DEPARTMENT OF COMPUTER SCIENCE

Faculty

Distinguished Professor Emeritae/i

Richard E. Stearns, Ph.D.
Princeton University

Professors

Harry B. Hunt III, Ph.D.
Cornell University

Neil V. Murray, Ph.D.
Syracuse University

Paliath Narendran, Ph.D.
Rensselaer Polytechnic Institute

Sekharipuram S. Ravi, Ph.D.
University of Pittsburgh

Daniel J. Rosenkrantz, Ph.D.
Columbia University

Dan E. Willard, Ph.D.
Harvard University

Professor Emeritae/i

Dean N. Arden, Ph.D.
Purdue University

Associate Professors

George Berg, Ph.D.
Northwestern University

Peter A. Bloniarz, Ph.D. (Collins Fellow)
Massachusetts Institute of Technology

Seth D. Chaiken, Ph.D.
Massachusetts Institute of Technology

Mei-Hwa Chen, Ph.D.
Purdue University

Andrew R. Haas, Ph.D.
University of Rochester

Lenore M. Restifo Mullin, Ph.D.
Syracuse University

Tomasz Strzalkowski, Ph.D.
Simon Fraser University

Associate Professor Emeritae/i

Edwin D. Reilly, Ph.D.
Rensselaer Polytechnic Institute

Assistant Professors

Ian N. Davidson, Ph.D.
Monash University, Australia

Robert F. Erbacher, Sc.D.,
University of Massachusetts at Lowell

William A. Maniatty, Ph.D.
Rensselaer Polytechnic Institute

Adjuncts (estimated):3

Teaching Assistants (estimated): 21

Courses offered by the Department of Computer Science provide an introduction to the theory and practice of computing. Familiarity with computer languages and data structures is developed in appropriate courses by the completion of programming assignments related to course material.

Students may elect a short sequence of courses in a particular aspect of computer science, complete a minor for broader competence, or obtain a foundation in both theory and practice by completing either a major in computer science or in computer science and applied mathematics.

Among the majors that combine well with either elective course work or a minor in computer science are mathematics, any science major, economics, geography, linguistics, rhetoric and communication, psychology, and sociology. A major in business administration (such as the management science concentrations) would also be appropriate, but students should be aware that they will also have to satisfy the School of Business admission requirements.

A familiarity with computers and their applications may also be obtained through noncredit “Short Courses” offered by the Computing Center and through computer courses offered by the Departments of Atmospheric Science, Biological Sciences, Chemistry, Physics, and Teacher Education, the School of Business, and the College of Arts and Sciences.

Students with a strong interest in the languages and programming techniques commonly used in business may wish to elect the sequence A Csi 101N, 203, 205, and 410.

The computer science majors combine advanced topics in computer practice with introductory material on the mathematical foundations of computer science including abstract models of computers and languages and the fundamental limits of computing.

Students with a primary interest in the applications of computing may combine the major in computer science with a major or minor in other disciplines. Since the range of applications of computing continues to increase, such combinations may be attractive to prospective employers.

The B.A. in computer science requires that the student elect at least one minor from the list of approved minors described in a previous section of this bulletin. Students considering a minor in either mathematics or physics are advised instead to consider one of the B.S. programs described below.

The interdisciplinary combined major and minor program in computer science and applied mathematics or the B.S. program in computer science is recommended for those students who intend to pursue graduate programs in computer science or who wish to qualify for positions involving research or advanced development in computer systems design. The interdisciplinary program combines a strong sequence in computer science with those courses in mathematics particularly relevant to advanced work in computer science.

The B.S. in computer science encompasses a two-course sequence in physics and a second two-course sequence in either more advanced physics or in a second science elected by the student.

Degree Requirements for the Majors in Computer Science

General Program B.A.:

A minimum of 41 credits including A Csi 201N, 310, 210, 333, 311, 402, 404; two additional A Csi courses numbered in the range 400–450 or 500–550; A Mat 111 or 112 or 118, 113 or 119, and 367; plus completion of an approved minor whose courses may not overlap with any of the courses used to complete the major.

General Program B.S. (combined major and minor sequence):

A minimum of 74 credits as follows: A Csi 201N 310, 210, 333, 311, 300Z, 401, 402, 403, 404, 409, plus two courses from A Phy 353, A Phy 454, or any A Csi course numbered 300–450 or 500–550 for a total of 42 credits; A Mat 111 or 112 or 118, 113 or 119, 220, 367, plus three credits from any A Mat course at the 300 level or above; A Phy 140N, 145, 150N, and 155; A Phy 240 and 250, or A Phy 240 and 315, or a two-course sequence in a second science as approved by the department..

Program in Computer Science and Applied Mathematics

The interdisciplinary combined major and minor program in computer science and applied mathematics is an integrated program providing a strong background in the theory and practice of computer science combined with those courses in mathematics which are most likely to be needed for advanced work in computer science, either in graduate study or industrial research and development.

The program provides excellent preparation for the advanced Graduate Record Examination in computer science and will provide an attractive background for admission to high quality graduate programs in computer science. The mathematics portion of the program, with the appropriate selection of one or two electives, can provide a good mathematical background for work in operations research which is an important area of computer application in business, or for numerical computation in a variety of areas related to the scientific and engineering use of computers.

Degree Requirements for the Major in Computer Science and Applied Mathematics

General Program B.S. (combined major and minor sequence): A minimum of 66 credits as follows: A Mat 111 or 112 or 118, 113 or 119, 214, 220, 367; A Csi 201N, 210, 310, 311, 333, 401, 402, 403, 404, 409; 15

additional credits, as advised, from the following list of courses, including at least 9 credits in mathematics: any course with an A Mat prefix numbered 300 or above, any course with an A Csi prefix numbered 300–450 or 500–550, A Csi 499, A Phy 353, A Phy 454, A Phi 432.

Honors Program

The honors program is recommended for students planning graduate study. To be eligible for admission, the student must declare one of the three Computer Science majors and must have completed the following courses: A Csi 201N, 210, 310, 333; A Mat 112 and 113. The student must have a GPA of at least 3.5 in the above courses and an overall GPA of at least 3.25. To complete the honors program, the student must complete 12 credits of course work (to be determined by the department in consultation with each student) designed to ensure a rigorous mastery of the discipline, together with an Honors seminar (A Csi 487/487Z), and an Honors project of at least 6 credits, (A Csi 488Z). Consult the department for further information.

Combined B.S./M.A. and B.S./M.S. Programs

Two combined bachelor's/master's degree programs are available with the undergraduate major in computer science and applied mathematics. The combined B.S./M.A. program combines the undergraduate program in computer science and applied mathematics with the graduate program in mathematics. The combined B.S./M.S. program combines the undergraduate program in computer science and applied mathematics with the graduate program in computer science.

Both programs provide an opportunity for students of recognized academic ability and educational maturity to fulfill integrated requirements of undergraduate and master's degree programs from the beginning of the junior year. A carefully designed program can permit a student to earn the B.S. and M.S. or the B.S. and M.A. degrees within nine or ten semesters.

The combined programs require a minimum of 140 credits, of which at least 32 must be graduate credits. In qualifying for the B.S., students must meet all University and college requirements, including the requirements of the undergraduate major described previously, the minimum 60-credit liberal arts and sciences requirement, general education requirements, and residency requirements.

In qualifying for the M.S. or M.A., students must meet all University and college requirements as outlined in the Graduate Bulletin, including completion of a minimum of 32 graduate credits, and any other conditions such as a research seminar, thesis, comprehensive examination, or other professional experience and residency requirements. Up to 12 graduate credits may be applied simultaneously to both the B.S. and M.S. or the B.S. and M.A. programs.

Students are considered as undergraduates until completion of 120 graduation credits and satisfactory completion of all B.S. requirements. Upon meeting B.S. requirements, students are automatically considered as graduate students.

Students may apply for admission to either combined degree program at the beginning of their junior year or after the successful completion of 56 credits, but no later than the accumulation of 100 credits. A cumulative grade point average of 3.20 or higher and three supportive letters of recommendation from faculty are required for consideration, but admission of a student who meets the minimum requirements is not automatic.

Courses

A Csi 100 Computing and Disability (3)
The relation between people with disabilities and computers. Lectures, tutorials, and laboratory will deal with topics such as how computers may be used by persons with disabilities, assistive devices, software, and applications such as word processing, database inquiries, spreadsheets, and telecommunications. For students with disabilities and for professionals who teach and assist people with disabilities.

A Csi 101N Elements of Computing (3)
Introduction to the principles and practice of computer programming through the use of the general purpose high level programming language VISUAL BASIC. Concepts introduced include algorithms, arrays, files, structured programming, and top-down design. Course also includes a brief introduction to computer technology and computer architecture from both a historical and modern perspective. Only one of A Csi 101N and B Msi 215 may be taken for

credit.

A Csi 102 Microcomputer Software (3)

Theory and practice of general purpose microcomputer software systems such as spreadsheet and relational database packages. Query languages for database access. Word processing with emphasis on spelling and grammar checking. Normally offered spring semester only.

A Csi 103 Topics in Computer Literacy (3)
Each offering of this course will address one or more topics that are germane to the use of computers in every day life. The main emphasis of this course will be on the use of available software packages.

A Csi 120N Computational Principles and Issues (3)
Principles and issues arising in a variety of computational situations. Discussion of topics from computation theory, artificial intelligence, and systems design. From computation theory, an emphasis on impediments to computation, such as undecidability and NP-hardness. From artificial intelligence, an emphasis on knowledge representation. From systems, an emphasis on computer design and on synchronization problems. May not be offered in 2003-2004.

A Csi 198 (formerly A Csi 298) Consulting Service (1–3)
Classroom instruction on the practical aspects of computing on the campus personal, network and mainframe computer environment, including word processing, data communications, networking and using various operating systems. Training is followed by continuing consulting work experience in the public user rooms. Work schedules are determined on an individual basis during the first two weeks of class. May be repeated for credit. Total credits for A Csi 198, A Csi 490, A Csi 497 and the former A Csi 298 and A Csi 498 may not exceed nine. Prerequisite(s): permission of instructor. *S/U* graded. [IL]

A Csi 201N Introduction to Computer Science (4)
Computer algorithms and their representation. The principle of information hiding and its relation to program block structure. File structure and access methods. The efficient use of computational resources. Program development and style.

A Csi 203 Data Processing Principles (3)
Introduction to systems analysis and structured programming techniques using COBOL (Common Business Oriented Language). Basic COBOL, table handling, sorting, file structures and maintenance, storage media, and basic functions of a multi-programming operating system. May not be taken for credit by students with credit for A Csi 206 or A Csi 306. Prerequisite(s): A Csi 101N or 201N or B Msi 215. Normally offered spring semester only.

A Csi 204 Scientific Computing (3)
Programming in the scientific languages Fortran 77 and APL. The effect of internal storage representation on precision and accuracy. Symbolic computation using Macsyma. Elementary numerical methods and the graphical presentation of scientific data. Software libraries of interest to scientists. Prerequisite(s): A Csi 101N or A Csi 201N or B Msi 215, and A Mat 113 or 119. Normally offered spring semester only.

A Csi 205 Object Oriented Programming for Data Processing Applications (3)
Introduction to object oriented programming, abstraction and system analysis techniques using the C++ and Java programming languages. Basic syntax and semantics, classes, objects, arrays and pointers. Modular software design using header or class files and separate compilations and linking. Use of standard class and function libraries and packages. Introduction to memory management and performance issues. Prerequisite(s): B Msi 215 or A Csi 101N or 201N.

A Csi 210 Discrete Structures (4)
Proofs by induction; mathematical reasoning, propositions, predicates and quantifiers; sets; relations, graphs, and trees; functions; counting, permutations and combinations. Prerequisite(s) or corequisite: A Csi 201N. Normally offered fall semester only.

A Csi 221 (= A Mat 221) Introduction to Discrete Mathematics (3)
Topics chosen from sets, relations, induction, binomial theorem, permutations and combinations, counting, and related topics in discrete mathematics. Only one of A Mat 221 & A Csi 221 may be taken for credit. Prerequisite(s) or corequisite: A Mat 113 or 119.

A Csi 300Z Social, Security, and Privacy Implications of Computing (3)
The ethical and moral implications of using computers to affect the lives of individual and collective members of human society. Material drawn from a variety of topics, including security and privacy in computers, networks, security measures, and human users, data banks vs. rights to privacy, intellectual property, open vs. closed software, software piracy, unauthorized access, and other computer crimes. Prerequisite(s): A Csi 201N. [WI]

A Csi 310 Data Structures (3)
Commonly used abstract data structures and their implementation. The use of pointers and recursive programming. Stacks, queues, lists and trees, and their application to such problems as sorting and searching. Analysis of algorithms for using these structures. Prerequisite(s): A Csi 201N. Normally offered spring semester only.

A Csi 311 Principles of Programming Languages (3)
Fundamental concepts and general principles underlying programming languages and their use as illustrated by Prolog and Lisp. Analysis and implementation of run-time environment including scope rules, binding, and parameter passing mechanism. Introduction to interpreters and compilers. Prerequisite(s): Grade of C or better required in A Csi 210 and 310. Majors who declare prior to September 1, 2002 will have the grade restriction waived. Normally offered spring semester only.

A Csi 333 Programming at the Hardware Software Interface (4)
Instruction set architecture of contemporary computers; boolean logic, memory, registers, instructions and interrupts. Assembly language programming; assembler passes, symbols, macros, function linkage and separate compilations. C language programming; syntax, control, types, abstractions, pointers and strings. dynamic memory, standard and user written libraries. ANSI and C++ standards. Instruction set simulation. Prerequisite(s): Grade of C or better required in A Csi 310. Majors who declare prior to September 1, 2002 will have the grade restriction waived. Normally offered fall semester only.

A Csi 400 Operating Systems (3)
Historical overview; operating system services; mass storage file organization; memory management in multiprogrammed systems; virtual memory; resource allocation; concurrent processes; deadlock detection and prevention; security; the design of contemporary operating systems such as UNIX. Prerequisite(s): A Csi 333.

A Csi 401 Numerical Methods for Digital Computers (3)
Study of practical methods for the numerical solution of a variety of problems on a digital computer. Topics covered will include roots of equations, numerical interpolation, numerical integration and differentiation; the evaluation of mathematical functions, least squares curve fitting; the solution of simultaneous linear equations, matrix inversion and linear programming. Prerequisite(s): A Mat 220 and A Csi 310. Normally offered fall semester only.

A Csi 402 Systems Programming (3)
Programming aspects of operating systems. Topics covered include implementation of storage management, resource allocation, multi-processing, scheduling, synchronization, inter-process communication, and terminal I/O. Emphasis on projects to enhance subject understanding, problem solving, and programming skills. Prerequisite(s): Grade of *C* or better required in A Csi 333. Majors who declare prior to September 1, 2001 will have this new restriction waived. Normally offered spring semester only.

A Csi 403 Algorithms and Data Structures (3)
Description of common data structures such as lists, push-down stores, queues, trees, and graphs. Definition of algorithm efficiency and efficient algorithms for integer and polynomial arithmetic, sorting, set manipulation, shortest paths, pattern matching, and Fourier transforms. Prerequisite(s): A Csi 210 and 310. Normally offered spring semester only.

A Csi 404 Computer Organization (3)
An introduction to the logical organization of the hardware components of computing systems. Topics include logic design from a functional point of view, data representation and processing, description of major components such as the central processing unit and memory, and control and communication within the components and in the system. Prerequisite(s): A Csi 333 and 210. Normally offered spring semester only.

A Csi 407 User Interfaces (3)
The C programming language. Event-driven systems. Aspects of the UNIX operating system that support simulation of multi-tasking in a single processor environment. Window-oriented user interfaces. Pop-up/pull-down menus. Human factors in software engineering. Prerequisite(s): A Csi 333. .May not be offered in 2003-2004.

A Csi 409 Automata and Formal Languages (3)
Introduction to the theory of computation. Models of computation including Turing machines and push-down automata will be examined along with their formal language counterparts such as context-free languages. Additional topics include unsolvability, computational complexity, and applications to computer science. Prerequisite(s): A Csi 210. Normally offered fall semester only.

A Csi 410 Database Management Systems (3)
Introduction to database management systems (DBMS) with emphasis on the relational model. Physical and logical database design, rollback and recovery techniques, access methods and query language concepts. The design and use of microcomputer-based relational systems and spreadsheets. The hierarchical and network DBMS models. Prerequisite(s): A Csi 310. Normally offered fall semester only.

A Csi 416 Computer Communication Networks (3)
Introduction to computer communication networks. Equal emphasis on all layers of the ISO reference model and the TCP/IP protocol suite. Topics include physical networks, sliding window protocols, remote procedure call, routing, naming and addressing, security, authentication, performance, and applications. Prerequisite(s): A Csi 402 and A Mat 367.

A Csi 417 Compiler Construction (3)
Compilation vs. interpretation; lexical analysis based on finite automata; parsing; syntax-directed translation; symbol tables; run-time storage allocation; error detection and recovery; code generation and optimization. Prerequisite(s): A Csi 333 and 409.

A Csi 418 Software Engineering (3)
Software engineering principles, the role of abstraction in programming, abstract data types, modularization and module interfaces, specifications, and teamwork. Project work in contemporary concurrent and object-oriented languages. Prerequisite(s): A Csi 333. Normally offered fall semester only.

A Csi 421 Discrete Mathematics with Applications (3)
A deeper coverage of the content of A Csi 210. Proofs by induction, recursive definitions, and combinatorial analysis. Introduction to recurrence equations, graph theory, and abstract algebra. Applications to proofs of correctness and analysis of combinatorial and algebraic algorithms. Prerequisite(s): A Csi 210. Normally offered fall semester only. .May not be offered in 2003-2004.

A Csi 422 (formerly A Csi 302) Introduction to Computer Graphics (3)
Mathematics, data structures, algorithms, system architecture and programming projects for implementing two and three dimensional computer graphics software. Rastorization, matrices, linear and projective transformations; clipping, removal of hidden lines and surfaces. Devices, event driven user interaction, and an introduction to window systems and visual programming tools. Prerequisite(s): A Mat 113 and either A Csi 333 or permission of instructor. A Mat 220 (Linear Algebra) is desirable but not required.

A Csi 424 Information Security (3)
This course covers the broad spectrum of technical issues surrounding computer security and intrusion detection. Topics considered include: viruses, worms, host- and network-based vulnerabilities and countermeasures, database security, intrusion detection, and privacy and legal issues. Facilities for securing hosts and limiting vulnerability are also discussed. Unlike in a systems administration class, detailed operational issues are not discussed. Prerequisite(s): A Csi 402 or A Csi 400.

A Csi 426 Cryptography (3)
The making of ciphers to encode information is the subject of cryptography. This course covers the field from its origins in early historic times through its most up-to-date implementations and uses in digital computers. Various ciphers will be shown and their security assessed. This latter is known as cryptanalysis – the attempt to break a cipher in order to read the underlying message. The course will emphasize how cryptography and cryptanalysis are intimately related, and how the arms race between the two has motivated progress throughout their history. Prerequisite(s): A Csi 333 and co-registration in A Csi 403.

A Csi 430 Introduction to Mathematical Logic (3)
Topics include logical validity, logical consequence, computerized theorem proving, compactness, soundness, consistency, completeness and incompleteness in the context of propositional logic, first order logic, Frege-Hilbert deduction and computerized Semantic Tableaux deduction. This course will survey Goedel's Completeness and Incompleteness Theorems along with decidability, undecidabaility, and a classification of theoretically computable and uncomputable problems. Prerequisite(s) A Csi 210 plus permission of instructor.

A Csi 435 Introduction to Artificial Intelligence (3)
An introduction to the broad spectrum of approaches and techniques of Artificial Intelligence. Emphasis on how to represent knowledge in a computer and how to process that knowledge to produce intelligent behavior. Topics include expert systems, heuristic search, natural language processing and logic-based approaches. Programming assignments using artificial intelligence languages. Prerequisite(s): A Csi 311.

A Csi 440 High Performance Scientific Computing I (3)
Introduction to distributed, shared memory, and non-uniform memory advanced architectures, advanced networks, advanced parallel and distributed languages supporting scientific computing. Basic linear algebra algorithms and their relation to decomposition, memory, access patterns, and scalability. High-level prototyping languages, experimental methods, performance analysis and polyalgorithm design. Prerequisite(s): A Csi 310, A Csi 401, A Mat 220 and knowledge of numerical methods and Fortran; or permission of instructor.

A Csi 441 High Performance Scientific Computing II (3)
Numerical methods for ODE's, PDE's and transforms (FFT) suitable for advanced parallel and distributed computing. Explicit versus implicit message generation and processing in distributed computing environments. Advanced experimental methods. High Performance Fortran, F90 and MPI. Prerequisite(s): A Csi 440.

A Csi 445 Topics in Computer Science (3)
The contents of this course will vary from semester to semester. Each offering will cover an advanced senior-level topic in Computer Science. Prerequisite(s): A Csi 333 (or A Csi 205 & 310) or permission of instructor. May be repeated for credit when content varies./

A Csi 487 Honors Seminar (3)
Each student is required to carry out independent study under the supervision of a faculty member and present a departmental colloquium on the chosen topic. Students may also be required to complete a theoretical or an experimental project, write reports or make short presentations. Only one of A Csi 487 and A Csi 487Z may be taken for credit. Prerequisite(s): Admission to the honors program.

A Csi 487Z Honors Seminar (3)
Each student is required to carry out independent study under the supervision of a faculty member and present a departmental colloquium on the chosen topic. Students may also be required to complete a theoretical or an experimental project, write reports or make short presentations. Only one of A Csi 487 and A Csi 487Z may be taken for credit. Prerequisite(s): Admission to the honors program. [WI]

A Csi 488Z Honors Project (3-12)
Students are required to pursue research supervised by a faculty member and submit final reports describing their research. Outcomes of this research may include software/hardware artifacts, data collected through experiments, bibliographies or research papers. Each student is evaluated by a faculty committee during the second semester of their senior year. Honors students must complete at least 6 credits of this course. Prerequisite(s): Admission to the honors program. [WI]

A Csi 490 Internships in Computer Science (1–3)
Arrangements with external agencies or companies requiring programming or design assignments involving computer systems in a practical environment. Interns are selected by the department and are required to submit a significant report upon completion of the internship. Total credits for A Csi 198, A Csi 490, and A Csi 497 and the former 298 and 498 may not exceed nine. **Internships are open only to qualified juniors and seniors who have an overall grade point average of 2.50 or higher.** Prerequisite(s): A Csi 203 or 310, and permission of department. *S/U* graded. For majors only.

A Csi 497 Independent Study in Computer Science (1–3)
Independent study in computer science under the guidance of faculty computer users. Students should expect to spend approximately three hours per week per credit solving real computer-related problems and submit a significant paper or report upon completion. May be repeated for credit. Total credits for A Csi 198, A Csi 490, and A Csi 497 and the former 298 and 498 may not exceed nine. Prerequisite(s): A Csi 203 or 310, and permission of department. *S/U* graded.

A Csi 499 Senior Project in Computer Science (3)
Introduction to software engineering. Students will participate in the design and production of a large, modular program typical of those encountered in business and industry. Prerequisite(s): A Csi 333 or 311, and permission of instructor.