Computer Science Program

Undergraduate Handbook

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UNDERGRADUATE STUDY IN COMPUTER SCIENCE

Department of Electrical Engineering and Computer Science
Howard University
Washington, DC 20059

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Overview of Degree Programs and Requirements

The Computer Science Program provides an undergraduate program leading to the award of the Bachelor of Science in Computer Science, and a computer science minor option for non-engineering disciplines at Howard University, and instruction and research leading to the Master's degree in Computer Science.

About Computer Science

Computer Science, generally defined, is the study of problem-solving procedures, computability and computation systems. Computer engineers and computer science professionals are proficient in several programming languages and are familiar with advanced mathematical concepts in subjects such as linear algebra, matrix theory, topology and Boolean algebra. Often, they work with individuals from other disciplines to coordinate new developments in hardware and software. Computer utilization has made the solutions to complex problems, once considered intractable, feasible because of the speed, accuracy and versatility of the modern computer.

Undergraduate Program

The Program offers a program of study geared to students who wish to pursue careers in the emerging field of software engineering. The undergraduate curriculum provides students with a comprehensive knowledge of the theory, design and application of digital computers, information processing technologies and systems engineering. The program is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 – telephone: (410) 347-7700.

There is an emphasis on the engineering of computer software, as well as engineering with computers, with particular stress on software and the software/hardware interface. The first two years of instruction prepare students in the engineering fundamentals, while the last two years of instruction focus on systems engineering and computer science and a concentration area of their own interest. In addition to formal course work, students are encouraged to serve an informal internship of at least one summer in a computer-oriented laboratory within the University or at another computing facility.

Students seeking the Bachelor of Science degree in Computer Science must complete a minimum of 120 credit hours including core courses in Computer Science, and Liberal Arts. Elective courses in Computer Science, Mathematics, Chemistry, Biology, Physics,

Computer Engineering, Electrical Engineering, Humanities/Social Science, and African American Studies are also required. The curriculum breakdown is listed below.

Concentration	Credit Hours
Computer Science Core	53
Technical Electives	12
Liberal Arts Core Curriculum	40
Social Sciences and Humanities Elective Courses	12
African American Cluster Core	3
Total	**120**

Computer Science Core (53 credit hours)

CSCI-100 Introduction to Computer Science, 3
CSCI-135 Computer Science I, 4
CSCI-136 Computer Science II, 3
CSCI-354 Computer Science III, 3
CSCI-201 Computer Organization I, 3
CSCI-202 Computer Organization II , 3
CSCI-211 UNIX Lab, 1
CSCI-363 Large Scale Programming, 3
CSCI-341 Theory of Computation, 3
CSCI-470 Fundamentals of Algorithms, 3
CSCI-375 Software Engineering, 3
CSCI-350 Structures of Programming Languages, 3
CSCI-432 Database Systems, 3
CSCI-376 Operations Research, 3
CSCI-401 Operating Systems, 3
CSCI-410 Modeling and Simulation, 3
CSCI-472 Systems Management Analysis, 3
CSCI-491 Senior Design Project I, 2
CSCI-492 Senior Design Project II, 2

University Requirements

The University-wide core curriculum course requirements are met by the curriculum. The core themes and Computer Science courses that satisfy the requirements are listed in the following table.

Core Theme	Computer Science
Intellectual Openness and Cultural Diversity	Introduction to Engineering EGPP-101 Introduction to Computer Sci. CSCI-100

Historical Awareness	African American Elective Humanities/Social Science Elective
Empirical Analysis	CSCI-491 Senior Design Project I CSCI-492 Senior Design Project II
Quantitative Literacy & Statistical Reasoning	MATH-189 Probability & Statistics (3)
Social and Human Relations	Humanities/Social Science Elective
Other Core Experiences	University Events – lectures, convocation, College/Department/Program Lecture series, CEACS Student Leadership Institute, Exhibitions, Study/travel Program, Middle & High School Education Programs, etc.

In addition to formal course work, students are encouraged to serve an informal internship of at least one summer in a computer-oriented laboratory within the University or at other computing facilities when deemed appropriate by their advisor. Students are eligible for internships after completion of at least three semesters of course work or in special instances upon recommendation of the advisor.

Computer Science Option for Non-Engineering Majors

The Computer Science option for non-engineering students is intended for use by departments that use it as a minor. Students must take the following three courses:

CSCI 100	Intro to Computer Science	3
CSCI 135	Computer Science I	4
CSCI 136	Computer Science II	3

At least two additional courses (more if required by the student's own departments) must be taken from the following list, or courses from the department approved by the chair and course instructor:

CSCI 201	Computer Organization I	3
CSCI 202	Computer Organization II	3
CSCI-263	Web Makers	3
CSCI 165	Scientific Computing for Eng.	3
EECE 211	Intro to Digital Systems	3
CSCI 432	Database Systems	3
MATH 181	Discrete Structures	3
CSCI 354	Computer Science III	3
CSCI 363	Large Scale Programming	3
CSCI-421	Computer and Video Game Dev	3
CSCI-402	Mobile Application Development	3
CSCI-410	Modeling and Simulation	3
CSCI-453	Introduction to Cybersecurity I	3

Any other selection must be approved in advance by the chair of the department.

Intro to Digital Systems (EECE-211) should not be taken until the student has completed Computer Science II (CSCI 136) and Computer Organization I (CSCI 201).

Discrete Structures (MATH 181) should not be taken until the student has completed Computer Science II (CSCI 136). Calculus is also a prerequisite for MATH 181. Minors based on this option may choose to count a calculus course taken from the department of Mathematics as part of the minor.

Large Scale Programming (CSCI-363), Computer and Video Game Development (CSCI-421), Mobile Application Development (CSCI-402) should not be taken until the student has completed Computer Science III (CSCI 354).

Prerequisite Structure for Core Computer Science Courses

For simplicity, only the most direct prerequisite is shown both a table and flow chart below.

Course	Prerequisite(s)
CSCI 135 Computer Science I	'C' or better in **CSCI 100** Intro. To Computer Science
CSCI 136 Computer Science II	'C' or better in **CSCI 135** Computer Science I
CSCI 354 Computer Science III	'C' or better in **CSCI 136** Computer Science II
CSCI 201 Computer Organization I	'C' or better in **CSCI 135** Computer Science I
CSCI 202 Computer Organization II	**CSCI 201** Computer Organization I
CSCI 363 Large Scale Programming	'C' or better in **CSCI 13**6 Computer Science II
CSCI 375 Software Engineering	**CSCI 354** Computer Science III
CSCI 376 Operations Research	**CSCI 375** Software Engineering
CSCI 350 Structure of Programming Languages	**CSCI 20**1 Computer Organization I and **CSCI 341** Theory of Computation
CSCI 472 Systems Management Analysis	**CSCI 375** Software Engineering
CSCI 410 Modeling and Simulation	
CSCI 341 Theory of Computation	**CSCI 136** Computer Science II and **MATH 181** Discrete Structures
CSCI 432 Database Systems	**CSCI 136** Computer Science II
CSCI 401 Operating Systems	**CSCI 202** Computer Organization II and **CSCI 363** Large Scale Programming
CSCI 470 Fundamentals of Algorithms	**CSCI 354** Computer Science III
CSCI 491 Senior Project I	
CSCI 492 Senior Project II	**CSCI 491** Senior Project I

Prerequisite Structure for Non-Core Computer Science Courses

For simplicity, only the most direct prerequisite is shown in table below.

Course	Prerequisite(s)
CSCI 165 Scientific Computing for Engineers	

CSCI 203 Object-Oriented Programming using Java	CSCI 136 Computer Science II
CSCI 364 Web Services	
CSCI 379 Introduction to Human Computer Interaction	CSCI 354 Computer Science III
CSCI 390 Ethical and Social Impact of Computing	
CSCI 391 Patents and Technology Entrepreneurship	Junior Standing
CSCI 402 Mobile Application Development	CSCI 363 Large Scale Programming
CSCI 421 Computer and Video Game Development	CSCI 354 Computer Science III, Software Engineering
CSCI 422 Game Engine Programming	CSCI 421 Computer and Video Game Development
CSCI 440 Object-Oriented Programming	CSCI 354 Computer Science III
CSCI 450 Data Communications and Network Programming	CSCI 354 Computer Science III, CSCI 201 Computer Organization I, CSCI 470 Fundamentals of Algorithms, MATH 181 Discrete Structures
CSCI 451 Applied Wireless Networking	CSCI 450 Data communications
CSCI 453 Intro to Cybersecurity I	Junior Standing
CSCI 454 Intro to Cybersecurity II	CSCI 453 Intro to Cybersecurity I
CSCI 460 Advanced Systems Administration	CSCI 211 Unix Lab
CSCI 474 Computational Biology	CSCI 470: Fundamentals of Algorithms, MATH 189: Probability and Statistics
CSCI 475 Introduction to Machine Learning	CSCI 354: Computer Science III, MATH 189: Probability and Statistics
CSCI 476 Intro to Artificial Intelligence	Pre-req: CSCI 350 Structures of Programming Languages.
CSCI 478 Engineering Economic System Design	CSCI 376 Operations Research
CSCI 493 Lean Launch Pad: Startups	Junior Standing
CSCI 480 Digital Media and Multimedia Applications	Junior Standing
CSCI 498 Special Topics: Robotics Programming	Junior Standing

Undergraduate Courses

EGPP-101 Introduction to Engineering 2 Credits

Provides information on engineering education, the engineering profession, engineering basic concepts and engineering tools. Introduces the engineering design process and provides the opportunity for students to complete engineering design projects.

CSCI-100 Introduction to Computer Science 3 Credits

This course introduces the fundamentals of computer science. A brief examination of critical, creative, scientific thinking, is followed by more details on computational thinking. The focus is hands on computing exercises and group exercises that stress the importance of algorithms and problem solving. Students are exposed to the research agenda of the program, the different track options and career opportunities along the different tracks.

CSCI-140 Programming Team 1 Credit

This course is for participants of the programming team.

CSCI-135 Computer Science I 4 Credits

This course introduces the discipline of computer programming. Closed laboratory to reinforce lecture topics and introduce new topics. Course is designed to expose students to basic programming concepts and to the use of the C++ language. This course is designed to enhance the student's ability to design, develop and test/debug programs. Each student will increase his or her skill in writing correct and maintainable programs. Emphasis will be placed on problem analysis and on the subsequent development of algorithms. Several standard data types will be discussed and the student will gain an understanding of the issues relating to the use, design and implementation of each type in C++. A major focus of the lectures will be to provide an overview of real-world problem-solving concepts and top-down software design. Prerequisite: Intro. to Computer Science (with a grade of 'C' or better).

CSCI-136 Computer Science II 3 Credits

Course exposes students to the software development life cycle with a focus on the concepts and use of the object-oriented paradigm in problem analysis, solution design, software development and implementation. This course is designed to enhance the student's ability to engineer software that is efficient, maintainable and cost efficient over its entire life cycle. Data abstraction is discussed in depth and students gain experience in the use of classes, object and member functions. Students gain an understanding of the development of reusable abstract data types. Software reuse is emphasized and object-oriented concepts are used throughout the course. O-notation and the complexity of algorithms are discussed at relevant points in the course. Prerequisite: Computer Science I (with a grade of 'C' or better).

CSCI-165 Scientific Computing for Engineers 3 Credits

Scientific computing consists of computing using computers to analyze and solve scientific problems which usually concerned with constructing mathematical models and quantitative analysis techniques. Scientists and engineers develop computer programs and software that model systems and run these programs with various sets of input. Typically, these models require intensive computing and are often executed on supercomputers or distributed computing platforms. In this course three software/programming tools (Excel, Maxima, and C) are studied to investigate how scientific problems are solved in their appropriate domain. All of the three tools would be running on a PC platform.

CSCI-354 Computer Science III 3 Credits

The course continues the study of data structures and algorithms, focusing on algorithmic design and problem analysis and the relationships between data representation, algorithm design, and program efficiency. Topics include advanced data structures, key algorithm design techniques, analysis of the time and space requirements of algorithms, and the subsequent development of solution of systems. Concrete examples will be drawn from a variety of domains, such as algorithms for trees and graphs, indexing and search, and real-world problems. Prerequisite: Computer Science II (with a grade of 'C' or better).

CSCI-201 Computer Organization I 3 Credits

This course will cover the fundamentals required to understand the relationship between computer hardware and software. Topics include data representation on computers, computer arithmetic, Boolean algebra and digital logic, and assembly programming in MIPS. Prerequisite: Computer Science I (with a grade of 'C' or better).

CSCI-202 Computer Organization II 3 Credits

This course will present the relationship between computer hardware and software, and the fundamental knowledge essential for understanding and designing the operations of computer systems. Topics include performance evaluation, non-pipelined and pipelined datapath, memory hierarchies, and I/O devices. Prerequisite: Computer Organization I.

CSCI 211 UNIX Lab 1 Credit

This course will present the basic concepts of LINUX and UNIX operating systems. Topics that will be examined include Vi editor, Linux Command, directories, Disks and File systems, Users and Groups, File Permissions, Processes, file compression, basic network use, manage files, create and modify files, and Shell script.

CSCI-203 Object-Oriented Programming using Java 1 Credit

This course introduces Java programming and object-oriented programming concepts for students with previous programming experience in C/C++. The course provides a

comprehensive overview of basic programming concepts in the Java programming language using an object-oriented approach. Prerequisite: Computer Science I.

CSCI-350 Structure of Programming Languages 3 Credits

The course will teach students the basic components of the design and analysis of computer programming languages as well as the fundamental computation theory that is required to understand those concepts. The course will also cover several non-imperative languages (unlike C, such as LISP and Prolog) to expose students to the diversity of programming languages. Prerequisite: Computer Organization I, Theory of Computation.

CSCI-341 Theory of Computation 3 Credits

Introduction to the classical theory of computer science. A study of the formal relationships between machines, languages and grammars; we will cover regular, context-free, context-sensitive, recursive and recursive enumerable languages. Sequential machines and their applications to devices, processes, and programming. Models of computation: finite state automata, push down automata, Turing machines. The role of non-determinism. Prerequisite: Computer Science II and Discrete Structures.

CSCI-363 Large Scale Programming 3 Credits

This course will introduce students to the Java Programming language, and to applications and systems in the large scale. Students will be introduced to the object-oriented method to software design using UML and will apply the object-oriented design/analysis techniques of UML to a realistic Java application. Students will gain familiarity with managing larger projects and OOA/D. Prerequisite: Computer Science II.

CSCI-375 Software Engineering 3 Credits

This course will introduce students to the basic concepts of software engineering and the software development life cycle. The course will cover methodological techniques for software specification, design, implementation, testing, verification, and documentation. The course will also present the use of state-of-the-art tools for computer-aided software engineering (CASE). Prerequisite: Computer Science III (CSCI-354).

CSCI-376 Operations Research 3 Credits

Methodology for planning, analyzing and evaluating optimal systems: identifying and structuring objectives and defining performance requirements that influence the design of the system. Synthesizing and analyzing alternative solutions and applying optimization techniques for the optimum queuing system. Applications to real world systems with open and closed queues with emphasis on computer systems using microcomputer software packages. Prerequisite: CSCI-375 Systems Engineering I.

CSCI-379 Introduction to Human Computer Interaction 3 Credits

Students will learn the fundamental concepts of human-computer interaction and user-centered design thinking, through working in teams on an interaction design project, supported by lectures, readings, and discussions. They will learn to evaluate and design usable and appropriate software based on psychological, social, and technical analysis. They will become familiar with the variety of design and evaluation methods used in interaction design, and will get experience with these methods in their project. Prereq: Computer Science III

CSCI-390 Ethical and Social Impact of Computing 3 Credits

This course will present the foundations of ethics in the context of computing. The broader social impact of computing and technology in general will also be reviewed. Areas of specific focus will include technology and human values, costs and benefits of technology, the character of technological change, and the social context of work in computer science and information technology.

CSCI-401 Operating Systems 3 Credits

This course will present the basic concepts of operating systems. Topics that will be examined include processes and interprocess communication/synchronization, virtual memory, program loading and linking system calls and system programs; interrupt handling, device and memory management, process scheduling, deadlock and the trade-offs in the design of large-scale multitasking operating systems. Prerequisite: Computer Organization II, and Large-Scale Programming.

CSCI-410 Modeling and Simulation 3 Credits

Introduces the fundamentals of system design and modeling. Emphasizes advantages and limitations of various modeling techniques for different applications. Introduces probability distributions typical of queuing models and presents in-depth discussions and experiments with existing simulation packages.

CSCI-450 Data Communications and Network Programming 3 Credits

This is an introductory course on computer networking. It will cover the layering model of the Internet. The upper four layers (application, transport, network and data link) will be discussed in detail with dominant networking protocols and algorithms introduced. Students will also learn how to do basic programming on the Internet. Prereq: Computer Science III, Computer Organization I, Fundamentals of Algorithms, Discrete Structures

CSCI-432 Database Systems 3 Credits

This course will present the basic concepts of database systems. Topics that will be covered include basic relational database theory, relational database modeling, relational database design and implementation, normalization, transaction management, the SQL

language and other languages and facilities provided by database management systems. Prerequisite: Computer Science III.

CSCI-472 Systems Management Analysis 3 Credits

This course presents methodology for large-scale system design and analysis using modern semantic analysis techniques. Identification and definition of large-scale (community/industrial-based) problems. Discusses how to select and quantify measures of the severity of the problem. Presents different techniques for modeling alternative solutions to problems. Prerequisite: Software Engineering.

CSCI-478 Engineering Economic System Design· 3 Credits

Presents methodology for system design. Methodology begins with identification and definition of private sector problems to which solutions are justified by economics. Discusses selection of appropriate economic measures for comparing alternative solutions such as present worth, equivalent annual cost, cost/benefit ratio, life cycle cost, return on investment payback period. Presents different techniques for modeling alternative solutions to the problems and predicting cost. Other topics discussed include decision-making, system implementation, operations and retirement. Prerequisite: Operations Research.

CSCI-491 Senior Project I 2 Credits

Allows the senior student the opportunity to demonstrate his or her knowledge of computer science principles by application to a class project of his or her choosing, with the guidance and supervision of a faculty member. The student develops a proposal for the project, followed by an architectural design and detailed design, all of which must be presented in class. Prerequisite: Computer Organization II.

CSCI-492 Senior Project II 2 Credits

In part two, the senior student develops and implements the system solution to the proposed project. The system, most commonly comprising computer software, hardware, procedures, etc., is implemented and tested in the program's Systems Development Laboratory. The student is required to demonstrate the system solution to the faculty and the student body of the program. Prerequisite: Senior Project I.

CSCI-451 Applied Wireless Networking· 3 Credits

From both the conceptual and practical standpoints, this course will present the basics of wireless networking. Topics that will be examined include the connection between wireless networks and the Internet, radio signal transmission fundamentals, wireless LAN/WAN industrial stands, and wireless network administration such as network design, installation, configuration, maintenance and trouble shooting. Prerequisite: Data Communications

CSCI-453 Introduction to Cybersecurity I 3 Credits

Computer Security Overview. Malware and Cyberwarfare. Passwords. Biometrics. Access Controls. Multilevel Security. Multilateral Security. Firewalls. Intrusion Detection. Cryptography Before 1970. Symmetric Key Cryptography. The Data Encryption Standard (DES). The Public Key Paradigm. Knapsacks. The RSA Approach to Public Key Cryptology. Elliptic Curve Cryptography. The Advanced Encryption Standard (Rijndael). Hash Functions. The Digital Signature Standard.

CSCI-454 Introduction to Cybersecurity II 3 Credits

Distributed Denial of Service (DDoS). Hash Functions. SHA-3 and Keccak. Network Security. Network attack and defense. Steganography, Software security I. Software flaws. Malware. Miscellaneous software based attacks. Software security II. Software reverse engineering. Software tamper resistance. Digital rights management. Software development. Stuxnet and Cyberwarfare. Advanced encryption techniques. Elliptic Curves and Elliptic Curve Cryptography. Electronic voting. Quantum cryptography. Prerequisite: Intro to Cybersecurity I

CSCI-421 Computer and Video Game Development 3 Credits

The course will span the software domains embedded in computer and video games. Topics such as game computational infrastructure, design, engines, and motion will be presented through discussion and assignments. Game industry guest speakers will discuss software challenges and opportunities. Students completing this course will understand the software development process required to create a successful game and possess the programming expertise to create a simple game. Prerequisite: Computer Science III, Software Engineering.

CSCI-422 Game Engine Programming 3 Credits

Game engine programming is introduced as a critical element in compelling game creation. Programming activity will feature input capture, world integration, object motion, collision detection and audio scoring. Game performance metrics, code optimization and quality assurance testing procedures will be emphasized. Code examples will be presented from XNA game studio and Torque. Course game project may be completed using a 2D or 3D game engine of choice including Torque, Gamestudio, Panda3D, or OGRE 3D rendering engine. Prerequisite: Computer and Video Game Development.

CSCI-402 Mobile Application Development 3 Credits

This course will introduce students to developing applications which target mobile devices. Students will be introduced to many issues unique to mobile applications, including synchronization, remote data access, security and sometimes-connected networks. They will research topics in these areas and develop a significant project which demonstrates their knowledge and understanding of these issues. Prerequisite: Large Scale Programming.

CSCI-480 Digital Media and Multimedia Applications· 3 Credits
This course provides an introduction to digital media fundamentals including audio, video formats, storage and delivery. Windows Media and other technology will be extensively utilized as a method for digital content manipulation, rights management and internet transfer. Students will be exposed to basic internet architecture, operations and useful world wide web (WWW) resources. In addition, a practical understanding of digital computational devices, communication ports and connection cables will be acquired. Prerequisite: Junior Standing.

CSCI-364 Web Services· 3 Credits
Presents topics in distributed computing with particular emphasis on Web Services using Microsoft .NET Framework. Also, discussion on layered protocols, the client-server model, remote procedure call. Students program extensively in C# and Visual Basic .NET. Prerequisite: 306-401 Operating Systems.

CSCI-460 Advanced Systems Administration· 3 Credits
Advanced system administration course provides a strong practical experience to Linux and Solaris operating systems. The course includes topics such as Samba (Windows file and print sharing), Email, Web serving with Apache, remote access, networking setup, Internet proxy services, fire wall and security administration, deploy LDAP in a Linux, Solaris and windows environment and also compile, configure and patch a Kernel module. Prerequisite: Unix Lab

CSCI-470 Fundamentals of Algorithms 3 Credits
Techniques for designing efficient algorithms, analyzing their complexity and applying these algorithms to a broad range of application settings. Methods for recognizing and dealing with hard problems are studied. Prerequisite: CSCI 354: Computer Science III.

CSCI-474 Computational Biology 3 Credits
Introduces computational methods for understanding biological systems at the molecular level. Problem areas such as mapping and sequencing, sequence analysis, structure prediction, phylogenic inference, regulatory analysis. Techniques such as dynamic programming, Markov models, expectation-maximization, local search. Prerequisite: CSCI 470: Fundamentals of Algorithms, MATH 189: Probability and Statistics

CSCI-475 Introduction to Machine Learning 3 Credits
Techniques for learning from data and applying these algorithms to application settings. Topics covered include Bayesian methods, linear classifiers such as the perceptron, regression, and non-parametric methods such as k-nearest neighbors. Prerequisite: CSCI 354: Computer Science III, MATH 189: Probability and Statistics

CSCI-476 Introduction to Artificial Intelligence 3 Credits

This course will introduce students to contemporary topics in artificial intelligence. Topics that will be examined include basic AI concepts, representations, and techniques used in building practical computational systems (agents) that appear to display artificial intelligence, through the use of adaptive information processing algorithms. During the semester students will learn general knowledge representation techniques and problem-solving strategies. Topics will include search, intelligent agents, game playing and rule-based systems. Prerequisite: CSCI 350 Structures of Programming Languages.

EGPP-493 Bison Startup: Technology Entrepreneurship and Lean Startups 3 Credits

This course provides real world, hands-on learning on what it's like to start a high-tech company. This class is not about how to write a business plan. It's not an exercise on how smart you are in a classroom, or how well you use the research library to size markets. And the end result is not a Power Point slide deck for a VC presentation. And it is most definitely not an incubator where you come to build the—hot-idea that you have in mind. This is a practical class–essentially a lab, not a theory or—book class. Our goal, within the constraints of a class room and a limited amount of time, is to create an entrepreneurial experience for you with all of the pressures and demands of the real world in an early stage startup. You will be getting your hands dirty talking to customers, partners, competitors, as you encounter the chaos and uncertainty of how a startup works. You'll work in teams learning how to turn a great idea into a great company. You'll learn how to use a business model to brainstorm each part of a company and customer development to get out of the classroom to see whether anyone other than you would want/use your product. Finally, based on the customer and market feedback you gathered, you would use agile development to rapidly iterate your product to build something customers would actually use and buy. Each day will be new adventure outside the classroom as you test each part of your business model and then share the hard-earned knowledge with the rest of the class. Junior Standing and CEACS major.

EGPP-494 Bison Accelerate: Launch and Iterate 3 Credits

This course is an immersive experience for students serious about launching a technology startup. Students will learn from invited guests and online material on specific activities that must take place to have a successful startup, and execute them through a series of sprints to launch their own technology venture. Student teams will enter the build phase as quickly as possible and develop a Minimal Viable Product (MVP) that will allow them to test clear hypothesis they have about their product/service. Students will measure the impact of their product/service into the marketplace using actionable metrics to analyze customer behavior. Student teams will learn whether their original assumptions about the product/service, process, and customer needs were correct, or whether they need to change strategies and iterate their MVP.

CSCI-498 Special Topics: Robotics Programming 3 Credits

The primary focus of this course will be behavior-based robotics, which uses semi-autonomous artificial intelligence modules for planning. Behavior-based robots use sensor information to react to changes in an environment, instead of complicated internal models. Higher level concepts that will be covered include multi-robot communication, robot localization and path planning. Prerequisite: Junior Standing, MEEG, ECEG, CSCI major.

CS Concentration Tracks

The Program offers students the ability to take prescribed technical electives and science elective courses geared toward their specific interest in the following tracks:

A. Computer Science
B. Gaming
C. Computer Networking
D. Cyber Security
E. Computational Biology
F. Computational Chemistry
G. Computational Mathematics
H. Computational Physics

By default, all students entering into the program are under the Computer Science track.

Science Requirements

Three courses based on the concentration track selected.

<Science A > --1/2 year of any laboratory science course listed must be taken:
<Science B (I) > and <Science B (II) > -- 1 full year of a different laboratory science course than <Science A> must be taken.

Science courses include:

1. BIOL 101 Biology I
2. BIOL 102 Biology II
3. CHEM 003 Chemistry I, and CHEM 005 Chemistry Lab
4. CHEM 004 Chemistry II, and CHEM 006 Chemistry Lab II
5. PHYS 013 Physics for Engineers I, and PHYS 023 Physics for Engineers Lab I
6. PHYS 014 Physics for Engineers II, and PHYS 024 Physics for Engineers Lab II

Science Courses By Track:

A. Computational Biology
    1. Can take any science course not from the Department of Biology (Science A).
    2. BIOL 101 General Biology I (Science B I)
    3. BIOL 102 General Biology II (Science B II)
B. Computational Chemistry
    1. Can take any science course not from the Department of Chemistry (Science A).
    2. CHEM 003 General Chemistry I, CHEM 005 General Chemistry Lab I (Science B I)
    3. CHEM 004 General Chemistry II, CHEM 006 General Chemistry Lab II (Science B II)

C. Gaming
    1. Can take any science course from the (Science A)
    2. Can take any science course from the list different from Science A (Science B I and II).
D. Computational Mathematics
    1. Can take any science course from the (Science A)
    2. Can take any science course from the list different from Science A (Science B I and II).
E. Computer Networking
    1. Can take any science course from the (Science A)
    2. Can take any science course from the list different from Science A (Science B I and II).
F. Computational Physics
    1. Can take any science course not from the Department of Physics & Atmospheric Science (Science A).
    2. PHYS 013 Physics for Science & Engineers I, PHYS 023 Physics for Science & Engineers Lab I (Science B I)
    3. PHYS 014 Physics for Science & Engineers II, PHYS 024 Physics for Science & Engineers Lab II (Science B II)
G. Computer Security
    1. Can take any science course from the (Science A)
    2. Can take any science course from the list different from Science A (Science B I and II).
H. Computer Science
    1. Can take any science course from the (Science A)
    2. Can take any science course from the list different from Science A (Science B I and II).

NOTE: CHEM003/004 and CHEM 005/006 will increase your total credits to 122.

Non-Technical Electives

Four courses, each of at least 3 credits, are required. Among these courses must be:

- One from the University's African-American Cluster

ENGL 054/055	African-American Literature
POLS 006	Pan-Africanism
HIST 005/006	Introduction to Black Diaspora
AFST 101	African World: Intro. To Contemporary Africa
AFRO 005/006	Afro-American Studies
MUTP 100	Blacks in the Arts
FASH 102	Perspectives on African-American Dress

ARTH 193 Black Body Dress and Culture

- Any course from AFRO, or AFST will classify as an African-American Cluster
- Any course from the Divisional Studies A, B, C, and D lists of the College of Arts and Sciences
- Any foreign language course at "Level II" or higher, or a "Level I" course provided that a more advanced course in the same language is included
- Any other course recommended in writing by the student's academic advisor and approved by the program director

Technical Electives

The objective of this requirement is to expand the student's contact with advanced, "state-of-the-art" topics in the major field geared toward their own interest. Students are prescribed technical electives based on their SCS Concentration track selected. Unless a student selects a track, by default all students are in the (I) Computer Science track.

A. Computational Biology
    1. BIOL 200 Genetics
    2. BIOL 320 Molecular Biology
    3. CSCI 474 Computational Biology
    4. Any technical elective approved for the Computer Science track
B. Computational Chemistry
    1. CHEM 001 General and Applied Chemistry
    2. CHEM 184 Methods in Computational Chemistry
    3. MATH 159 Differential Equations or MATH 164 Introduction to Numerical Analysis
    4. Any technical elective approved for the Computer Science track
C. Gaming
    1. CSCI 421 Computer and Video Game Development

2. CSCI 422 Game Engine Programming
3. Any technical elective approved for the Computer Science track

D. Computational Mathematics
1. MATH 159 Differential Equations
2. MATH 164 Introduction to Numerical Analysis
3. Any technical elective approved for the Computer Science track

E. Computer Networking
1. CSCI 450 Introduction to Computer Networks,
2. CSCI 451 Applied Wireless networks
3. CSCI 452 Internet/Web Programming
4. INFO 393 Network/Internet Security Management

F. Computational Physics
1. PHYS 154 Computational Physics I
2. PHYS 155 Computational Physics II
3. MATH 159 Differential Equations or MATH 164 Introduction to Numerical Analysis
4. Any technical elective approved for the Computer Science track

G. Computer Security
1. INFO 395 Information Assurance
2. INFO 391 Intro. to Information Security
3. CSCI 453 Intro to Cybersecurity I
4. CSCI 454 Intro to Cybersecurity II, or INFO 393 Network/Internet Security Management

H. Computer Science
1. In Junior Fall semester, the Tech. Elective course is Introduction to Computer Networking
2. Any CSCI course numbered 300 to 499 (excluding required courses).
3. Any CSCI Graduate courses open to seniors.
4. Computer Engineering EECE 211 Introduction to Digital Systems 5. Computer Engineering EECE 406 Advanced Digital Systems
6. Electrical Engineering ELEG-416 Microcomputer Design.
7. Electrical Engineering ELEG-417 Microprocessor Applications.
8. Any Mathematics courses not required and having a Calculus prerequisite.
9. INFO-304 Visual Basic OOP
10. INFO-330 Data Base Management
11. Any course approved by the program director.

COLLEGE OF ARTS AND SCIENCES
Non Technical Electives for Computer Science Students

Divisional Studies Courses and Course Titles

Note: No more than 6 hours in a single department of the College of Arts and Sciences or in any other school or college can be counted to satisfy the divisional studies requirement. Some courses may require the completion of prerequisite or co-requisite courses.

DIVISIONAL STUDIES A: HUMANITIES

Courses numbered 014 & 015 cover the same content across disciplines. Students are NOT permitted to enroll in multiple 014 & 015 courses.

ARTH	161	Art Appreciation
CLAS	014	Intro to Humanities I
CLAS	015	Intro to Humanities II
CLAS	016	Ideas in Antiquity
CLAS	050	Ancient Egypt and Near East
CLAS	051	Greece and Rome
CLAS	101	Greek Literature
CLAS	102	Roman Literature
CLAS	103	Classical Art
CLAS	108	Greek Drama
CLAS	109	Classical Mythology
CLAS	111	Satire and Comedy in the Ancient World
CLAS	113	Women in the Ancient World
CLAS	114	Love in Antiquity
ENGL	014	Intro to Humanities I
ENGL	015	Intro to Humanities II
ENGL	054	Afro-Am Lit to 1940
ENGL	055	Afro-Am Lit since 1940
ENGL	056	Modern Caribbean Lit (formerly 168 and 225)
ENGL	180	Third World Lit Myth and Archetype
FREN	014	Intro to Humanities I
FREN	015	Intro to Humanities II
FREN	100	Francophone Literature in English
FREN	106	Africa Cinema
FREN	107	Women in Literature
GERM	014	Intro to Humanities I
GERM	015	Intro to Humanities II
GERM	100	Individual & Society
GERM	101	Literature of Love
GERM	107	Women in Literature
GERM	109	Slavic Mythology
GERM	111	Classic Films in English
GERM	100	Individual & Society
HUMA	107	Women in Literature
MUSC	100	Introduction to Music
RUSS	014	Intro to Humanities
RUSS	100	Russian Short Stories in English
RUSS	101	Literature in Revolution
RUSS	103	Love and Hate in Literature
RUSS	109	Slavic Mythology
SPAN	014	Intro to Humanities I
SPAN	015	Intro to Humanities II
SPAN	100	Hispanic Literature in English
SPAN	107	Women in Literature
THFD	010	Introduction to the Theatre

DIVISIONAL STUDIES B: SOCIAL SCIENCES (OPEN TO FRESHMEN)

AFRO	005	Afro-American Studies I
AFRO	006	Afro-American Studies II
AFST	106	Intro to African Studies
CLAS	104	Greek Civilization
CLAS	105	Roman Civilization
CLAS	112	Ancient Law and Politics
CLAS	115	Slavery in the Greco-Roman World
GERM	145	Cultural Life of Germany I
GERM	146	Cultural Life of Germany II
HIST	001	Intro to Study of Civilization
HIST	005	Intro to Black Diaspora I
HIST	006	Intro to Black Diaspora II
HIST	101	World Geography
HIST	102	Economic Geography
POLS	001	Intro to Political Science
RUSS	145	Cultural Life of Russia
RUS	150	Introduction to Black Diaspora
SOCI	001	Intro to Sociology

DIVISIONAL STUDIES C: SOCIAL SCIENCES (OPEN TO SOPHOMORES)

AFRO	131	Black Philosophy I
AFRO	133	19th Century Black Social-Political Thought
AFRO	191	Contemporary Slavery
AFST	101	Intro to Contemporary Africa
ANTH	110	Intro to Cultural Anthropology
ANTH	120	Intro to Biological Anthropology
CLAS	110	Blacks in Antiquity
ECON	001	Principles of Economics I
ECON	002	Principles of Economics II
ECON	199	Intro to Urban Economics
HIST	003	Europe and the Wider World I
HIST	004	Europe and the Wider World II
HIST	009	US History to 1877
HIST	010	US History since 1877
HIST	030	Intro to African History I
HIST	031	Intro to African History II
HIST	040	Intro the Hist of Latin Am and the Caribbean I
HIST	041	Intro the Hist of Latin Am and the Caribbean II
HIST	150	Intro to European History I
HIST	051	Intro to European History II
HIST	054	Intro to England
HIST	060	Intro to East Asian Civilization I
HIST	061	Intro to East Asian Civilization II
POLS	003	Intro to Comparative Politics
POLS	005	Intro to African Politics
POLS	011	State and Local Government
POLS	143	Black Electoral Politics
SOCI	198	Negro in America

DIVISIONAL STUDIES D: NATURAL SCIENCES

BIOL	101	General Biology I Lecture/Lab
BIOL	102	General Biology II Lecture/Lab
CHEM	003	General Chemistry Lecture/Lab
COMP	001	Life Sciences Lecture/Lab
COMP	002	Planetary Sciences Lecture/Lab
COMP	003	Physical Sciences Lecture/Lab
COMP	004	Computers and Society Lecture/Lab
MATH	006	College Algebra I
MATH	007	Pre-calculus
MATH	009	Introduction Statistics
MATH	010	College Algebra II
MATH	012	Patterns in Mathematics
MATH	026	Applied Calculus
MATH	156	Calculus
PHYS	001	General Physics Lecture/Lab
PHYS	002	General Physics Lecture/Lab
PHYS	010	General Astronomy I
PHYS	011	General Astronomy II
PHYS	012	The Astronomical Universe
PHYS	013	Physics for Science & Engineering Students I Lecture/Lab
PHYS	014	Physics for Science & Engineering Students II Lecture/Lab
PSYC	050	Introduction to Psychology