

CMPSCI 190DM	A Mathematical Foundation for Informatics	CREDITS 3
<i>David Barrington</i>		
Mathematical techniques useful in the study of computing and information processing. The mathematical method of definition and proof. Sets, functions, and relations. Combinatorics, probability and probabilistic reasoning. Graphs and trees as models of data and of computational processes. Prerequisite: R1 math skills recommended. Not intended for Computer Science majors – students interested in a majors-level treatment of this material should see CMPSCI 240 and 250, or MATH 455. 3 credits.		
CMPSCI 190IN	Introduction to Informatics	CREDITS 3
<i>William Verts, Michelle Trim</i>		
An introduction to the main concepts of Informatics. There are several "Big Ideas" in computing, including but not limited to abstraction, data and information, algorithms, programming, and analysis of both computational problems and computational artifacts. This class provides an introduction to those ideas and considers some of the ways that those computing principles might be used to solve real world problems. Computer-based assignments are an integral part of this course but no programming knowledge or prior programming experience is expected or required. Not for CMPSCI majors. 3 credits.		
CMPSCI 191A	Computer Science Majors RAP Seminar	CREDITS 1
<i>David Barrington, Robert Moll</i>		
A weekly seminar for students in the CMPSCI RAP residential program. Exploration of computer science topics through presentations and problem-solving games. Mandatory pass/fail. Open only to first-year students in the CMPSCI RAP. This course does not count toward any requirements for the CMPSCI major or minor. 1 credit.		
CMPSCI 197B	Special Topics - Advanced Assignments for CMPSCI 121	CREDITS 1
<i>Gordon Anderson, Robert Moll</i>		
This add on to CMPSCI 121 consists entirely of five additional more advanced programs that students write to extend the coding experience available in the base 121 class. The course is intended primarily for students in 121 who have some previous programming experience. Must be enrolled in CMPSCI 121 concurrently. 1 credit.		
CMPSCI 197C	Special Topics - Programming in C	CREDITS 1
<i>Nicolas Scarrci</i>		
A brief introduction to the C programming language for students with a good working knowledge of Java and data structures. This course is good preparation for CMPSCI 230 and courses that use C and C++. Prerequisites: CMPSCI 121 and 187. Runs for 6 weeks. This course is for CMPSCI minors and majors only, but it does not count towards either degree. 1 credit.		
CMPSCI 197U	Special Topics - A Hands-on Introduction to UNIX	CREDITS 1
<i>Jarred DeVaughn-Brown</i>		
This course offers a 6-week introduction to working with Unix, and it is intended to help students work with tools commonly used in CS courses. The class is comprised of both discussion and hands-on exercises in the EdLab. Topics covered include working with the command line, installing and maintaining the OS and software packages, version control systems, compiling programs, and more. No previous experience with Unix is required. This course is for CS minors and majors only, but it does not count towards either degree. 1 credit.		
CMPSCI 197WP	Special Topics - Introduction to HTML/CSS	CREDITS 1
<i>Nicolas Scarrci</i>		
An academic approach to building websites with html and css. This course is aimed at beginning programmers and self-taught web developers who would like to cement their skills. Topics include structural html5, css, and introductory javascript/jquery (if time permits). Prerequisite: CMPSCI 121. Mandatory P/F. Students who are enrolled in or have taken CMPSCI 326 are not eligible to take this course. 1 credit.		
CMPSCI 220	Programming Methodology	CREDITS 4
<i>Arjun Guha, Timothy Richards</i>		
Development of individual skills necessary for designing, implementing, testing and modifying larger programs, including: use of integrated design environments, design strategies and patterns, testing, working with large code bases and libraries, code refactoring, and use of debuggers and tools for version control. There will be significant programming and a mid-term and final examination. Prerequisite: CMPSCI 187 or ECE 242. 4 credits.		

CMPSCI 230 Computer Systems Principles CREDITS 4

Timothy Richards, Vasanta Chaganti

Large-scale software systems like Google - deployed over a world-wide network of hundreds of thousands of computers - have become a part of our lives. These are systems success stories - they are reliable, available ("up" nearly all the time), handle an unbelievable amount of load from users around the world, yet provide virtually instantaneous results. On the other hand, many computer systems don't perform nearly as well as Google - hence the now-cliché "the system is down." In this class, we study the scientific principles behind the construction of high-performance, scalable systems. The course begins with a discussion of the relevant features of modern architectures, and moves up the stack from there to operating system services such as programming language runtime systems, concurrency and synchronization, with a focus on key operating system features, I/O and networking, and distributed services. Prerequisites: CMPSCI 187 or ECE 242. 4 credits.

CMPSCI 240 Reasoning Under Uncertainty CREDITS 4

David Jensen

Development of mathematical reasoning skills for problems that involve uncertainty. Each concept will be illustrated by real-world examples and demonstrated through in-class and homework exercises, some of which will involve Java programming. Counting and probability -- basic counting problems, probability definitions, mean, variance, binomial distribution, Markov and Chebyshev bounds. Probabilistic reasoning -- conditional probability and odds, Bayes' Law, Naive Bayes classifiers, Monte Carlo simulation. Markov chains, Markov decision processes, classical game theory, introduction to information theory. This is a core course for the new CMPSCI curriculum and may be used as a math elective for the old curriculum. Prerequisites: CMPSCI 187 (or ECE 242) and MATH 132 or consent of instructor. 4 credits.

CMPSCI 250 Introduction to Computation CREDITS 4

Neil Immerman

Lecture, discussion. Basic concepts of discrete mathematics useful to computer science: set theory, strings and formal languages, propositional and predicate calculus, relations and functions, basic number theory. Induction and recursion: interplay of inductive definition, inductive proof, and recursive algorithms. Graphs, trees, and search. Finite-state machines, regular languages, nondeterministic finite automata, Kleene's Theorem. Problem sets, 2-3 midterm exams, timed final. Corequisite: MATH 132 or equivalent. Prerequisite: MATH 131 and CMPSCI 187 (or ECE 242). 4 credits.

CMPSCI 290NW A Networked World CREDITS 3

Marc Liberatore

The course will cover the technical foundations of today's communication networks, particularly the Internet. It will also address key social, policy, economic and legal aspects of these networks, their use (and abuse), and their regulation. This course covers computer science topics, but all material will be presented in a way that is accessible to an educated audience with or without a strong technical background. Not intended for Computer Science majors – students interested in a majors-level treatment of this material should see CMPSCI 453. 3 credits.

CMPSCI 305 Social Issues in Computing CREDITS 3

Michelle Trim

Using a range of different disciplinary perspectives we will explore various impacts of computers on modern society. This exploration will focus primarily on the social impacts of computers, with an emphasis on ethical concerns. Students will gain practice in several technical communication genres, public writing, and academic writing. Students will produce approximately 10 informal writing assignments and 4-6 larger written projects. Writing experiences will also include writing for electronic environments, collaborative writing, and public writing; there will be one individual and one team presentation assignment. Prerequisite: ENGLWRIT 112. 3 credits.

CMPSCI 311 Introduction to Algorithms CREDITS 4

Hava Siegelmann

This course will introduce you to algorithms in a variety of areas of interest, such as sorting, searching, string-processing, and graph algorithms. You will learn to study the performance of various algorithms within a formal, mathematical framework. You will also learn how to design very efficient algorithms for many kinds of problems. There will be one or more programming assignments as well to help you relate the empirical performance of an algorithm to theoretical predictions. Mathematical experience (as provided by CMPSCI 250) is required. You should also be able to program in Java, C, or some other closely related language. Prerequisite: CMPSCI 250 or MATH 455. 4 credits.

CMPSCI 320 Introduction to Software Engineering (IE) CREDITS 4

Gordon Anderson

Honors Colloq

In this course, students learn and gain practical experience with software engineering principles and techniques. The practical experience centers on a semester-long team project in which a software development project is carried through all the stages of the software life cycle. Topics in this course include requirements analysis, specification, design, abstraction, programming style, testing, maintenance, communication, teamwork, and software project management. Particular emphasis is placed on communication and negotiation skills and on designing and developing maintainable software. Use of computer required. Several written assignments, in-class presentations, exams, and a term project. This course satisfies the IE Requirement. Prerequisite: CMPSCI 220. 4 credits.

CMPSCI 325 Usability CREDITS 3

Eva Hudlicka

In this course we examine the important problems in Usability, Human Computer Interaction, User Interfaces, and Human Centered Computing. We will examine elements of HCI history, understanding human capabilities, HCI design, several methods for prototyping user interfaces, and new applications and paradigms in human computer interaction. This is not a course in how to make dialog boxes, but rather a much more general approach to design and to interacting with human beings and evaluating designs. Some elementary programming (or user interface prototyping tools) may be required, but people without prior programming experience should feel right at home in this class. The course is available to any undergraduate student, not just computer scientists. IT-minor students, and students from other majors with an interest in design, are especially encouraged to participate. The course emphasizes group projects, class discussions and presentations of on-going work in class. There is one midterm exam and periodic in-class quizzes. No prerequisites. 3 credits.

CMPSCI 326 Web Programming (IE) CREDITS 3

Timothy Richards

The World Wide Web was proposed originally as a collection of static documents inter-connected by hyperlinks. Today, the web has grown into a rich platform, built on a variety of protocols, standards, and programming languages, that aims to replace many of the services traditionally provided by a desktop operating system. Topics will include: producing dynamic content using a server-based language, content serving databases and XML documents, session state management, multi-tier web-based architectures, web security, and core technologies including HTTP, HTML5, CSS, JavaScript, and SQL will be emphasized. This course will also study concepts and technologies including AJAX, social networking, mashups, JavaScript libraries (e.g., jQuery), and web security. This course is hands-on and project-based; students will construct a substantial dynamic web application based on the concepts, technologies, and techniques presented during lecture. This course satisfies the IE Requirement. Prerequisites: CMPSCI 187 or ECE 242. 3 credits.

CMPSCI 345 Practice and Applications of Data Management CREDITS 3

Alexandra Meliou

Honors Colloq

Computing has become data-driven, and databases are now at the heart of commercial applications. The purpose of this course is to provide a comprehensive introduction to the use of data management systems within the context of various applications. Some of the covered topics include application-driven database design, schema refinement, implementation of basic transactions, data on the web, and data visualization. The class will alternate between lecture and practice, and the students will experience the covered topics through a semester-long collaborative mini-project. This course counts as a CS Elective toward the CMPSCI major (BA/BS). Students who have taken CMPSCI 445 are not eligible to take this course. Prerequisite: CMPSCI 187 (or ECE 242). 3 credits.

CMPSCI 377 Operating Systems CREDITS 4

Prashant Shenoy

In this course we examine the important problems in operating system design and implementation. The operating system provides a well-known, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer), and protecting individual programs from one another. The course will start with a brief historical perspective of the evolution of operating systems over the last fifty years, and then cover the major components of most operating systems. This discussion will cover the tradeoffs that can be made between performance and functionality during the design and implementation of an operating system. Particular emphasis will be given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping), file systems, and operating system support for distributed systems. Prerequisites: CMPSCI 230 with a grade of 'C' or better. 4 credits.

- CMPSCI 453 Computer Networks CREDITS 3**
Arunkumar Venkataramani Honors Colloq
 This course provides an introduction to fundamental concepts in computer networks, including their design and implementation. Topics covered include the Web and other applications, transport protocols (providing reliability and congestion control), routing, and link access. Special attention is also paid to wireless networks and security. Homework assignments involve programming and written tasks. Prerequisites: Experience programming; CMPSCI 230 (or CMPSCI 377) and CMPSCI 240 (or STATS 515). 3 credits.
- CMPSCI 460 Introduction to Computer and Network Security CREDITS 3**
Christopher Misra
 This course provides an introduction to the principles and practice of system and network security with a focus on both fundamentals and practical information. The three key topics of this course are cryptography, system and network security, and protecting information technology resources. Subtopics include ciphers, key exchange, security services (integrity, availability, confidentiality, etc.), system, network, and web based security attacks, vulnerabilities, exploits, countermeasures and responses. Students will complete several lab assignments experimenting with security countermeasures. Grades will be determined by class participation, lab work, homework, quizzes and exams. Prerequisites include CMPSCI 377 and a familiarity with Unix. 3 credits.
- CMPSCI 491IP Seminar - Programming the iPhone and iPad CREDITS 3**
Charles Weems
 The iPad, iPhone, and iPod Touch present examples of a mobile processor with an interesting set of peripheral devices and limitations. They are programmed using Objective C and a large set of APIs. This seminar will be an introduction to the Objective C language and iOS development environment, and will include student programming assignments and development projects targeting the Apple iPhone/iPad simulator. We will spend much of the class time actually working through examples, and discovering how some of the features really work. Students will need to have access to an Intel machine running OSX, because the development environment and simulator work only on that platform. Students also must join the Apple Developer Program, and accept their license agreements in order to obtain and use the necessary software. This course counts as a CS Elective toward the CMPSCI major (BA/BS). Prerequisites: CMPSCI 320. 3 credits.
- CMPSCI 521 Software Engineering: Analysis and Evaluation CREDITS 3**
Yuriy Brun
 Software has become ubiquitous in our society. It controls life-critical applications, such as air traffic control and medical devices, and is of central importance in telecommunication and electronic commerce. In this course, we will examine state-of-the-art practices for software testing and analysis to verify software quality. We will initially look at techniques for testing and analyzing sequential programs, and then examine the complexity that arises from distributed programs. The students will be required to complete regular homework assignments and exams, and carry out a group research project extending techniques described in class and/or applying them to new domains. No required text. Papers from the open literature will be assigned and made available. Prerequisites: CMPSCI 320, Introduction to Software Engineering (or equivalent course). 3 credits.
- CMPSCI 529 Software Engineering Project Management CREDITS 3**
Gordon Anderson
 The purpose of this course is to provide students with practical experience in the management of software development projects. Students in this course will gain this experience by serving as software development team technical managers for teams of software engineering students in CMPSCI 320. As project managers, the students in CMPSCI 529 will be responsible for: supervising and managing the work of teams of CMPSCI 320 students; interfacing with the other CMPSCI 529 students managing other teams in the course; interfacing with the course instructor, course TA, and course customer. CMPSCI 529 students will be assigned readings in software engineering project management to provide a theoretical basis for their work in this course. But the majority of work in the course will be related to the actual management of assigned development teams. As team managers, CMPSCI 529 students will set goals and schedules for their teams, track and report team progress, negotiate with leaders of other teams and the course customer, and evaluate the work of members of their teams. CMPSCI 529 course assignments may include: written team goals, plans and schedules; periodic reports on team progress; documentation of agreements reached with other team leaders and customers; evaluations of the applicability of theoretical papers to the work of this course. This course will meet at the same times and places as CMPSCI 320. Additional meetings with team members and other students in CMPSCI 529 are also expected to be arranged by mutual agreement. An additional one hour weekly meeting of all of the students in CMPSCI 529 is required. Enrollment in this course is only by permission of the instructor, and is restricted to students who have previously taken CMPSCI 320, and received a grade of A or A-. 3 credits.

CMPSCI 575 Combinatorics and Graph Theory [MATH 513] CREDITS 3

Robert Moll

This course is a basic introduction to combinatorics and graph theory for advanced undergraduates in computer science, mathematics, engineering and science. Topics covered include: elements of graph theory; Euler and Hamiltonian circuits; graph coloring; matching; basic counting methods; generating functions; recurrences; inclusion-exclusion; and Polya's theory of counting. Prerequisites: mathematical maturity; calculus; linear algebra; strong performance in some discrete mathematics class, such as CMPSCI 250 or MATH 455. Modern Algebra - MATH 411 - is helpful but not required. 3 credits.

CMPSCI 585 Introduction to Natural Language Processing CREDITS 3

Brendan O'Connor

Natural Language Processing addresses fundamental questions at the intersection of human languages and computer science. How can computers acquire, comprehend and produce English? How can computational methods give us insight into observed human language phenomena? How can you get a job at Google? In this interdisciplinary introductory course, you will learn how computers can do useful things with human languages, such as translate from French into English, filter junk email, extract social networks from the web, and find the main topics in the day's news. You will also learn about how computational methods can help linguists explain language phenomena, including automatic discovery of different word senses and phrase structure. Over the past decade, natural language processing has been revolutionized by statistical and probabilistic methods; you will learn about robust approaches to parameter estimation and inference. Our work will include learning new methods, discussions, and hands-on laboratories modifying provided programs. Prerequisites: CMPSCI 220 (or CMPSCI 230, or equivalent). 3 credits.

CMPSCI 610 Compiler Techniques CREDITS 3

J. Eliot Moss

This course explores the basic problems in the translation of programming languages focusing on theory and common implementation techniques for compiling traditional block structured programming languages to produce assembly or object code for typical machines. The course involves a substantial laboratory project in which the student constructs a working compiler for a considerable subset of a realistic programming language, within a provided skeleton. The lectures are augmented by a discussion section that covers details of the programming language used to build the compiler, the operating system, the source language, and various tools. Use of computer required. Text: Engineering a Compiler, Cooper and Torczon. 3 credits.

CMPSCI 611 Advanced Algorithms CREDITS 3

Ramesh Sitaraman

Principles underlying the design and analysis of efficient algorithms. Topics to be covered include: divide-and-conquer algorithms, graph algorithms, matroids and greedy algorithms, randomized algorithms, NP-completeness, approximation algorithms, linear programming. Prerequisites: The mathematical maturity expected of incoming Computer Science graduate students, knowledge of algorithms at the level of CMPSCI 311. 3 credits.

CMPSCI 621 Advanced Software Engineering: Analysis and Evaluation CREDITS 3

Yuriy Brun

Software has become ubiquitous in our society. It controls life-critical applications, such as air traffic control and medical devices, and is of central importance in telecommunication and electronic commerce. In this course, we will examine state-of-the-art practices for software testing and analysis to verify software quality. We will initially look at techniques for testing and analyzing sequential programs, and then examine the complexity that arises from distributed programs. The students will be required to complete regular homework assignments and exams, and carry out a group research project extending techniques described in class and/or applying them to new domains. No required text. Papers from the open literature will be assigned and made available. Prerequisites: CMPSCI 320, Introduction to Software Engineering (or equivalent course). 3 credits.

CMPSCI 630 Systems CREDITS 3

Emery Berger

This class is an in-depth introduction to systems, focusing on principles of system design that cross-cut numerous systems artifacts, including operating systems, databases, runtime systems, and architecture. We will cover all levels of the "system stack", from chips to distributed systems. This class may be used to satisfy systems core requirements. 3 credits.

CMPSCI 646 Information Retrieval CREDITS 3

James Allan

The course will cover basic and advanced techniques for text-based information systems. Topics covered include retrieval models, indexing and text representation, browsing and query reformulation, data-intensive computing approaches, evaluation, and issues surrounding implementation. The course will include a substantial project such as the implementation of major elements of search engines and applications. Prerequisite: CMPSCI 446, CMPSCI 445, or equivalent. 3 credits.

CMPSCI 650 Applied Information Theory CREDITS 3

Erik Learned-Miller

This course will introduce the basic concepts of Information Theory: entropy, relative entropy, mutual information, channel capacity, and rate distortion. Applications, rather than proofs, will be emphasized. In addition, the statistical problem of computing information theoretic quantities from data will be emphasized. Non-parametric and semi-parametric statistical models will also be covered. Applications in vision, machine learning, coding, and medical imaging will be covered. 3 credits.

CMPSCI 653 Computer Networking CREDITS 3

James Kurose

This course covers advanced fundamental principles of computer networks, studying foundational material in the field. Topics include advanced network architecture, network algorithmics, network control, network measurement, and wireless networks. The goal of this course is to teach networking fundamentals/techniques that will be useful for years to come. Prerequisites: Introductory (undergraduate level) courses in computer networks (e.g., CMPSCI 453), and algorithms (e.g., CMPSCI 311). Some familiarity with probability and with optimization theory will be helpful. 3 credits.

CMPSCI 670 Computer Vision CREDITS 3

Subhransu Maji

People are able to infer the characteristics of a scene or object from an image of it. In this course, we will study what is involved in building artificial systems which try to infer such characteristics from an image. Topics include: Basics of image formation - the effect of geometry, viewpoint, lighting and albedo on image formation. Basic image operations such as filtering, convolution and correlation. Frequency representations of images. The importance of scale in images. Measurements of image properties such as color, texture, appearance and shape. Inference of motion and structure from moving objects and images. Detecting and recognizing objects in images. Statistical methods in computer vision. Prerequisite: Linear algebra, calculus, basic knowledge of probability, and an ability to program. 3 credits.

CMPSCI 683 Artificial Intelligence CREDITS 3

Shlomo Zilberstein

In-depth introduction to Artificial Intelligence focusing on techniques that allow intelligent systems to reason effectively with uncertain information and cope limited computational resources. Topics include: problem-solving using search, heuristic search techniques, constraint satisfaction, local search, abstraction and hierarchical search, resource-bounded search techniques, principles of knowledge representation and reasoning, logical inference, reasoning under uncertainty, belief networks, decision theoretic reasoning, representing and reasoning about preferences, planning under uncertainty using Markov decision processes, multi-agent systems, and computational models of bounded rationality. 3 credits.

CMPSCI 689 Machine Learning CREDITS 3

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Machine learning is the computational study of artificial systems that can adapt to novel situations, discover patterns from data, and improve performance with practice. This course will cover the popular frameworks for learning, including supervised learning, reinforcement learning, and unsupervised learning. The course will provide a state-of-the-art overview of the field, emphasizing the core statistical foundations. Detailed course topics: overview of different learning frameworks such as supervised learning, reinforcement learning, and unsupervised learning; mathematical foundations of statistical estimation; maximum likelihood and maximum a posteriori (MAP) estimation; missing data and expectation maximization (EM); graphical models including mixture models, hidden-Markov models; logistic regression and generalized linear models; maximum entropy and undirected graphical models; nonparametric models including nearest neighbor methods and kernel-based methods; dimensionality reduction methods (PCA and LDA); computational learning theory and VC-dimension; reinforcement learning; state-of-the-art applications including bioinformatics, information retrieval, robotics, sensor networks and vision. Prerequisites: undergraduate level probability and statistics, linear algebra, calculus, AI; computer programming in some high level language. 3 credits.

CMPSCI 690IV Intelligent Visual Computing CREDITS 3

Evangelos Kalogerakis

The course will teach students algorithms that intelligently process, analyze and generate visual data. The course will start by covering the most commonly used image and shape descriptors. It will proceed with statistical models for representing 2D images, textures, 3D shapes and scenes. The course will then provide an in-depth background on topics of shape and image analysis and co-analysis. Particular emphasis will be given on topics of automatically inferring function from shapes, as well as their contextual relationships with other shapes in scenes and human poses. Finally, the course will cover topics on automating the design and synthesis of 3D shapes with machine learning algorithms and advanced human-computer interfaces. Students will read, present and critique state-of-the-art research papers on the above topics. This course counts as a CS Elective toward the CMPSCI major (BA/BS). 3 credits.

