

Interdisciplinary Major in Computer Science

for students in the *College of Arts & Sciences*

Overview Computer Science is the study of information processes. Computer scientists learn how to describe information processes, how to reason about and predict properties of information processes, and how to implement information processes elegantly and efficiently in hardware and software. The Computer Science curriculum concentrates on developing the deep understanding of computing and critical thinking skills that will enable graduates to pursue a wide variety of possible fields and to become academic, cultural, and industrial leaders. The core curriculum focuses on developing methods and tools for describing, implementing, and analyzing information processes and for managing complexity including abstraction, specification, and recursion. Computing connects closely with a wide range of disciplines including, but not limited to, the visual arts, music, life sciences including biology and cognitive science, the physical sciences, linguistics, mathematics, and the social sciences. The Computer Science major provides students with a strong foundation in computer science, combined with courses in arts, humanities, and sciences, in order to develop broad understanding of other areas and their connections to computing.

Faculty The Computer Science department has twenty-six faculty members. Our faculty is strongly committed to teaching as well as conducting world-class research. Faculty interests span major areas of computer science with particular strengths in algorithms, programming languages, security, sensor networks, software engineering, and theory. The Computer Science major is administered by the Computer Science BA Committee, composed of faculty from various departments in the College and the Computer Science Department. The BA Committee is responsible for the BA curriculum, student advising, and deciding on exceptions to the major requirements.

Students Computer Science majors are not required to enter the University with any previous background in computing. To enroll in the major, students must submit an application form (see <http://www.cs.virginia.edu/ba/>).

Requirements for Major Computer Science majors must complete two gateway courses, four core courses, four computing electives, and four integration electives. The two gateway courses are CS 150 and CS 205; CS 201 can be substituted for the CS 205 requirement. The four core courses are CS 202, CS 216, CS 333, and CS 432. The four computing electives are computing-intensive courses selected from a list of approved courses. The list of approved courses includes CS 230 and all Computer Science courses at 300-level or above (except the core courses). The four integration electives are courses are offered by departments other than Computer Science, that either provide

fundamental computing depth and background or explore applications of computing to arts and sciences fields.

Distinguished Majors Program Distinguished majors complete the BA degree requirements in addition to a fourth year thesis project that is approved by two advisors, one from Computer Science and one from Arts and Sciences. Both advisors must approve the student's plan of study, thesis proposal, and thesis report.

Contact For more information about the major, contact David Evans (evans@cs.virginia.edu), Director of the Undergraduate Program. From September 2008, Tom Horton (horton@cs.virginia.edu) will be Director of the Undergraduate Program.

Course Descriptions

Gateway courses

CS150: Computing from Ada and Euclid to Quantum Computing the World Wide Web

Introduction to computer science that focuses on describing and reasoning about information processes using language and logic.

(Offered in Spring semesters only.)

CS205: Engineering Software

Covers tools and techniques used to manage complexity needed to build, analyze, and test complex software systems including abstraction, analysis, and specification.

Prerequisite: CS150

Note: CS201 can be used to satisfy the CS205 requirement.

(Offered in Fall semesters only.)

Core courses

After completing CS205, A&S Computer Science students will have comparable background to the SEAS CS majors entering these courses.

CS202: Discrete Mathematics I

Introduces discrete mathematics and proof techniques involving first order predicate logic and induction. Application areas include sets (finite and infinite), elementary combinatorial problems, and finite state automata. Development of tools and mechanisms for reasoning about discrete problems.

Prerequisite: CS150 or CS101

CS216: Program and Data Representation

Introduces programs and data representation at the machine level. Data structuring techniques and the representation of data structures during

program execution. Operations and control structures and their representation during program execution. Representations of numbers, arithmetic operations, arrays, records, recursion, hashing, stacks, queues, trees, graphs, and related concepts.

Prerequisite: CS 205 or CS201; and CS 202 with grades of C- or higher.

CS333: Computer Architecture

Includes the organization and architecture of computer systems hardware; instruction set architectures; addressing modes; register transfer notation; processor design and computer arithmetic; memory systems; hardware implementations of virtual memory, and input/output control and devices.

Prerequisite: CS216 and CS230

CS432: Algorithms

Introduces the analysis of algorithms and the effects of data structures on them. Algorithms selected from areas such as sorting, searching, shortest paths, greedy algorithms, backtracking, divide- and-conquer, and dynamic programming. Data structures include heaps and search, splay, and spanning trees. Analysis techniques include asymptotic worst case, expected time, amortized analysis, and reductions between problems.

Prerequisite: CS216 (and mathematics experience comparable to MATH 131)

Computing Electives

Four computing-intensive electives selected from a list of approved courses. Approved courses include CS230 (Digital Logic Design) and all 300-level and higher CS courses.

Integration Electives

Four courses selected with the approval of the student's advisor from the list of computing-related courses approved by the BA CS committee. These courses are offered by departments other than Computer Science, and should either provide fundamental computing depth and background or explore applications of computing to arts and sciences fields. The list of approved integration electives is maintained by the CS BA committee and is available from the CS BA website: <http://www.cs.virginia.edu/ba/>. Additional courses may be counted as integration electives if they satisfy the goals of an integration elective.

Approved Courses for Integration Electives

Anthropology: ANTH 243 (Languages of the World), ANTH 340 (Structure of English), ANTH 343 (Introduction to Generative Linguistics), ANTH 542 (Theories of Language), ANTH 544 (Morphology), ANTH 548 (Language and Thought)

Architecture: ARCH 241 (Computer Applications in Design I), ARCH 444 (Digital Moviemaking and Animation), ARCH 541 (Computer Aided Architectural Design), ARCH 542 (Digital Animation & Storytelling), ARCH 544 (Computer Graphics and Design Application), ARCH 545 (Digital Moviemaking and Animation), ARCH 551 (Photography and Digital Media)

Art (Studio Art): ARTS 222 (Introduction to Digital Art I), ARTS 223 (Introduction to Digital Art II), ARTS 323 (Intermediate Digital Art II), ARTS 332 (Intermediate Digital Art I), ARTS 422 (Advanced Digital Art I), ARTS 423 (Advanced Digital Art II)

Biology: BIOL 317 (Introduction to Neurobiology), BIOL 324 (Introduction to Immunology), BIOL 401 (Macroevolution), BIOL 402 (Ecology and Evolutionary Genetics), BIOL 403 (Evolutionary Biology Laboratory), BIOL 405 (Developmental Biology), BIOL 408 (Neuronal Organization of Behavior), BIOL 413 (Population Ecology and Conservation Biology), BIOL 416 (Functional Genomics), BIOL 417 (Cellular Neurobiology), BIOL 425 (Human Genetics), BIOL 448 (Macromolecular Structure), BIOL 508 (Developmental Mechanisms), BIOL 537 (Epidemiology and Evolution of Infectious Disease)

Biomedical Engineering: BIOM 310 (Biomedical Systems Analysis and Design), BIOM 315 (Computational Biomedical Engineering), BIOM 483 (Medical Image Modalities), BIOM 484 (Medical Image Analysis)

Civil Engineering: CE 446 (Introduction to Geographic Information Systems)

Drama: DRAM 224 (Digital Design: Re-making and Re-imagining), DRAM 262/263 (Sound Design and Sound Lab), DRAM 264 (Sound Design: Studio), DRAM 411 (Lighting Design), DRAM 421 (Scenic Design)

Economics: ECON 401 (Game Theory), ECON 402 (Auction Theory and Practice), ECON 472 (Introductory Econometrics), ECON 488 (Seminar in Policy Analysis)

Electrical and Computer Engineering: ECE 200 (Science of Information)

Environmental Sciences: EVSC 362 (GIS Methods), EVSC 466 (GIS and Arc/Info), EVSC 468 (Advanced GIS), EVSC 503/L (Applied Statistics for Environmental Scientists), EVSC 511 (Systems Analysis in Environmental Sciences)

Linguistics: LNGS 325 (Introduction to Linguistic Theory and Methodology), LING 501 (Synchronic Linguistics), LING 506 (Syntax and Semantics), LING 507 (Syntactic Theory) (see also Anthropology and Philosophy)

Mathematics: MATH 215 (Mathematical Explorations), MATH 351 (Elementary Linear Algebra), MATH 354 (Survey of Algebra), MATH 408 (Operations Research), MATH 430 (Elementary Numerical Analysis), MATH 452 (Algebraic Coding Theory), MATH 453 (Number Theory), MATH 551 (Stochastic Processes)

Media Studies: MDST 311 (Computers and Languages), MDST 350 (History of Media), MDST 411 (Theory of Digital Media), MDST 511 (Topics in Digital Media)

Music: MUSI 235 (Digital Music and Sound Art Composition), MUSI 239 (Introduction to Music Technology), MUSI 339 (Introduction to Music and Computers), MUSI 435 (Interactive Media), MUSI 440 (Computer Sound Generation and Spatial Processing), MUSI 443 (Sound Studio), MUSI 445 (Computer Applications in Music)

Neuroscience: NESC 533 (Neural Network Models of Cognition and Brain Computation)

Philosophy: PHIL 233 (Computers Minds and Brains), PHIL 242 (Introduction to Symbolic Logic), PHIL 350 (Philosophy of Language), PHIL 542 (Symbolic Logic), PHIL 543 (Advanced Logic)

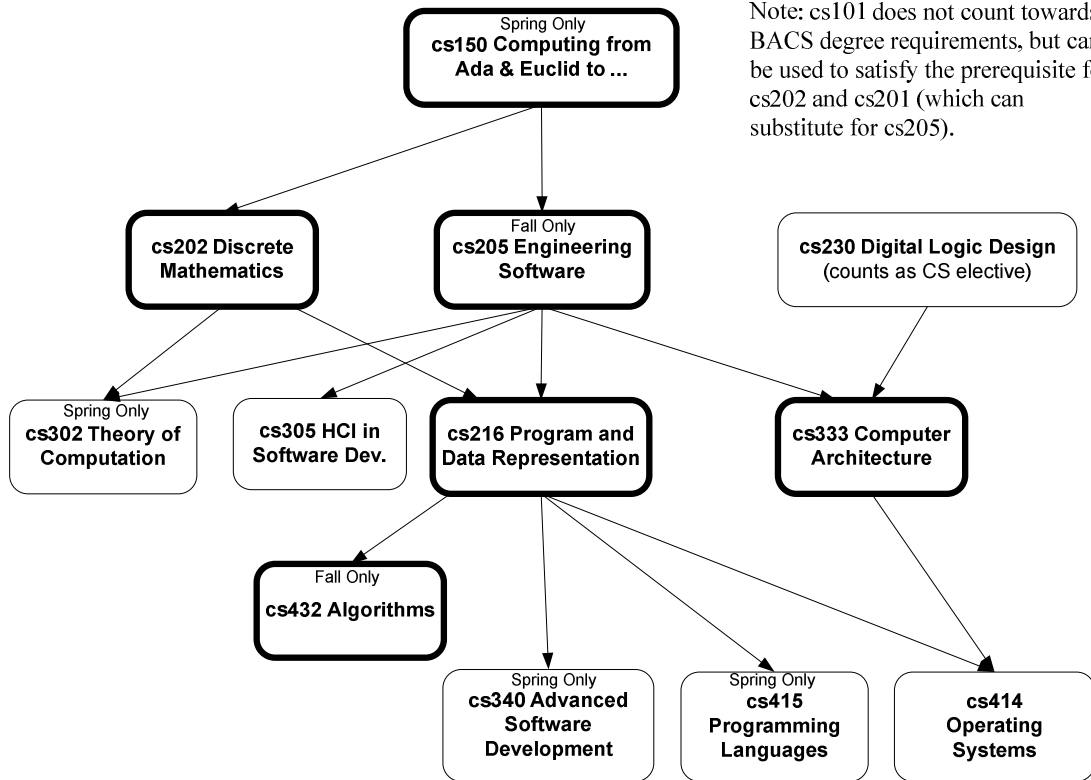
Physics: PHYS 254 (Fundamentals of Scientific Computing), PHYS 553 (Computational Physics I), PHYS 554 (Computational Physics II)

Psychology: PSYC 215 (Introduction to Cognition), PSYC 220 (A Survey of the Neural Basis of Behavior), PSYC 230 (Introduction to Perception), PSYC 401-409 (Topical Seminars, as appropriate), PSYC 411 (Psycholinguistics), PSYC 415 (Cognitive Processes), PSYC 420 (Neural Mechanisms of Behavior), PSYC 430 (Theories of Perception), PSYC 515 (Advanced Cognition), PSYC 521 (Developmental Psychobiology), PSYC 526 (Psychobiology and Memory)

Statistics: STAT 301 (Statistical Computing and Graphics), STAT 322 (Introduction to Regression Analysis), STAT 500 (Introduction to Applied Statistics), STAT 533 (Data Mining/Machine Learning)

Course Flow Chart

(Updated November 2007)



Note: cs101 does not count towards BACS degree requirements, but can be used to satisfy the prerequisite for cs202 and cs201 (which can substitute for cs205).

Boxes with heavy lines are required courses. Some commonly taken electives are also shown. Arrows indicate required pre-requisites.

Sample Schedules

Students typically take CS150 in their second semester, CS205 and CS202 in their third semester, CS216 in their fourth semester, and spread the remaining 2 CS core courses, 4 CS electives, and 4 Integration Electives over their remaining four semesters.

New First-Year Students

First Year, Fall Semester

(Competency requirements and electives)

First Year, Spring Semester

Gateway 1: CS150: Computer Science

Second Year, Fall Semester

Gateway 2: CS205: Engineering Software

CS Core 1: CS202: Discrete Mathematics I

Second Year, Spring Semester

CS Core 2: CS216: Program and Data

Representation

CS Elective 1 (CS230: Digital Logic Design)

Third Year, Fall Semester

CS Core 3: CS333: Computer Architecture

CS Core 4: CS432: Algorithms

Integration Elective 1

Third Year, Spring Semester

CS Elective 2

Integration Elective 2

Fourth Year, Fall Semester

CS Elective 3

Integration Elective 3

Fourth Year, Spring Semester

CS Elective 4

Integration Elective 4

Second-Year Students with no CS Courses

Students entering the major after completing a first year with no CS courses can still complete the major if they have already satisfied most of the College Competency requirements:

Second Year, Fall Semester

Integration Elective 1

CS101: Introduction to Computer Science

(does not count towards major requirements, but satisfies prereqs)

Second Year, Spring Semester

Gateway 2: CS201: Software Development Methods (substitute for CS205)

CS Core 1: CS202: Discrete Mathematics I

Integration Elective 2

Third Year, Fall Semester

CS Core 2: CS216: Program and Data Representation

Integration Elective 3

Third Year, Spring Semester

CS Elective 1 (CS230: Digital Logic Design)

CS Elective 2 (CS302: Theory of Computation)

Integration Elective 4

Fourth Year, Fall Semester

CS Core 3: CS333: Computer Architecture

CS Core 4: CS432: Algorithms

CS Elective 3

Fourth Year, Spring Semester

CS Elective 4

CS150 (or substitute CS415 with approval)

Current First-Year Students with CS101

Students entering the major after completing a first year who have already taken CS101 (or have equivalent experience) can take CS201 in the fall as a substitute for CS205.

Second Year, Fall Semester

*Gateway 2: CS201: Software Development
Methods (substitute for CS205)
CS Core 1: CS202: Discrete Mathematics I*

Second Year, Spring Semester

*Gateway 1: CS150: Computer Science
CS Elective 1 (CS230: Digital Logic
Design)
Integration Elective 2*

Third Year, Fall Semester

*CS Core 2: CS216: Program and Data
Representation
CS Core 3: CS333: Computer Architecture*

Third Year, Spring Semester

*Integration Elective 3
CS Elective 2*

Fourth Year, Fall Semester

*CS Core 4: CS432: Algorithms
CS Elective 3*

Fourth Year, Spring Semester

*CS Elective 4
Integration Elective 4*

Current Second-Year Students with CS101

Students entering the major after their second year who have already taken CS101 (or have equivalent experience) can take CS201 in the fall as a substitute for CS205.

Third Year, Fall Semester

*Gateway 2: CS201: Software Development
Methods (substitute for CS205)
CS Core 1: CS202: Discrete Mathematics I
Integration Elective 1*

Third Year, Spring Semester

*Gateway 1: CS150: Computer Science
CS Core 2: CS216: Program and Data
Representation
CS Elective 1 (CS230: Digital Logic
Design)*

Integration Elective 2

Fourth Year, Fall Semester

*CS Core 4: CS432: Algorithms
CS Core 3: CS333: Computer Architecture
Integration Elective 3
CS Elective 2*

Fourth Year, Spring Semester

*CS Elective 3
CS Elective 4
Integration Elective 4*