be used to compose various software components, even binaries, into more complex and powerful applications. This course introduces the principles of scripting, covers one or two selected scripting languages in depth, and illustrates the advanced use of scripting by extensive case studies in application areas such as system administration, web application development, graphical user interface development, and text processing.
Prerequisites: CSE 114 or CSE 160 or ISE 208; CSE or ISE major; U3 or U4 standing
3 credits

CSE 340: Theory of Computation: Honors
Introduces the abstract notions of machine computation for honors students. Includes finite automata, regular expressions, and formal languages, with emphasis on regular and context-free grammars. Explores what can and cannot be computed by considering various models of computation including Turing machines, recursive functions, and universal machines.
Prerequisites: CSE 150; AMS 210 or MAT 211; CSE Honors Program or Honors College or WISE.
4 credits

CSE 346: Computer Communications
Basic theory and technology of computer communications. Introduction to performance evaluation, error codes and routing algorithms. Other topics include Ethernet, wireless networks including LTE and 5G, fiber optic networking, software defined networking, networking on chips, space networks, data centers, grids and clouds, and network security. Not for credit in addition to CSE 310 or ISE 316. This course is offered as both CSE 346 and ESE 346.
Pre- or corequisite for ESE and ECE majors: ESE 306
Pre- or corequisite for CSE majors: AMS 310 or 311
3 credits

CSE 350: Theory of Computation
This multidisciplinary course introduces both theoretical concepts and practical approaches to extract knowledge from data. Topics include linear algebra, probability, statistics, machine learning, and programming. Using large data sets collected from real-world problems in areas of science, technology, and medicine, we introduce how to preprocess data, identify the best model that describes the data, make predictions, evaluate the results, and finally report the results using proper visualization methods. This course also teaches state-of-the
art tools for data analysis, such as Python and its scientific libraries.

Prerequisites: CSE 214 or CSE 260; AMS 310; CSE major
3 credits

CSE 352: Artificial Intelligence
Topics covered include critique of artificial intelligence research; state-space problem representations and search algorithms; game-playing programs; theorem-proving programs; programs for the study and simulation of cognitive processes and pattern recognition. Further topics in current research as time permits.

Prerequisites: C or higher in CSE 216 or CSE 219 or CSE 260; CSE major
3 credits

CSE 353: Machine Learning
Covers fundamental concepts for intelligent systems that autonomously learn to perform a task and improve with experience, including problem formulations (e.g., selecting input features and outputs) and learning frameworks (e.g., supervised vs. unsupervised), standard models, methods, computational tools, algorithms and modern techniques, as well as methodologies to evaluate learning ability and to automatically select optimal models. Applications to areas such as computer vision (e.g., character and digit recognition), natural-language processing (e.g., spam filtering) and robotics (e.g., navigating complex environments) will motivate the coursework and material.

Prerequisites: CSE 216 or CSE 219 or CSE 260; CSE major
Pre- or Co-requisite: AMS 310 or AMS 311 or AMS 312
3 credits

CSE 354: Natural Language Processing
Natural language processing techniques power many intelligent language based applications. This course will introduce basic language analysis tasks such as language modeling and syntactic analysis, as well as core applications such as text classification, information extraction, question answering, and machine translation. The course will cover relevant algorithms, machine learning solutions, and evaluation methodologies.

Prerequisites: CSE 216 or CSE 219 or CSE 260; CSE major
3 credits

CSE 355: Computational Geometry
The design and analysis of efficient algorithms to solve geometric problems that arise in computer graphics, robotics, geographical information systems, manufacturing, and optimization. Topics include convex hulls, triangulation, Voronoi diagrams, visibility, intersection, robot motion planning, and arrangements. This course is offered as both AMS 345 and CSE 355.

Prerequisites: AMS 301; programming knowledge of C or C++ or Java
3 credits

CSE 356: Cloud Computing
Creating online services capable of handling millions of users requires a different mindset compared to traditional software development and deployment. Rather than building monolithic software packages from the ground up, bringing up modern online services calls for architecting systems by gluing together mature existing technologies deployed across many unreliable servers, working in concert to provide high-availability robust services. In this course, students will be exposed to the concepts and technologies behind deploying and scaling online services on the computing resources available in modern datacenters.

Prerequisites: C or higher in CSE 216 or CSE 219 or CSE 260; CSE major
Advisory prerequisite: CSE 336
3 credits

CSE 357: Statistical Methods for Data Science
This interdisciplinary course introduces the mathematical concepts required to interpret results and subsequently draw conclusions from data in an applied manner. The course presents different techniques for applied statistical inference and data analysis, including their implementation in Python, such as parameter and distribution estimators, hypothesis testing, Bayesian inference, and likelihood.

Prerequisites: C or higher in CSE 216 or CSE 219 or CSE 260; AMS 310; CSE major
3 credits

CSE 358: Security and Data Protection
This course will cover all aspects of web security, including browser security, web server security, and web application security. Topics include: SOP and JavaScript; application and protocol vulnerabilities; probing, surveillance, and tracking; penetration testing; modern social engineering techniques; monetary incentives and monetization.

Prerequisites: CSE 331; CSE major
3 credits

CSE 362: Mobile Security
The course covers the latest security technologies for mobile platforms (e.g., Android and iOS). It first introduces the security issues plaguing mobile apps and discusses defensive mechanisms, such as code signing, app permissions, and sandbox. It then peeks into mobile OS, explaining how jailbreaking/rooting works and the internals of iOS/Android security designs. Finally, it surveys modern hardware-level security features, such as secure booting, TrustZone, and biometrics.

Prerequisites: CSE 331; CSE major
3 credits

CSE 363: Offensive Security
Hands-on course with the goal of understanding various security problems in depth, through a more adversarial way of thinking. By focusing on finding and exploiting vulnerabilities, the course will cover a broad range of topics, including the ethics of offensive security, reverse engineering, software vulnerability discovery and exploitation, malicious code analysis, network traffic interception and manipulation, reconnaissance and information gathering, physical security, and social engineering. All topics will be covered from a highly practical perspective, following a hands-on approach and tutorial-like sessions, along with programming assignments.

Prerequisites: CSE 331; CSE major
3 credits

CSE 364: Advanced Multimedia Techniques
Digital media production techniques for high-bandwidth applications such as electronic magazine illustration, broadcast television, and motion picture special effects. Students explore techniques such as 3D modeling and character animation, video compositing, and high-resolution image processing in a state-of-the-art multimedia computing laboratory. High-capacity multimedia storage, high-speed networks, and new technologies such as DVD, HDTV, and broadband will be reviewed. This
CSE 366: Introduction to Virtual Reality
An introduction to the practical issues in the design and implementation of virtual environments. Topics covered include the fundamentals of systems requirements, transformations, user-interaction models, human vision models, tracking systems, input/output devices and techniques, and augmented reality. The topics covered are explained through the use of real-life applications of virtual-reality systems in engineering, science, and medicine.
Prerequisites: CSE 328 or CSE/ISE 332; CSE major
3 credits

CSE 370: Wireless and Mobile Networking
Prerequisite: CSE 310 or 346; CSE major
3 credits

CSE 371: Logic
A survey of the logical foundations of mathematics: development of propositional calculus and quantification theory, the notions of a proof and of a model, the completeness theorem, Goedel's incompleteness theorem. This course is offered as both CSE 371 and MAT 371.
Prerequisite: CSE 150 or CSE 215 or MAT 200 or MAT 250
3 credits

CSE 373: Analysis of Algorithms
Mathematical analysis of a variety of computer algorithms including searching, sorting, matrix multiplication, fast Fourier transform, and graph algorithms. Time and space complexity. Upper-bound, lower-bound, and average-case analysis. Introduction to NP completeness. Some machine computation is required for the implementation and comparison of algorithms. This course is offered as CSE 373 and MAT 373.
Prerequisites: C or higher in MAT 211 or AMS 210 or MAT 219 or 260; CSE 214 or CSE 260
3 credits

CSE 376: Advanced Systems Programming in UNIX/C
Focuses on several aspects of producing commercial-grade system software: reliability, portability, security, and survivability. Uses Unix and C, heavily used in industry when developing systems and embedded systems code. Emphasizes techniques and tools to produce reliable, secure, and highly portable code. Requires substantial programming as well as a course project.
Prerequisites: C or higher: CSE 216 or CSE 219 or 260; CSE 320 or 230 or ESE 224 or ESG 111; CSE or ECE major
3 credits

CSE 377: Introduction to Medical Imaging
An introduction to the mathematical, physical, and computational principles underlying modern medical imaging systems. Covers fundamentals of X-ray computer tomography, ultrasonic imaging, nuclear imaging, and magnetic resonance imaging (MRI), as well as more general concepts required for these, such as linear systems theory and the Fourier transform. Popular techniques for the visualization, segmentation, and analysis of medical image data are discussed, as well as applications of medical imaging, such as image-guided intervention. The course is appropriate for computer science, biomedical engineering, and electrical engineering majors.
Prerequisites: AMS 161 or MAT 127 or 132 or 142; AMS 210 or MAT 211
3 credits

CSE 378: Introduction to Robotics
Introduces basic concepts in robotics including coordinate transformation, kinematics, dynamics, Laplace transforms, equations of motion, feedback and feedforward control, and trajectory planning. Covers simple and complex sensors (such as cameras), hybrid and behavior based control and path planning. Concepts are illustrated through laboratories using the LEGO Robot Kit.
Prerequisites: AMS 161 or MAT 127 or 132 or 142; AMS 210 or MAT 211 or MEC 262
3 credits

CSE 380: Computer Game Programming
An introduction to the fundamental concepts of computer game programming. Students design and develop original games for PCs applying proven game design and software engineering principles.
Prerequisite: CSE 214 or CSE 230 or CSE 260; CSE major
3 credits

CSE 381: Advanced Game Programming
This course explores the concepts and technologies behind making 3D, networked games. This will include the examination of game engine creation as well as the use of middleware to build graphically sophisticated game systems.
Prerequisites: CSE 328 or CSE 380; CSE major
3 credits

CSE 385: Analysis of Algorithms: Honors
Algorithmic design and analysis for Computer Science Honors students. Mathematical analysis of a variety of computer algorithms including searching, sorting, matrix multiplication, fast Fourier transform, and graph algorithms. Time and space complexity. Upper-bound, lower-bound, and average-case analysis. Randomization. Introduction to NP completeness. Some machine computation is required for the implementation and comparison of algorithms.
Prerequisites: CSE 260; AMS 210 or MAT 211; Computer Science Honors Program or Honors College or WISE
4 credits

CSE 390: Special Topics in Computer Science
A lecture or seminar course on a current topic in computer science. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements.
Prerequisite: CSE Major
3 credits

CSE 391: Special Topics in Computer Science
A lecture or seminar course on a current topic in computer science. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements.
Prerequisite: CSE Major
3 credits

CSE 392: Special Topics in Computer Science
A lecture or seminar course on a current topic in computer science. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements.
Prerequisite: CSE Major
3 credits

CSE 393: Special Topics in Computer Science

A lecture or seminar course on a current topic in computer science. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements.

**Prerequisite:** CSE Major

**3 credits**

**CSE 394: Special Topics in Computer Science**

A lecture or seminar course on a current topic in computer science. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements.

**Prerequisite:** CSE Major

**3 credits**

**CSE 475: Undergraduate Teaching Practicum**

Students assist faculty in teaching by conducting a recitation or laboratory section that supplements a lecture course. The student receives regularly scheduled supervision from the faculty instructor. May be used as an open elective only and repeated once.

**Prerequisites:** U3 or U4 standing as an undergraduate CEAS major; a minimum g.p.a. of 3.00 in all Stony Brook courses; grade of B or better in the course in which the student is to assist and permission of department.

**SBC:** EXP+

**3 credits**

**CSE 487: Research in Computer Science**

An independent research project with faculty supervision. Only three credits of research electives (AMS 487, CSE 487, BME 499, ESE 499, ESM 499, ISE 487, and MEC 499) may be counted toward technical elective requirements. May not be taken for more than six credits.

**Prerequisites:** Permission of instructor and department

**0-6 credits**

**CSE 488: Internship in Computer Science**

Participation in local, state, national, or international private enterprise, public agencies, or nonprofit institutions. To obtain permission to register for the courses, students are required to submit proof that the work is related to their studies and the work will include a minimum of 180 hours during the semester. During the semester, the student will submit progress reports and a final report on their experience to the client and to the department. May be repeated up to a limit of 12 credits but can only be used once as a technical elective to satisfy CSE major requirements.

**Prerequisites:** CSE major, U3 or U4 standing; permission of department

**SBC:** EXP+

**3 credits, S/U grading**

**CSE 495: Senior Honors Research Project I**

A two-semester research project carried out under the supervision of a computer science faculty member. Students who enroll in CSE 495 must complete CSE 496 in the subsequent semester and receive only one grade upon completion of the sequence.

**Prerequisite:** Admission to the Computer Science Honors Program

**3 credits**

**CSE 496: Senior Honors Research Project II**

A two-semester research project carried out under the supervision of a computer science faculty member. Students must submit a written project report and make a presentation to the department at the year-end Honors Project Colloquium.

**Prerequisite:** CSE 495

**3 credits**