

## Computer Science

ASSOCIATE PROFESSOR **Torczon** (Chair). PROFESSORS **R. Noonan, Smirni, Stathopoulos** and **Torczon**. ASSOCIATE PROFESSORS **Kearns, Kemper, Li, Mao, Necaize** (visiting) and **Wang** (Wilson and Martha Claiborne Stephens Term Distinguished Associate Professor of Computer Science) ASSISTANT PROFESSORS **I. Dillig, T. Dillig, Poshyvanyk, Shen** and **Zhou**. INSTRUCTOR **D. Noonan**. PROFESSORS EMERITUS **Bynum, Feyock, Prosl** and **Stockmeyer**.

Computer science studies the development of algorithms and data structures for representing and processing information using computers. Additionally, computer science examines the logical organization of computers themselves. Questions which arise include the following. Given the enormous difficulty of writing large programs, what kinds of computer languages can be easily specified, easily understood, and yet mechanically translated? What concepts govern information processing? What are the most advantageous ways of distributing computing loads over a collection of distributed processors? How are graphical images best stored and processed? Are some functions inherently harder to compute than others? Do functions exist which cannot be computed? How is knowledge best represented in a computer?

The department's programs prepare students for graduate study in computer science and for employment as computer science professionals.

### Requirements for Major

**Required Credit Hours:** 37 (if given 4 credits for CSCI 141) otherwise 36.

**Major Computing Requirement:** CSCI 141 or CSCI 241.

**Major Writing Requirement:** Completion of CSCI 423W (in conjunction with CSCI 423), or by fulfilling the requirements of CSCI 495-496, Honors Project in Computer Science.

### Core Requirements:

1. Computer Science 141, 241, 243, 301, 303, 304, 312, and 423. Mathematics 214 may be substituted for Computer Science 243.
2. Any 12 credits chosen from 300-400 level computer science courses excluding Computer Science 320, 430 and 498. Math 413 and 414 may be counted toward partial fulfillment of this requirement.
3. Proficiency in Math 111, 112 and 211 is also required for a major in computer science.

Students who intend to concentrate in computer science are encouraged to have completed Computer Science 141, Computer Science 241, either Computer Science 243 or Mathematics 214, and a required 300 level computer science course by the end of their sophomore year. Proficiency in Math 111 and 112 should also be completed by that time.

### Requirements for Minor

**Required Credit Hours:** 19 if given 4 credits for CSCI 141; otherwise 18.

**Core requirements:** A minor in computer science requires Computer Science 141, Computer Science 241, either Computer Science 243 or Mathematics 214, and any nine elective credits chosen from 300-400 level computer science courses excluding Computer Science 320, 430 and 498. Math 413 and 414 may be counted toward partial fulfillment of the requirement for nine elective credits.

## Description of Courses

### 120. Elementary Topics.

*Fall or Spring (1-3 credits, depending on material) Staff.*

A treatment of elementary topics not covered in existing courses. Course material, chosen from various areas of computer science, will be described and prerequisites/corequisites will appear in detailed course schedule.

### 121. Elementary Topics with Laboratory.

*Fall or Spring (1-3 credits, depending on material) Staff.*

A treatment of elementary topics not covered in existing courses. Course material, chosen from various areas of computer science, will be described and prerequisites/corequisites will appear in appropriate registration bulletins. Scheduled weekly two-hour laboratory sessions account for one of the credit hours assigned to this course.

### 131. Concepts in Computer Science.

*Fall and Spring (3) D. Noonan, Staff. Corequisite: CSCI 131L.*

An overview of computer science, presenting an introduction to key issues and concepts: elementary computer organization and arithmetic, algorithms, program translation, operating systems, elementary data structures, file systems and database structures. Required laboratory sessions introduce students to application software for data management, text processing and network use. Not open to students who have received credit for any 300-400 level computer science course. Two lecture hours, two laboratory hours. Some majors require their students to satisfy the Major Computing Requirement by taking a computer science course designated for that purpose. CSCI 131 is designated for that purpose.

### 135. Web Design.

*Spring (3) Noonan. Prerequisite: CSCI 131 or CSCI 141*

Principles of web site design; introduction to markup languages; visual design; interactive web pages; introduction to web site tools; systems for managing content. Not open to students who have credit for CSCI 300-400-level course.

### 141. Computational Problem Solving.

*Fall and Spring (4) D. Noonan. Corequisite: CSCI 141L.*

An introduction to computational problem solving, including basic programming and algorithms. Programming assignments will emphasize the solution of problems taken from the natural sciences, the social sciences, and business.

### 146. Reasoning Under Uncertainty.

*(GER 1) (3) Staff. Prerequisite: CSCI 141. (Not Offered 2009-2010)*

A computationally-oriented exploration of quantitative reasoning for situations in which complete information is not available. Topics will include an introduction to discrete probability theory, Monte Carlo simulation, sampling theory and elementary game theory.

### 150W. Freshman Seminar.

*Fall or Spring (4) Staff.*

A course designed to introduce freshmen to the study of issues related to the use of computing technology. Satisfies the lower-level writing requirement.

### 241. Data Structures.

*Fall and Spring (3) R. Noonan, Torczon. Prerequisite: CSCI 141.*

Continuation of fundamental concepts of computer science: data abstraction, data structures, and data representation. Lists, stacks, queues, trees, balanced trees, priority queues, hashing, and applications. The implementation of abstract data structures using classes gives this course a significant programming component.

### 243. Discrete Structures of Computer Science.

*Fall and Spring (3) Li, Mao. Prerequisite: CSCI 141.*

Theoretical foundations of computer science, including sets, functions, boolean algebra, first order predicate calculus, trees, graphs and discrete probability.

**301. Software Development.**

Fall (3) Kemper. Prerequisites: CSCI 241.

An introduction to principled software development, emphasizing design at the module level as well as tools and techniques. Topics include object-oriented class design and implementation, abstraction techniques, debugging techniques, defensive programming, development and analysis tools, and testing. Emphasizes the role of the individual programmer in large software development projects.

**303. Algorithms.**

Fall (3) Mao, Stathopoulos, Torczon. Prerequisites: CSCI 241, either CSCI 243 or MATH 214.

A systematic study of algorithms and their complexity, including searching, sorting, selecting, and algorithms for graphs. A survey of algorithm design methods, including greedy algorithms, divide-and-conquer, dynamic programming, and backtracking. An introduction to NP-complete problems.

**304. Computer Organization.**

Fall (3) Necaise. Prerequisites: CSCI 241.

Organization of computer hardware and software; virtual machines, computer systems organization, machine language, assembler language and microprogramming.

**312. Principles of Programming Languages.**

Fall and Spring (3) R. Noonan. Prerequisites: CSCI 241, either CSCI 243 or MATH 214.

A study of programming language principles and paradigms. Formal syntax, including grammars, and semantics. Paradigms, including: imperative, object oriented, functional, logic, event-driven, and concurrent. Run-time implementation issues, including: memory management, parameter passing, and event handling.

**315. Systems Programming.**

Spring (3) Kearns. Prerequisite: CSCI 304.

The design and implementation of programs which provide robust and efficient services to users of a computer. Macro processors; scripting languages; graphical interfaces; network programming. Unix and X are emphasized.

**320. Directed Study.**

Fall, Spring (1-3) Staff. Prerequisites: one of CSCI 301, 303, 304, 312.

A directed study course to investigate aspects of computer science. Course can be based on readings from the literature, on a project, or on a research topic.

Cannot be applied to the requirements for a concentration or a minor in computer science. Permission of instructor required.

**321. Database Systems.**

Fall (3) Kearns, Zhou. Prerequisites: CSCI 241, either CSCI 243 or MATH 214.

Design, organization and implementation of database management systems: file organization and processing, hierarchical, network, and relational models of database structure, data definition and data manipulation languages, security and integrity of databases, and the study of existing database implementations.

**412. Web Programming.**

Spring (3) R. Noonan. Prerequisites: CSCI 321, either CSCI 301 or 312.

Overview of the Internet. Markup languages: HTML, CSS, XML. Server-side programming languages: Perl/Python, PHP, Java. Other topics include: N-tier programming, security, database access, XML processing.

**420. Special Topics in Computer Science.**

Fall or Spring (1-3 credits, depending on material) Staff.

A treatment of topics of interest not routinely covered by existing courses. Material may be chosen from various areas of computer science. A complete course description and a list of prerequisites will appear in appropriate registration bulletins.

**423. Finite Automata and Theory of Computation.**

(3) Mao. Prerequisites: CSCI 303.

Theory of sequential machines, finite automata, Turing machines, recursive functions, computability of functions.

**424. Computer Architecture.**

Spring (3) Staff. Prerequisite: CSCI 304. (Not offered 2011-2012).

An introduction to the principles of computer design. Topics include data representation, including adders, signed integer arithmetic, floating point representation and character representation. A study of microprocessor, minicomputer and mainframe architecture including clocks, memory management, bus communication and input/output.

**426. Simulation.**

Fall (3) Smirni. Prerequisites: CSCI 301, CSCI 303, MATH 112.

Introduction to simulation. Discrete and continuous stochastic models, random number generation, elementary statistics, simulation of queueing and inventory systems, discrete event simulation, point and interval parameter estimation.

**427. Computer Graphics.**

Spring (3) Piers. Prerequisites: CSCI 301, CSCI 303, MATH 211.

Introduction to computer graphics and its applications. Topics include coordinate systems, the relationship between continuous objects and discrete displays, fill and flood algorithms, two-dimensional geometric transformations, clipping, zooming, panning and windowing. Topics from three-dimensional graphics include representations for objects, geometric and projection transformations, geometric modeling and hidden line/surface removal algorithms.

**430. Computer Languages.**

Fall (1-3 credits, depending on language; Pass/Fail only) Staff. Prerequisite: CSCI 241.

Topics include syntax, semantics and pragmatics of one computer language as well as the influence of the languages intended areas of applications on its design. The language studied will vary and students may repeat the course for different languages. This course does not count toward satisfying the major requirements or the major GPA.

**434. Network Systems and Design.**

Spring (3) Zhou. Prerequisite: CSCI 301, CSCI 315.

The Internet; principles and design of network applications, including web servers and multimedia; transport, network and data link layers; network security; network performance evaluation and capacity planning.

**435. Software Engineering.**

Spring (3) R. Noonan, Poshyvanyk. Prerequisite: CSCI 301, CSCI 312.

The software life cycle. Software design methodologies. Testing and maintenance. Programming teams.

**442. Compiler Construction.**

Fall (3) R. Noonan, Shen. Prerequisites: CSCI 301, CSCI 304, CSCI 312.

The emphasis in this course is on the construction of translators for programming languages. Topics include lexical analysis, block structure, grammars, parsing, program representation and run-time organization.

**444. Principles of Operating Systems.**

Fall (3) Kearns, Wang. Prerequisites: CSCI 303, CSCI 315.

The conceptual view of an operating system as a collection of concurrent processes; semaphores, monitors and rendezvous. Real and virtual memory organization and management, processor allocation and management, and external device management.

**454. Computer and Network Security.**

*Spring (3) Wang. Prerequisites: CSCI 315.*

An introduction to the principles and practices of cryptography, network security, and secure software. Cryptography topics includes: basic methods, key distribution, and protocols for authenticated and confidential communications. The practice of network security includes: Kerberos, PGP, public key infrastructures, SSL/TLS. IP security, intrusion detection, password management, firewalls, viruses and worms, and Denial of Service (DoS) attacks.

**†\*495-496. Honors.**

*Fall, Spring (3,3) Staff.*

Students admitted to Honors study in computer science will be enrolled in this course during both semesters of their senior year. The course comprises: (a) supervised research in the student's area of interest; (b) presentation by April 15 of an Honors thesis; and (c) satisfactory performance in a comprehensive oral examination in the field of the student's major interest. For College provisions governing the Admission to Honors, see catalog section titled Honors and Special Programs.

**†498. Internship.**

*Fall and Spring (3; Pass/Fail only) Kemper.*

Students wishing to receive academic credit for an internship program must request and obtain departmental approval prior to participation in the program. A student may not receive credit for this course more than once.

**Graduate Program**

The department offers the degrees of Master of Science in Computer Science and Doctor of Philosophy in Computer Science. For degree requirements and a full description of graduate courses in computer science, visit the department's website at <http://www.cs.wm.edu>.

**Special Five-Year M.S. Program**

The department offers a special program designed to enable particularly well-prepared B.S. or B.A. students to obtain an M.S. in Computer Science 12 or 15 months after receiving their bachelors degrees. Students taking computer science as either their major or as a minor in their undergraduate years may be eligible for this program. Upon request, an eligible candidate will receive an advisor in computer science by the end of the junior year. Candidates will register for two