Computer Science

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Faculty from mathematics with joint teaching appointments in computer science: Conjura, Iannone

The computer science curriculum is designed to prepare students for employment as computer science specialists, as well as to provide a strong background for advanced study. The BS in Computer Science is accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). All students take courses in problem solving and programming fundamentals, software engineering, data structures, operating systems, compilers, computer organization, and algorithm analysis. Upper-level options provide exposure to a range of subdisciplines including, but not limited to, artificial intelligence, databases, graphics, information retrieval, networks, and programming languages. Special topics courses offered each semester offer the opportunity to study and work with the latest trends in technology. Students participate in research and/or in industry experiences, which culminate in professional presentations. Students balance their studies with course work in mathematics and science, as well as in arts, humanities, history, and the social sciences. A total of at least 32 course units is required for graduation.

The Department of Computer Science supports and encourages its students to consider including a study abroad semester as part of their curriculum. For more information about studying outside of the United States without delaying your graduation, please speak to your academic advisor and visit the college's Office of International and Off-Campus Programs.

Requirements for the major:

I. Required Courses (seven or eight course units)
CSC 220/CS I: Computational Problem Solving*	1 course unit
CSC 230/CS II: Data Structures and Algorithms*	1 course unit

*CSC 250/Accelerated CS I and II (one course unit) may fulfill the CSC 220 and 230 requirement — by permission

Additional Required Courses (six course units)
CSC 310/Discrete Structures of Computer Science	1 course unit
CSC 325/Computer Architecture	1 course unit
CSC 330/Operating Systems	1 course unit
CSC 340/CS III: Programming in the Large	1 course unit
CSC 410/Advanced Analysis of Algorithms	1 course unit
CSC 434/Compilers and Interpreters	1 course unit

II. Computer Science Options (four or five course units)
Select three courses from the following "Option A" list. Students who take CSC 250 must select four courses. Students may take additional options courses for free elective credit (exception: placement out of WRI 102 or foreign language must be replaced by liberal learning courses, not CSC courses).

PART A: Choose three courses from the following: 3 course units
   CSC 307/Data Minig and Predictive Modeling
   CSC 320/Information Retrieval
   CSC 350/Digital Computer Graphics
   CSC 360/Networks
   CSC 365/Games I: Design and Arhitecture
   CSC 380/Artificial Intelligence

        CSC 390/Programming Languages
        CSC 446/Database Management Systems
        CSC 460/Theory of Computation
        CSC 465/Games II: Implementation and Project Management
        CSC 470/Topics in Computer Science
        CSC 471/Genomics and Bioinfomatics

PART B: Choose one course from the following:
(Practicum Courses)   1 course unit
        CSC 399/Internship in Computer Science
        CSC 498/Mentored Research I in Computer Science
        CSC 499/Mentored Research II in Computer Science

Up to three practicum courses may be chosen, selected with advisement and departmental approval. The extra practicum course(s) may apply toward the Part A options, with departmental approval. CSC 491/Independent Study in Computer Science also requires departmental approval.

III. Required Mathematics Courses   **3 course units**
    MAT   127/Calculus A
    MAT   128/Calculus B
    STA   215/Statistical Inference

IV. Computer Science Natural Sciences Options   **4 course units**
Three major-level laboratory sciences (two in sequence) and one additional math or science course (with advisement). Consult the department for details.

V. Foreign Language Requirements   **3 course units**
Three courses in a sequence in any of the modern languages. This requirement may be reduced in two ways. If a student wishes to continue any language studied in high school, a placement test in that language must be taken. Based on the student's performance on that language placement test, 0, 1, 2 or 3 courses may be required. If a student wishes to study a language not studied before, two courses (levels 1 and 2) are required. Any course reduction in foreign language requirements results in an equivalent number of free elective courses, which must be selected from the areas of art, humanities, social science or history. Consult the department for details.

Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for the computer science program. Minimum grades are noted in parentheses:

- Retention in the program is based on the following performance standards in these "critical content courses": CSC 220*/Computer Science I: Computational Problem Solving (C); CSC 230*/Computer Science II: Data Structures (C); CSC 310/Discrete Structures of Computer Science (C).

- Transfer into the program from another program within the College is based upon the following performance standards in these "foundation courses": MAT 127/Calculus A (C); CSC 220/Computer Science I: Computational Problem Solving (C).

- Graduation requires a GPA of 2.0 in computer science courses, GPA of 2.0 overall, and a grade of C in the following courses: CSC 220*/Computer Science I: Computational Problem Solving; CSC 230*/Computer Science II: Data Structures; CSC 310/Discrete Structures of Computer Science; and CSC 340/Computer Science III: Programming in the Large.

or CSC 250 if used as a replacement.

Computer Science Minor   five course units

I. Required Courses
CSC 220/CS I: Computational Problem Solving	1 course unit
CSC 230/CS II: Data Structures and Algorithms	1 course unit
CSC 310/Discrete Structures of Computer Science	1 course unit
CSC 340/CS III: Programming in the Large	1 course unit

II. Options for Computer Science Minor

An additional course chosen from the following:

CSC 320, CSC 325, CSC 330, CSC 350, CSC 360, CSC 365, CSC 380, CSC 390, CSC 410, CSC 434, CSC 446, CSC 465 or CSC 470.

Minimum grade point average for retention and completion for the minor is the same as for the major.

Department Academic Regulations

A minimum of 5.25 course units (equals 21 credits) in the major must be earned in the department. A minimum of 3.75 course units of the final 5.25 (equals 15 of the final 21 credits) in the major must be earned in the department.

CSC 101, CSC 102, CSC 105, CSC 215, and HON 280 may not be taken by computer science majors except with special permission of the department and then only as free electives.

Students who take CSC 250 accelerate requirements through their junior year.

Suggested Course Sequence

First-Year (CSCA)

Fall
CSC	099/Orientation to Computer Science	0 course unit
CSC	220/CS I: Computational Problem Solving	1 course unit
MAT	127/Calculus A	1 course unit
FSP	First Seminar*	1 course unit
Liberal Learning (Foreign Language suggested)		1 course unit

Selected to fulfill a Liberal Learning requirement for Arts and Humanities or Social Sciences and History.

Spring
CSC	230/CS II: Data Structures	1 course unit
MAT	128/Calculus B	1 course unit
WRI	102/Academic Writing (if not exempted)	1 course unit
Liberal Learning (Foreign Language suggested)		1 course unit

Total   8 (plus orientation) course units

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Second-Year

CSC	310/Discrete Structures	1 course unit
CSC	325/Computer Architecture	1 course unit
CSC	340/Computer Science III	1 course unit
CSC	Option Course (Option A list)	1 course unit
STA	215/Statistical Inference	1 course unit
Liberal Learning		3 course units

Total   **8 course units**

Third-Year

CSC	330/Operating Systems	1 course unit
CSC	434/Compilers and Interpreters	1 course unit
CSC	Option Course (Option A list)	1 course unit
CSC	Practicum Course (Option B list)	1 course unit
Natural Sciences		2 course units
(in sequence; for science majors; with lab)		
Liberal Learning		2 course units

Total   **8 course units**

Fourth-Year

CSC	410/Advanced Data Structures and Algorithms	1 course unit
CSC	Option Course (Option A list)	1 course unit
Natural Sciences		1 course unit
(for science majors; with lab)		
Math or Science Option		1 course unit
Liberal Learning		1 course unit
Free Elective		3 course units

Total   **8 course units**

COURSES

CSC 099/Orientation to Computer Science   **0 course unit**
(annually)
An introduction to the computer science program and a focus on the discipline, including an investigation of computing ethics. Students familiarize themselves with procedures, standards, and people of the department. An introduction to mentored research and internship experiences engages the first-year student in the culture and expectations of the department and of the discipline. Students develop an appreciation for the services offered by the College and for the resources available within the department and across campus.

CSC 101/Introduction to Interactive Computing   **1 course unit**
(same as IMM 120)
(every semester)
A first course in computing languages for interactive multimedia. Students are introduced to the art of programming through state-of-the-art multimedia technologies (e.g., Macromedia Studio MX). Through intensive laboratory experience students learn the programming fundamentals (e.g., variables, functions, control structures and logic, persistent storage, and networking). Problems related to interactivity are emphasized (e.g., through assignments based on HTML and Flash coding). Students will understand the distinction between markup languages, scripting languages, and general purpose programming languages

and develop proficiency in the first two. Persistent storage and networking concepts are introduced through high-level applications (e.g., Macromedia Studio). Efficiency, data structure organization, and objects are introduced within the context of interactive computing problem solving. This course may not be taken by computer science majors without permission of the department, and then only for free elective credit.

CSC 102/Introduction to Computational Modeling   **1 course unit**
(annually)
In this course, students model various social and other complex problems and analyze them using multiple computer simulation programs. Students also modify existing programs and implement simple custom modules so that they can analyze the problems of their choice. Through this process students are expected to learn the principles behind computational modeling which would let them see real-world problems in a precise and concise manner. This course may not be taken by computer science majors without permission of the department, and then only for free elective credit.

CSC 105/Applying Computing to Mathematical Problem Solving   **1 course unit**
(every semester)
Problem specification, problem-solving techniques, goals and sub goals, search, repetition, algorithm description, elements of pseudo code, high-level computer languages and their use and implementation. This course may not be taken by computer science majors without permission of the department, and then only for free elective credit.

CSC 215/Computer Science I for Science and Engineering   **1 course unit**
(every semester)
A first course in computer science for science, mathematics, and engineering majors. Emphasis is on using computational methods to solve scientific problems. A high level programming language will be used to teach structured programming and algorithm development. Topics include control structures, data typing, including structures and arrays, parameterized procedures, and recursion as well as simple I/O control. This course may not be taken by computer science majors without permission of the department, and then only for free elective credit.

CSC 220/Computer Science I: Computational Problem Solving   **1 course unit**
(every semester)
A first course in computer science for computer science majors in which students learn to express algorithmic ideas in an abstract manner. An object-oriented language such as Java will be introduced; however, the emphasis is on algorithmic design and implementation rather than language mechanics. Students will become intimately familiar with expressing mathematical ideas as programs.

CSC 230/Computer Science II: Data Structures   **1 course unit**
(every semester)
Prerequisites: CSC 220 with a grade of C or higher
A second course in computer science for computer science majors in which students learn how the algorithms and structures studied in CSC 220 are implemented on a sequential machine. Classic data structures (lists, queues, stacks, trees, and tables) and algorithms (searching and sorting) are considered, but the emphasis is on analysis. First, analysis of implementation techniques is addressed by studying the trade-offs between static and dynamic structures. Second, analysis of complexity of algorithms is studied informally and then using formal proof techniques. The implementation of the object-oriented paradigm is also shown via Java.

CSC 250/Accelerated CS I, II   **1 course unit**
(annually)
Prerequisite: Permission of the department
A first, intensive course in computer science for students with demonstrated extensive experience programming, or those who have placed above a standard set by the department on the Computer Science AP exam. The course is also for students with some computer science background but with gaps in their knowledge of the standard CS I/CS II curriculum. Additionally, it is for students who took CS I/CS II courses elsewhere but have no experience programming in the programming language or paradigm that supports the CS I/CS II sequence. The course covers the material of CSC 220 (CS I) and CSC 230 (CS II) in one semester. The basic introduction to programming of CSC 220 is considered a review, while the emphasis on problem solving and solution design is presented within the context of a thorough grounding in the classic data structures using the modern object-oriented framework. The course contains section placements for both computer science and computer engineering students.
   NOTE: Students (majors or minors) who take CSC 250 must complete an additional CS option course or receive Advanced Placement credit.

CSC 307/Data Mining and Predictive Modeling   **1 course unit**
(spring-even years)
Prerequisites: CSC 320 or ECO 231 or PSY 303 or MAT 316 or any 300-level statistics course
Students will be introduced to a variety of statistical techniques that are widely used in modern data mining. The techniques include decision trees, link functions, logistic regression, neural networks, tree/net, prior vector and profit/loss matrix, two-stage modeling, text mining, missing value imputation techniques, association rules, self-organizing maps, and independent component analysis. Computer technology will be used extensively throughout the course.

CSC 310/Discrete Structures of Computer Science   **1 course unit**
(every semester)
Prerequisite: MAT 127, and CSC 230 with a grade of C or higher
Concepts and structures fundamental to computer science. Declarative programming techniques will be used to explore discrete structures. Topics will include logic, relations, functions, word algebras, induction, and recursion.

CSC 320/Information Retrieval   **1 course unit**
(same as IMM 320)
(annually)
Prerequisites: For CS students or other majors: CSC 230 with a grade of C or higher. For IMM students: IMM core with a grade of C or higher
The course discusses theory and practice of searching and retrieval of information. Topics covered include automated indexing, statistical and linguistic models, text classification, Boolean and probabilistic approaches to indexing, query formulation and output ranking, information routing and filtering, topic detection and tracking, as well as measures of retrieval effectiveness, including relevance, utility, miss/false-alarm. Techniques for enhancing retrieval effectiveness including relevance feedback, query reformulation, thesauri, concept extraction, and automated summarization. Experimental retrieval approaches from relevant state of the art conferences as well as modern Internet search engines are discussed in detail.

CSC 325/Computer Architecture 1 course unit

(annually)
Prerequisites: CSC 340 with a grade of C or higher
Introduces the architecture of a general-purpose computer by considering its structure at the hardware and software levels through the instruction set. Project-oriented course that stresses design and implementation of the processor of a computer. Introduces design and simulation of logic circuits, combinational and sequential, the design of the instruction set for a von Neumann architecture and the writing of programs in an assembly language for such a machine. Topics include combinational logic design; finite state machines; instruction set architectures; elements of computer organization; RTL; processor and hardware control unit design; computer arithmetic and ALU design; memory subsystem and cache design; reduced instruction sets; and I/O interfaces.

CSC 330/Operating Systems 1 course unit

(annually)
Prerequisites: CSC 325 and CSC 340, the latter with a grade of C or higher
Operating systems theory and implementation, examining the operating system as an interface between the application program and computer hardware. OS services for memory, processor, file, and device management are examined. Study of resource management implemented by an operating system in a multiprogramming environment. Case studies include system software design and implementation highlighting standard operating systems such as Unix, Linux, and Windows.

CSC 340/Computer Science III: Programming in the Large 1 course unit

(annually)
Prerequisites: CSC 230 with a grade of C or higher
The emphasis of this course is on learning and applying the principles of the design and development of software systems involving numerous interacting data types. The students are expected to work in a large collaborative group, which either receives a proposal and specifications for a software system from an outside client or produces their own. Integration, testing, and enhancements of the system begin at the prototype level and move incrementally to full integration. Documentation and product presentation are expected.

CSC 350/Digital Computer Graphics 1 course unit

(annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
An introduction to the fundamentals underlying the design of computer graphics software that is platform independent. Takes an algorithmic approach to the study of graphic operations required to create a complex scene and mixes it with a study of the properties of hardware elements used in generating a graphic. The modeling and transformation process is stressed. Topics include 2-D graphic elements and transformations; viewing and clipping; hierarchical modeling; 3-D concepts and objects; splines; solid geometry; 3-D transformations and the viewing pipeline; visible surface detection; and lighting models.

CSC 360/Networks 1 course unit

(annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course introduces concepts of network programming. The emphasis is on the protocols used to communicate between various implementations of UNIX as well as PCs, Macs, and other systems. Topics include: ethernet, token ring, fiber-optic topologies; IP, ICMP, UDP, TCP protocols; applications such as telnet, ftp, ping; and ATM networks. Laboratory experiences include the use of network viewing tools such as traceroute, tcpdump, and dig. Network applications are written in languages such as C, Perl, and TCL.

CSC 365/Games I: Design and Architecture   **1 course unit**
(annually)
Prerequisites: CSC 340 or IMM 270 or permission of the instructor
This is a multidisciplinary course that invites students from a variety of disciplines to participate in the development of a game design while learning about the underlying architecture of a game engine. Students will customize a broad set of learning goals to their own needs, ranging from the purely artistic to the purely technical. Lecture and workshops will provide a full range of exposure to game development including game engine design, story telling, interactivity, networking for multi-user, 3-D pipeline for games, sound, music and dialog. Each semester will focus on a particular type of game, including but not limited to "Role playing", "First person shooter", "Immersive Learning", "Real world simulation." Students will also address issues of gender and racial equity in the games industry as well as social, ethical and health concerns.

CSC 380/Artificial Intelligence   **1 course unit**
(annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
The study of how to make the computer behave intelligently. Topics: state-space methods of problem solving, heuristic search techniques, representation and use of knowledge, applications and design of expert systems, natural language processing, vision and image understanding. Design of specifications for intelligent agents is discussed at length and a high level implementation is developed in First Order Logic, LISP, Prolog, or any of the current AI languages.

CSC 390/Programming Languages   **1 course unit**
(annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course covers alternatives to the imperative procedural programming paradigm. Included are object-oriented, functional, and logic programming. The emphasis is on language design, use, and implementation.

CSC 391/Independent Study in Computer Science   **1 course unit**
(every semester)
Prerequisite: By invitation only, with permission of the department
Student studies independently an appropriate area. A faculty advisor and a project description must be agreed upon before registering for this course.

CSC 399/Internship in Computer Science   **1 course unit**
(every semester)
Prerequisites: Permission of department and college specified minimum GPA
A supervised computer-related field experience in industrial, governmental, or private sector. Faculty supervisor advises the student where to focus the learning objective for the given internship. A project at the internship is to be the level of research in junior/senior independent study topics in computer science. Grading is a letter grade. Paper and public lecture required.

CSC 410/Advanced Analysis of Algorithms   **1 course unit**
 (annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course presents the major principles of algorithm design and analysis, and applies those principles to classical problems in computer science. Topics include complexity, advanced ADTs, searching and sorting, graph search and traversal, dynamic programming, cryptography, theoretical computer science, operations on polynomials and matrices, and pattern matching. As a capstone experience, students participate in a mini-colloquium covering the course topics.

CSC 434/Compilers and Interpreters   **1 course unit**
 (annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course balances the theory and practice, by applying theoretical principles within a software project. Topics: Formal language theory, regular expressions, finite state automata, Backus-Naur form grammars, formal and informal specification of semantics. Lexical analysis, parsing, scope analysis, type checking, and code generation. Issues of programming language design. Following an attribute grammar specification, students implement a compiler for an object-oriented language.

CSC 446/Database Management Systems   **1 course unit**
 (annually)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course introduces the student to abstracts of well-known database systems and the design and implementation of a database system using a relational database package.

CSC 460/Theory of Computation   **1 course unit**
(every other year)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
This course focuses on the traditional, algorithmic theory of computation consisting of three subareas: (1) computability, (2) complexity theory, and (3) formal languages and automata. The topics include: Turing machines, decidability/undecidability, reducibility, Church-Turing thesis, context-free grammars/languages, push-down automata, finite automata, regular expressions/languages, and time/space complexity including NP-completeness.

CSC 465/Games II: Implementation and Project Management   **1 course unit**
(annually)
Prerequisites: CSC 365 or permission of the instructor
This is a multidisciplinary course that invites students from a variety of disciplines to participate in the implementation of a robust demonstration video game. Programmers, software engineers, digital artists, sound specialists and musicians work collaboratively to create a single game (designed in CSC 365/Games I). Each student defines a personal role in the process so that no two students will complete the same set of course requirements. All students however participate in learning about and implementing a project management structure to plan and execute the sequence of activities that must take place to complete the game. Each semester will focus on a particular type of game, including but not limited to "Role playing", "First person shooter", "Immersive Learning", "Real world simulation." Students will also address issues of gender and racial equity in the games industry as well as social, ethical and health concerns.

CSC 470/Topics in Computer Science   **1 course unit**
(every semester)
Prerequisites: CSC 310 and CSC 340, both with a grade of C or higher
Study of an advanced topic in computer science chosen by the instructor. Normally taken by junior or senior computer science majors, this course may be elected several times, as long as the topics differ.

CSC 471/Genomics and Bioinformatics   **1 course unit**
(annually)
(same as BIO 470 when the topic is Genomics and Bioinfomatics)
Prerequisites: BIO 185 and CSC 230
This course will cover theoretical and practical components of genomics and bioinformatics. The major topics will include mapping and sequencing genomes, sequence alignment of nucleic acids and proteins,

haplotype maps, analysis of complex traits, parallel profiling of gene expression, proteomics, phylogenetic analysis, and data mining. The laboratory will begin with the *in silico* analysis of gene families, continue to the formulation of a testable hypothesis about gene function, writing a mini-grant for peer review, testing of the hypothesis in a model organism, and conclude with a formal presentation of the data generated during the semester. This course is best suited for undergraduates who wish to continue with a career in basic science or biomedical research.

CSC 498/Mentored Research I in Computer Science   **1 course unit**
(every semester)
Prerequisites: Permission of department and minimum 2.5 GPA
Intensive study of an advanced topic in computer science under the supervision of a faculty mentor. Emphasizes student activity, use of journals and monographs, discussions, solution and presentations of problems. This course culminates in the writing of a journal-style paper and the presentation of a public lecture.

CSC 499/Mentored Research II in Computer Science   **1 course unit**
(every semester)
Prerequisites: Permission of department and minimum 2.5 GPA
For continuing projects begun in CSC 498.