

CICS 290M Make: A Hands-on Introduction to Physical Computing

INSTRUCTOR(S): Rui Wang

4 Credits

Inspired by the Maker movement, this course provides a hands-on introduction to physical computing: sensing and responding to the physical world using computers. Specific topics include: basic electronics and circuit design, microcontroller programming using Arduinos, sensing and responding to the physical world, rapid prototyping (3D printing and laser cutting etc.), soft circuits and wearable electronics. The course will encourage and empower students to invent, design, and build practical hardware projects that interact with the physical world. This course has a required lab section, and counts as one of the CS Lab Science Requirement courses for the BS-CS. Prerequisite: COMPSCI 187 and Basic Math Skills (R1). 4 credits.

CICS 597C Special Topics - Introduction to Computer Security

INSTRUCTOR(S): Parviz Kermani

3 Credits

This course provides an introduction to the principles and practice of computer and network security with a focus on both fundamentals and practical information. The key topics of this course are applied cryptography; protecting users, data, and services; network security, and common threats and defense strategies. Students will complete several practical lab assignments involving security tools (e.g., OpenSSL, Wireshark, Malware detection). The course includes homework assignments, quizzes, and exams. 3 credits.

COMPSCI 105 Computer Literacy

INSTRUCTOR(S): William Verts

3 Credits

Microcomputers are used widely in all areas of modern life. For this reason it is important for all students to understand how computers work and how computers can be used as a problem-solving tool. The focus of this course is on computer applications. The course stresses the ways in which computers can help you solve problems efficiently and effectively. The course provides a broad introduction to hardware, software, and mathematical aspects of computers. Four application areas are discussed: Internet tools (including Web page design), word processing, spreadsheets, and databases. Weekly lab assignments are an integral part of the course, and it is expected that students have access to their own computing equipment. There are optional lab times set up for students who do not have the proper equipment or software available to them. This course is a "Foundations" course for the Information Technology minor. Students who are more interested in computer programming should take a course such as COMPSCI 119 or COMPSCI 121. Prerequisites: reasonable high school math skills. Typing ability is also an important asset for the course. Some previous computer experience, while not absolutely required, will prove helpful. Not for CS majors. 3 credits.

COMPSCI 119 Introduction to Programming

INSTRUCTOR(S): William Verts

3 Credits

This introduction to computer programming with Python emphasizes multimedia (graphics and sound) applications that are relevant for Web designers, graphic artists, and anyone who just wants to have more fun with their computer. Students will explore basic concepts in computer science and computer programming by manipulating digital images and sound files. No prior programming experience is needed. Not for CS majors. 3 credits.

COMPSCI 121 Introduction to Problem Solving with Computers

INSTRUCTOR(S): Gordon Anderson, Neena Thota

4 Credits

COMPSCI 121 provides an introduction to problem solving and computer programming using the programming language Java. The course teaches how real-world problems can be solved computationally using the object-oriented metaphor that underlies Java. Concepts and techniques covered include data types, expressions, objects, methods, top-down program design, program testing and debugging, state representation, interactive programs, data abstraction, conditionals, iteration, interfaces, inheritance, arrays, graphics, and GUIs. No previous programming experience required. A companion introduction to programming class, COMPSCI 119 is also offered. If you are fairly sure you only want to do just one programming class, take that course; if you think it likely that you will do more than one programming course, take 121. Use of computer is required. Prerequisite: R1 (or a score of 20 or higher on the math placement test Part A), or one of the following courses: MATH 101&102 or MATH 104 or MATH 127 or MATH 128 or MATH 131 or MATH 132. 4 credits.

COMPSCI 145 Representing, Storing, and Retrieving Information

INSTRUCTOR(S): William Verts

3 Credits

An introductory course in the use of data in computer systems, a core course for the Information Technology certificate. Formats for representing text, numbers, sound, images, etc., as strings of bits. Equations of lines and curves, modeling of synthetic scenes (i.e., ray tracing), exploring the frequency domain and holography. Basic information theory, use and limitations of file compression and encryption. Structured databases and how to use them. Information retrieval in heterogeneous environments such as the Web. XML as a language for defining new formats for representing data. Review of historical, pre-computer methods of information representation. Prerequisites: "Basic computer literacy", i.e., user-level familiarity with a modern operating system and some experience with application programs. Tier I math skills. Recommended for First Year and Sophomore Non-Majors. Prerequisite: R1. 3 credits.

COMPSCI 186 Using Data Structures

INSTRUCTOR(S): Neena Thota, David Wemhoener

4 Credits

This course introduces foundational abstract data types and algorithms. The main focus is on the use of data structures in designing and developing programs to solve problems in a variety of domains. Specific topics include lists, sets, maps, graphs, stacks, queues, searching, and sorting. There will be weekly programming assignments, assignments in discussion sections consisting of programming and written exercises, several announced quizzes, and a final exam. This course is not a substitute for COMPSCI 187. If unsure of whether this course or COMPSCI 187 is more appropriate, contact instructor. Prerequisites: COMPSCI 121 and Basic Math Skills (R1). 4 credits.

COMPSCI 187 Programming with Data Structures

INSTRUCTOR(S): Mark Corner

4 Credits

The course introduces and develops methods for designing and implementing abstract data types using the Java programming language. The main focus is on how to build and encapsulate data objects and their associated operations. Specific topics include linked structures, recursive structures and algorithms, binary trees, balanced trees, and hash tables. These topics are fundamental to programming and are essential to other courses in computer science. The course involves weekly programming assignments, in-class quizzes, discussion section exercises, and multiple exams. Prerequisites: COMPSCI 121 (or equivalent Java experience). A grade of B or better in COMPSCI 121 (or a grade of C or better in COMPSCI 186 (or COMPSCI 190D) is required for students enrolling in COMPSCI 187 and Basic Math Skills (R1). Basic Java language concepts are introduced quickly; if unsure of background, contact instructor. 4 credits.

COMPSCI 197C Special Topics - Programming in C

INSTRUCTOR(S): John Foley

1 Credits

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 COMPSCI 230 and courses that use C and C++. Prerequisites: COMPSCI 186, 187(or E&C-ENG 242). Runs for 6 weeks. This course is for CS minors and majors only, but it does not count towards either degree. 1 credit.

COMPSCI 197S Special Topics - Basics of Cybersecurity

INSTRUCTOR(S): Shruti Jadon

1 Credits

This short course provides an introduction to basic principles and practices of computer and network security. Topics include ethics, primary definitions, applied cryptography, networking, operating systems, malware, and incident handling. The course is flipped: students complete readings and assignments ahead of each class, and class time is used to discuss this work. Class discussion includes current events related to security as well. Attendance is mandatory. Open to FROSH/SOPH CS Majors only. 1 credit.

COMPSCI 197U Special Topics - A Hands-on Introduction to UNIX

INSTRUCTOR(S): John Foley

1 Credits

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.

COMPSCI 198J Practicum - High School Teaching Practicum

INSTRUCTOR(S): Emery Berger

1 Credits

Assisting high school students in learning computer programming in the context of a high school course. The language of instruction will be Java or Python. Students taking this independent study will be expected to work under the direct supervision of the high school computer science teacher at a local high school. Students are expected to attend classes weekly for approximately one hour. Course evaluation will be performed by the high school teacher in cooperation with the supervising faculty member, and a final written report will be required. 1 credit.

COMPSCI 220 Programming Methodology

INSTRUCTOR(S): Arjun Guha

4 Credits

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: COMPSCI 187 (or E&C-ENG 242). 4 credits.

COMPSCI 230 Computer Systems Principles

INSTRUCTOR(S): Timothy Richards

4 Credits

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 C language, and moves up the stack from there to the features of modern architectures, assembly languages, and operating system services such as I/O and synchronization. Prerequisites: COMPSCI 187 (or E&C-ENG 242). 4 credits.

COMPSCI 240 Reasoning Under Uncertainty

INSTRUCTOR(S): Emma Tosch, Luis Pineda

4 Credits

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 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. Prerequisites: COMPSCI 187 (or E&C-ENG 242) and MATH 132 or consent of instructor. 4 credits.

COMPSCI 250 Introduction to Computation

INSTRUCTOR(S): David Barrington

4 Credits

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. Prerequisite: MATH 132 and COMPSCI 187 (or E&C-ENG 242). 4 credits.

COMPSCI 305 Social Issues in Computing

INSTRUCTOR(S): Michelle Trim, Anna Napoleone

3 Credits

Through a careful analysis and discussion of a range of computing issues, topics, and policies, we will explore various impacts of computers on modern society. This class satisfies the Junior Year Writing requirement by providing directed practice and specific instruction in a range of writing genres. Students will produce approximately 20-25 pages of polished written work over the course of the semester. Prerequisite: ENGLWRIT 112 or equivalent and COMPSCI 220 (or COMPSCI 230) and COMPSCI 240 (or COMPSCI 250). 3 credits.

COMPSCI 311 Introduction to Algorithms

INSTRUCTOR(S): Akshay Krishnamurthy

4 Credits

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 COMPSCI 250) is required. You should also be able to program in Java, C, or some other closely related language. Prerequisite: COMPSCI 250 or MATH 455. 4 credits.

COMPSCI 320 Introduction to Software Engineering

INSTRUCTOR(S): Gordon Anderson, Neena Thota

4 Credits

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, and a term project. This course satisfies the IE Requirement. Prerequisite: COMPSCI 220. 4 credits.

COMPSCI 326 Web Programming

INSTRUCTOR(S): Timothy Richards

3 Credits

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: COMPSCI 220 or COMPSCI 230. 3 credits.

COMPSCI 345 Practice and Applications of Data Management

INSTRUCTOR(S): David Wemhoener

3 Credits

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 follow a flipped classroom model; students will be required to review materials in preparation for each week and they will work collaboratively on practical problems in class. This course counts as a CS Elective toward the COMPSCI major (BA/BS). Students who have completed COMPSCI 445 are not eligible to take this course without instructor permission. Prerequisite: COMPSCI 187 (or ECE 242). 3 credits.

COMPSCI 365 Digital Forensics

INSTRUCTOR(S): Marc Liberatore

3 Credits

The goal of forensics is to gather artifacts for refinement into evidence that supports or refutes a hypothesis about an alleged crime or policy violation. Done correctly, forensics represents the application of science to law. The techniques can also be abused to thwart privacy. This course is a broad introduction to forensic investigation of digital information and devices. We will cover the acquisition, analysis, and courtroom presentation of information from file systems, operating systems, networks, cell phones, and the like. Students do not need experience with these systems. We will review the use of some professional tools that automate data harvesting, however, the primary goal of the class is to understand why and from where artifacts are recoverable in these systems. Several assignments involve coding forensic tools from scratch. For a small portion of the class, we will cover some relevant issues from the law, privacy, and current events. Thus, the class serves the well-rounded student who is eager to participate in class discussion on a variety of technical and social issues. Prerequisites: COMPSCI 220 or COMPSCI 230; CS majors only. 3 credits.

COMPSCI 370 Introduction to Computer Vision

INSTRUCTOR(S): Subhansu Maji

3 Credits

This introductory computer vision class will address fundamental questions about getting computers to "see" like humans. We investigate questions such as -What is the role of vision in intelligence? -How are images represented in a computer? -How can we write algorithms to recognize an object? -How can humans and computers "learn to see better" from experience? We will write a number of basic computer programs to do things like recognize handwritten characters, track objects in video, and understand the structure of images. Prerequisite: COMPSCI 240 or 383. 3 credits.

COMPSCI 373 Introduction to Computer Graphics

INSTRUCTOR(S): Evangelos Kalogerakis

3 Credits

This course introduces the fundamental concepts of 2D and 3D computer graphics. It covers the basic methods for modeling, rendering, and imaging. Topics include: image processing, digital photography, 2D/3D modeling, 3D graphics pipeline, OpenGL, shading, texture mapping, ray tracing, 3D printing. Throughout the class, we will teach students to learn modern graphics techniques, to model the visual world algorithmically, and to implement algorithms using Java. Students who have taken COMPSCI 473 are not eligible to take this course. Students cannot take COMPSCI 497C after taking this course. Prerequisites: COMPSCI 187 (or ECE 242) and INFO 150 (COMPSCI 190DM or MATH 235 or COMPSCI 240). 3 credits.

COMPSCI 377 Operating Systems

INSTRUCTOR(S): Ahmed Aleyeldin Hassan

4 Credits

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: COMPSCI 230. 4 credits.

COMPSCI 383 Artificial Intelligence

INSTRUCTOR(S): Philip Thomas

3 Credits

The course explores key concepts underlying intelligent systems, which are increasingly deployed in consumer products and online services. Topics include problem solving, state-space representation, heuristic search techniques, game playing, knowledge representation, logical reasoning, automated planning, reasoning under uncertainty, decision theory and machine learning. We will examine the use of these concepts in the design of intelligent agents in the context of several applications. Prerequisites: COMPSCI 220 (or COMPSCI 230) and COMPSCI 240. 3 credits.

COMPSCI 390N Internet of Things

INSTRUCTOR(S): Sunghoon Lee

3 Credits

We are living in a world where everyday objects, such as smartphones, cars, TVs, and even refrigerators, are becoming smarter and constantly connected to each other to build, operate, and manage the physical world. This emerging paradigm, namely the Internet of Things (IoT), has great potential to impact how individuals live and work by providing a source of innovative decision making. The design of the IoT, which is defined as "a internetwork of physical items – each embedded with sensors – that are connected to the Internet", requires the understanding of embedded electronics, software, sensors, network, and data analytics. To prepare our students as forerunners of this future, this course will introduce a wide range of topics in the broad areas of IoT, and provide hands-on experiences via a series of exciting projects. Prerequisite: COMPSCI 187 (or E&C-ENG 242). This course counts as a CS Elective for the CS Major (BA/BS). 3 credits.

COMPSCI 403 Introduction to Robotics: Perception, Mechanics, Dynamics, and Control

INSTRUCTOR(S): Joydeep Biswas

3 Credits

This course covers basic methods and concepts in order to explain how robots work. We will study how they sense things in the world, how you make a robot move, and how robots can make their own decisions. We will study mechanisms (kinematics and dynamics), actuators, sensors, (with a focus on machine vision), signal processing, feedback control theory, machine learning, and path planning. Students will build software systems for simulated robots and logged real robot sensor data, and do experiments with system identification and control, image processing, and path planning to reinforce the material presented in class. Prerequisites: MATH 235 (or MATH 236) and COMPSCI 220 (or COMPSCI 230). 3 credits.

COMPSCI 445 Information Systems

INSTRUCTOR(S): Gerome Miklau

3 Credits

This course is an introduction to the efficient management of large-scale data. The course includes principles for representing information as structured data, query languages for analyzing and manipulating structured data, and core systems principles that enable efficient computation on large data sets. Classical relational database topics will be covered (data modeling, SQL, query optimization, concurrency control), as well as semi-structured data (XML, JSON), and distributed data processing paradigms (e.g. MapReduce and Spark). Additional application topics may include web application development, data integration, processing data streams, database security and privacy. Prerequisites: COMPSCI 220 (or 230) and COMPSCI 311 and COMPSCI 345. 3 credits.

COMPSCI 446 Search Engines

INSTRUCTOR(S): David Fisher

3 Credits

This course provides an overview of the important issues in information retrieval, and how those issues affect the design and implementation of search engines. The course emphasizes the technology used in Web search engines, and the information retrieval theories and concepts that underlie all search applications. Mathematical experience (as provided by COMPSCI 240) is required. You should also be able to program in Java (or some other closely related language). Prerequisite: COMPSCI 240 or COMPSCI 383. 3 credits.

COMPSCI 453 Computer Networks

INSTRUCTOR(S): Parviz Kermani

3 Credits

Introduction to computer communication networks and protocols. Fundamental concepts in the design and analysis of computer networks. Topics include: layered network architectures, applications, network, programming interfaces, transport, congestion, routing, data link protocols, local area networks, emerging high-speed networks, network security, and wireless networks. Examples drawn from the Internet (e.g., TCP, UDP, and IP) protocol suite. Homework assignments involve programming and written tasks. Prerequisites: Experience programming; COMPSCI 230 (or COMPSCI 377). 3 credits.

COMPSCI 490P Secure Distributed Systems

INSTRUCTOR(S): Brian Levine

3 Credits

This is a class devoted to the study of securing distributed systems, with blockchain-based cryptocurrencies serving as our real platform of interest. We'll start with the fundamentals of Lamport's, Fischer's, and Douceur's results that fence-in all consensus system, and discuss Byzantine fault tolerance. We'll also look at the efficiency of the network architectures for peer-to-peer/distributed system communication and attacks on their security, such as denial of service attacks. And we'll review relevant applied cryptography such as elliptical curves. We'll discuss in detail the mechanisms of Bitcoin and Ethereum and we'll program distributed applications for Ethereum. Other topics include economics and finance. Assignments will include programming projects and reading research papers. The grade is also based on exams and participation in discussion. The course is based on a "flipped classroom". This course counts as a CS Elective toward the CS major (BA/BS), as well an Any 2 menu choice for the Security & Privacy track. Prerequisites:COMPSCI 326, COMPSCI 345, COMPSCI 377, COMPSCI 453, COMPSCI 460, COMPSCI 497P, OR COMPSCI 590CC 3 credits.

COMPSCI 491G Seminar - Computer Networking Lab

INSTRUCTOR(S): Parviz Kermani

3 Credits

In this course, students will learn how to put "principles into practice," in a hands-on-networking lab course. The course will cover router, switches and end-system labs in the areas of Single Segment IP Networks, Multiple Segment IP Networks and Static Routing, Dynamic Routing Protocols (RIP, OSPF and BGP), LAN switching, Transport Layer Protocols: UDP and TCP, NAT, DHCP, DNS, and SNMP. Students will also get engaged in evaluating power consumption of network components as an aid in the design of energy efficient (green) networks. This course counts as a CS Elective toward the CS major (BA/BS). Prerequisite: COMPSCI 453. 3 credits.

COMPSCI 497C Special Topics in Computer Graphics

INSTRUCTOR(S): Evangelos Kalogerakis

3 Credits

This course introduces the fundamental concepts of two-dimensional (2D) and three-dimensional (3D) computer graphics. It covers the basic methods needed to model, render, and animate 3D objects. Topics include raster displays, line drawing, affine and perspective transformations, windows and viewpoints, clipping, visibility, illumination models, reflectance models, radiometry, curves and surfaces, shading, texture mapping, ray tracing, graphic toolkits, animation, and 3D printing. Throughout the class, students will learn algorithmic ways to model the visual world, and write Java programs to implement various computer graphics algorithms. Students are required to complete 5 programming assignments in Java (as in 373), and in addition extra questions in assignments and a course project to receive 400-level credit. Students will also meet with the instructor to discuss special topics in graphics related to the course project. This course counts as a CS Elective toward the CS major (BA or BS).Prerequisites: COMPSCI 187 (or E&C-ENG 242) AND INFO 150 (or MATH 235 or COMPSCI 240). 3 credits.

COMPSCI 501 Formal Language Theory

INSTRUCTOR(S): Neil Immerman

3 Credits

Introduction to formal language theory. Topics include finite state languages, context-free languages, the relationship between language classes and formal machine models, the Turing Machine model of computation, theories of computability, resource-bounded models, and NP-completeness. Undergraduate Prerequisites: COMPSCI 311 or equivalent. It is recommended that students have a 'B-' or better in 311 in order to attempt 501. 3 credits.

COMPSCI 514 Algorithms for Data Science

INSTRUCTOR(S): Barna Saha

3 Credits

Big Data brings us to interesting times and promises to revolutionize our society from business to government, from healthcare to academia. As we walk through this digitized age of exploded data, there is an increasing demand to develop unified toolkits for data processing and analysis. In this course our main goal is to rigorously study the mathematical foundation of big data processing, develop algorithms and learn how to analyze them. Specific Topics to be covered include: 1) Clustering 2) Estimating Statistical Properties of Data 3) Near Neighbor Search 4) Algorithms over Massive Graphs and Social Networks 5) Learning Algorithms 6) Randomized Algorithms. This course counts as a CS Elective toward the CS major (BS or BA). Undergraduate Prerequisites: COMPSCI 240 and COMPSCI 311. 3 credits.

COMPSCI 529 Software Engineering Project Management

INSTRUCTOR(S): Gordon Anderson, Neena Thota

3 Credits

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 COMPSCI 320. As project managers, the students in COMPSCI 529 will be responsible for: supervising and managing the work of teams of COMPSCI 320 students; interfacing with the other COMPSCI 529 students managing other teams in the course; interfacing with the course instructor, course TA, and course customer. COMPSCI 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, COMPSCI 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. COMPSCI 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 COMPSCI 320. Additional meetings with team members and other students in COMPSCI 529 are also expected to be arranged by mutual agreement. An additional one hour weekly meeting of all of the students in COMPSCI 529 is required. Enrollment in this course is only by permission of the instructor, and is restricted to students who have previously taken COMPSCI 320, and received a grade of A or A-. 3 credits.

COMPSCI 535 Computer Architecture

INSTRUCTOR(S): Charles Weems

3 Credits

The structure of digital computers is studied at several levels, from the basic logic level, to the component level, to the system level. Topics include: the design of basic components such as arithmetic units and registers from logic gates; the organization of basic subsystems such as the memory and I/O subsystems; the interplay between hardware and software in a computer system; the von Neumann architecture and its performance enhancements such as cache memory, instruction and data pipelines, coprocessors, and parallelism. Weekly assignments, semester project, 2 hours exams, final. Undergraduate Prerequisites: COMPSCI 335. 3 credits.

COMPSCI 589 Machine Learning

INSTRUCTOR(S): David Jensen

3 Credits

This course will introduce core machine learning models and algorithms for classification, regression, clustering, and dimensionality reduction. On the theory side, the course will focus on understanding models and the relationships between them. On the applied side, the course will focus on effectively using machine learning methods to solve real-world problems with an emphasis on model selection, regularization, design of experiments, and presentation and interpretation of results. The course will also explore the use of machine learning methods across different computing contexts. Students will complete programming assignments and exams. Python is the required programming language for the course. Undergraduate Prerequisites: COMPSCI 383 and MATH 235. 3 credits.

COMPSCI 590B Detecting Interference in Networks

INSTRUCTOR(S): Phillipa Gill

3 Credits

This course will cover topics related to the broad issue of detecting and measuring network interference. This will include topics such as traffic differentiation, network neutrality, surveillance, and blocking/censorship of content. The course will focus on network measurement tools and techniques in the context of detecting and observing manipulations and interference with network traffic. When relevant, historical and ethical/legal context will be discussed in relation to these topics. This course counts as a CS Elective toward the CS major (BS/BA) as well as an Any 2 Menu for BS subplans: SECURPRV, NETWORK, SOFTSYS. Undergraduate Prerequisite: COMPSCI 453. 3 credits.

COMPSCI 590C Human Computer Interaction

INSTRUCTOR(S): Eva Hudlicka

3 Credits

This course will provide an in-depth introduction to Human Computer Interaction (HCI). The topics will include: HCI history; discussion of human capabilities and limitations (perceptual, cognitive, physical), human error, and human emotions, and their relevance for HCI; generic principles of design and the principles guiding user interface and interaction design; design of WIMP (windows, icons, menus, pointing) and direct-manipulation user interfaces; virtual and augmented reality and novel modes of interaction; approaches to prototyping (storyboarding, paper prototyping, and low- and high-fidelity user interface prototyping); cognitive modeling; usability evaluation; affective HCI and current trends in HCI; as well as ethical considerations. The course will include several brief projects reinforcing selected topics (UI design, cognitive modeling, usability evaluation) and a semester-long major project that will involve the design and development of a mobile device app. This course counts as a CS Elective toward the CS major (BA/BS). Undergraduate prerequisites: COMPSCI 187 (or E&C-ENG 242) and COMPSCI 220 (or COMPSCI 230). 3 credits.

COMPSCI 590F Digital Forensics

INSTRUCTOR(S): Marc Liberatore

3 Credits

This course offers a broad introduction to the forensic investigation of digital devices. We cover the preservation, recovery, harvesting, and courtroom presentation of information from file systems, operating systems, networks, database systems applications, media files, and embedded systems. The primary goal of the class is to understand why and from where information is recoverable in these systems. We also cover relevant issues from criminology, law, and the study of privacy. Students who have completed COMPSCI 365 are not eligible for this course. Graduate students will be expected to read selected current technical and law articles and to implement and analyze state-of-the-art systems. 3 credits.

COMPSCI 590IV Intelligent Visual Computing

INSTRUCTOR(S): Evangelos Kalogerakis

3 Credits

Intelligent visual computing is an emerging new field that seeks to combine modern trends in machine learning, computer graphics, computer vision to intelligently process, analyze and synthesize 2D/3D visual data. The course will start by covering 2D image and 3D shape representations, classification and regression techniques, and the fundamentals of deep learning. The course will then provide an in-depth background on analysis and synthesis of images and shapes with deep learning, in particular convolutional neural networks, recurrent neural networks, memory networks, auto-encoders, adversarial networks, reinforcement learning methods, and probabilistic graphical models. Students will complete 5 programming assignments in Matlab/Octave and work on a course project related to visual computing with machine learning. This course counts as a CS Elective toward the CS major (BA/BS). Undergraduate Prerequisites: COMPSCI 311, COMPSCI 383, COMPSCI 373 (or COMPSCI 473) 3 credits.

COMPSCI 590M Introduction to Simulation

INSTRUCTOR(S): Peter Haas

3 Credits

How can we use computers to design systems and, more generally, make decisions, in the face of complexity and uncertainty? Simulation techniques apply the power of the computer to study complex stochastic systems when analytical or numerical techniques do not suffice. It is the most frequently used methodology for the design and evaluation of computer, telecommunication, manufacturing, healthcare, financial, and transportation systems, to name just a few application areas. Simulation is an interdisciplinary subject, incorporating ideas and techniques from computer science, probability, statistics, optimization, and number theory. Simulation models, which embody deep domain expertise, can effectively complement machine-learning approaches. This course will provide the student with a hands-on introduction into this fascinating and useful subject. Undergraduate Prerequisite: COMPSCI 187 and STAT 515. This course counts as a CS Elective toward the CS major (BA/BS). 3 credits.

COMPSCI 590U Mobile and Ubiquitous Computing

INSTRUCTOR(S): Tauhidur Rahman

3 Credits

This course will introduce students to the field of Ubiquitous Computing – an emerging CS research area that draws from Machine Learning, Signal Processing, Sensor Systems, Hardware Prototyping, Mobile Computing, Embedded Systems, and various application areas including Human Computer Interaction, Sustainability, Medicine, as well as from Psychology, Economics and Sociology. We will discuss various Ubicomp solutions to real-world problems, advanced prototyping techniques, data collection approaches, signal representation, modeling, and evaluation. This course counts as a CS Elective toward the CS major (BA/BS). 3 credits.

COMPSCI 590V Data Visualization and Exploration

INSTRUCTOR(S): John Fallon

3 Credits

In this course, students will learn the fundamental algorithmic and design principles of visualizing and exploring complex data. The course will cover multiple aspects of data presentation including human perception and design theory; algorithms for exploring patterns in data such as topic modeling, clustering, and dimensionality reduction. A wide range of statistical graphics and information visualization techniques will be covered. We will explore numerical data, relational data, temporal data, spatial data, graphs and text. Hands-on projects will be based on Python or JavaScript with D3. This course counts as a CS Elective toward the CS major (BA/BS). Undergraduate Prerequisite: COMPSCI 220 or 230. No prior knowledge of data visualization or exploration is assumed. This course counts as a CS Elective toward the CS major (BA/BS). 3 credits.

COMPSCI 603 Robotics

INSTRUCTOR(S): Roderic Grupen

3 Credits

An advanced course in robotics that covers mechanisms (kinematics and dynamics), actuators, sensors, feedback control, and signal processing. The target is to provide a general understanding of sensorimotor systems that can be related to machine learning and other disciplines. Relationships to biological systems will be highlighted. Programming exercises will accumulate code for a simulated mobile manipulator and students will pit their robots against those of their classmates. 3 credits.

COMPSCI 611 Advanced Algorithms

INSTRUCTOR(S): Ramesh Sitaraman

3 Credits

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 COMPSCI 311. 3 credits.

COMPSCI 621 Advanced Software Engineering: Analysis and Evaluation

INSTRUCTOR(S): Yuriy Brun

3 Credits

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: COMPSCI 320, Introduction to Software Engineering (or equivalent course). 3 credits.

COMPSCI 630 Systems

INSTRUCTOR(S): Emery Berger

3 Credits

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.

COMPSCI 645 Database Design and Implementation

INSTRUCTOR(S): Alexandra Meliou, Yanlei Diao

3 Credits

This course covers the design and implementation of traditional relational database systems as well as advanced data management systems. The course will treat fundamental principles of databases such as the relational model, conceptual design, and schema refinement. We will also cover core database implementation issues including storage and indexing, query processing and optimization, and transaction management. Additionally, we will address challenges in modern networked information systems, including data mining, provenance, data stream management, and probabilistic databases. 3 credits.

COMPSCI 650 Applied Information Theory

INSTRUCTOR(S): Arya Mazumdar

3 Credits

This course will introduce the basic concepts of Information Theory: entropy, relative entropy, mutual information, channel capacity, and rate distortion (data compression). Applications of these concepts will be emphasized. The notions of sparse-graph codes, message passing and belief propagation will also be introduced and studied in detail. Applications in inference algorithms and machine learning will be highlighted; in particular, topics of neural networks, statistical estimation, community detection and clustering will be covered. 3 credits.

COMPSCI 660 Advanced Information Assurance

INSTRUCTOR(S): Amir Houmansadr

3 Credits

This course provides an in-depth examination of the fundamental principles of information assurance. While the companion course for undergraduates is focused on practical issues, the syllabus of this course is influenced strictly by the latest research. We will cover a range of topics, including authentication, integrity, confidentiality of distributed systems, network security, malware, privacy, intrusion detection, intellectual property protection, and more. Prerequisites: COMPSCI 460 or 466, or equivalent. 3 credits.

COMPSCI 677 Distributed and Operating Systems

INSTRUCTOR(S): Prashant Shenoy

3 Credits

This course provides an in-depth examination of the principles of distributed systems in general, and distributed operating systems in particular. Covered topics include processes and threads, concurrent programming, distributed interprocess communication, distributed process scheduling, virtualization, distributed file systems, security in distributed systems, distributed middleware and applications such as the web and peer-to-peer systems. Some coverage of operating system principles for multiprocessors will also be included. A brief overview of advanced topics such as multimedia operating systems and mobile computing will be provided, time permitting. Prerequisites: Students should be able to easily program in a high-level language such as C, have had a course on data structures, be familiar with elements of computer architecture and have had previous exposure to the operating system concepts of processes, virtual memory, and scheduling. A previous course on uniprocessor operating systems (e.g., COMPSCI 377) will be helpful but not required. Lect 2 is on-line. 3 credits.

COMPSCI 682 Neural Networks: A Modern Introduction

INSTRUCTOR(S): Erik Learned-Miller

3 Credits

This course will focus on modern, practical methods for deep learning. The course will begin with a description of simple classifiers such as perceptrons and logistic regression classifiers, and move on to standard neural networks, convolutional neural networks, and some elements of recurrent neural networks, such as long short-term memory networks (LSTMs). The emphasis will be on understanding the basics and on practical application more than on theory. Most applications will be in computer vision, but we will make an effort to cover some natural language processing (NLP) applications as well, contingent upon TA support. The current plan is to use Python and associated packages such as Numpy and TensorFlow. Prerequisites include Linear Algebra, Probability and Statistics, and Multivariate Calculus. All assignments will be in the Python programming language. 3 credits.

COMPSCI 683 Artificial Intelligence

INSTRUCTOR(S): Shlomo Zilberstein

3 Credits

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.

COMPSCI 688 Probabilistic Graphical Models

INSTRUCTOR(S): Benjamin Marlin

3 Credits

Probabilistic graphical models are an intuitive visual language for describing the structure of joint probability distributions using graphs. They enable the compact representation and manipulation of exponentially large probability distributions, which allows them to efficiently manage the uncertainty and partial observability that commonly occur in real-world problems. As a result, graphical models have become invaluable tools in a wide range of areas from computer vision and sensor networks to natural language processing and computational biology. The aim of this course is to develop the knowledge and skills necessary to effectively design, implement and apply these models to solve real problems. The course will cover (a) Bayesian and Markov networks and their dynamic and relational extensions; (b) exact and approximate inference methods; (c) estimation of both the parameters and structure of graphical models. Although the course is listed as a seminar, it will be taught as a regular lecture course with programming assignments and exams. Students entering the class should have good programming skills and knowledge of algorithms. Undergraduate-level knowledge of probability and statistics is recommended. 3 credits.

COMPSCI 690B Detecting Interference in Networks

INSTRUCTOR(S): Phillipa Gill

3 Credits

This course will cover topics related to the broad issue of detecting and measuring network interference. This will include topics such as traffic differentiation, network neutrality, surveillance, and blocking/censorship of content. The course will focus on network measurement tools and techniques in the context of detecting and observing manipulations and interference with network traffic. When relevant, historical and ethical/legal context will be discussed in relation to these topics. 3 credits.

COMPSCI 690IV Intelligent Visual Computing

INSTRUCTOR(S): Evangelos Kalogerakis

3 Credits

Intelligent visual computing is an emerging new field that seeks to combine modern trends in machine learning, computer graphics, computer vision to intelligently process, analyze and synthesize 2D/3D visual data. The course will start by covering 2D image and 3D shape representations, classification and regression techniques, and the fundamentals of deep learning. The course will then provide an in-depth background on analysis and synthesis of images and shapes with deep learning, in particular convolutional neural networks, recurrent neural networks, memory networks, auto-encoders, adversarial networks, reinforcement learning methods, and probabilistic graphical models. Students will complete 5 programming assignments in Matlab/Octave and work on a course project related to visual computing with machine learning. 3 credits.

COMPSCI 690N Advanced Natural Language Processing

INSTRUCTOR(S): Brendan O'Connor

3 Credits

This course covers a broad range of advanced level topics in natural language processing. It is intended for graduate students in computer science who have familiarity with machine learning fundamentals. It may also be appropriate for computationally sophisticated students in linguistics and related areas. Topics include probabilistic models of language, computationally tractable linguistic representations for syntax and semantics, and selected topics in discourse and text mining. After completing the course, students should be able to read and evaluate current NLP research papers. Coursework includes homework assignments and a final project. 3 credits.

COMPSCI 690P Secure Distributed Systems

INSTRUCTOR(S): Brian Levine

3 Credits

This is a class devoted to the study of securing distributed systems, with blockchain-based cryptocurrencies serving as our real platform of interest. We'll start with the fundamentals of Lamport's, Fischer's, and Douceur's results that fence-in all consensus system, and discuss Byzantine fault tolerance. We'll also look at the efficiency of the network architectures for peer-to-peer/distributed system communication and attacks on their security, such as denial of service attacks. And we'll review relevant applied cryptography such as elliptical curves. We'll discuss in detail the mechanisms of Bitcoin and Ethereum and we'll program distributed applications for Ethereum. Other topics include economics and finance. Assignments will include programming projects and reading research papers. The grade is also based on exams and participation in discussion. The course is based on a "flipped classroom". 3 credits.

COMPSCI 692N Seminar - Novel Computational Hardware and Machine Learning

INSTRUCTOR(S): Edward Rietman

3 Credits

The seminar will consist of readings and discussions on novel computational systems and machine learning. Will include oscillatory computing, DNA computing, quantum computing, molecular computing, non-Turing architecture, among others. We will also look at novel machine learning algorithms. 3 credits.

COMPSCI 692P Seminar-Programming Languages and Systems at Massachusetts

INSTRUCTOR(S): Emery Berger, Yuriy Brun, Arjun Guha

1 -3 Credits

This seminar covers research spanning programming languages, software engineering, security and systems. 1-3 credits.

COMPSCI 701 Advanced Topics in Computer Science

INSTRUCTOR(S):

6 Credits

This is a 6 credit reading course corresponding to the master's project. The official instructor is the GPD although the student does the work with and is evaluated by the readers of his or her master's project. 6 credits.

COMPSCI 711 Parallel Algorithms and Architectures

INSTRUCTOR(S): Andrew McGregor

3 Credits

An introduction to some more advanced algorithmic topics with a focus on data stream algorithms, communication complexity, and linear sketching for distributed, parallel, and streaming computation. Topics will include sketches for processing massive graphs; problems in large-scale numerical linear algebra; hashing and other basic randomized techniques; core sets and other geometric techniques; and multiparty communication. Time permitting we will also cover other basic techniques from the field of sub-linear algorithms. Prerequisite: COMPSCI 611 with a 'B' or better. It is recommended that students have an 'A' in COMPSCI 611 in order to attempt COMPSCI 711. Students with COMPSCI 590D with an 'A' may also be considered with instructor permission. 3 credits.

COMPSCI 891M Seminar - Theory of Computation

INSTRUCTOR(S): Ramesh Sitaraman

1 Credits

The theory seminar is a weekly meeting in which topics of interest in the theory of computation - broadly construed - are presented. This is sometimes new research by visitors or local people. It is sometimes work in progress, and it is sometimes recent material of others that some of us present in order to learn and share. This is a one-credit seminar which may be taken repeatedly for credit up to six times. 1 credit.

COMPSCI H250 Honors Colloquium for Introduction to Computation

INSTRUCTOR(S): David Barrington

1 Credits

We will have weekly readings from Godel, Esher, Bach: An Eternal Golden Braid by Douglas Hofstadter. This book contains mathematical problems related to the main course material, and presents some of the same topics as well as others. Students will report on their reading in the seminar, and we will discuss connections between the book and the CS 250 material. Each student will make an oral presentation on a topic of their choice at the end of the term. 1 credit.

COMPSCI H383 Honors Colloquium for Artificial Intelligence

INSTRUCTOR(S): Philip Thomas

1 Credits

In the honors section, students will conduct a more in-depth study of reinforcement learning - an increasingly important sub-field of machine learning. Specifically, students will read the book "Reinforcement Learning: An Introduction" by Sutton & Barto and have weekly discussions about the readings. They will also implement some of the methods described in the readings, including Sarsa (λ) and $q(\lambda)$. 1 credit.

COMPSCI H403 Honors Colloquium for Introduction to Robotics: Perception, Mechanics, Dynamics and Control

INSTRUCTOR(S): Joydeep Biswas

1 Credits

The honors section will cover a few selected robotics algorithms, and will include a project to implement. 1 credit.

INFO 203 A Networked World

INSTRUCTOR(S): David Wemhoener

3 Credits

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 COMPSCI 453. 3 credits.

INFO 397F Special Topics - Introduction to Data Science

INSTRUCTOR(S): Gordon Anderson

3 Credits

The terms "data science" and "big data" appear in the news media and in everyday conversations. Moreover, we are told that we live in the "age of information", where almost every business venture and scientific research initiative collect a massive amount of data which may contain valuable information. This course is an introduction to the concepts and skills involved with the collection, management, analysis, and presentation of large data sets and the data products that result from the work of data scientists. Privacy and ethical issues are discussed. Students will work with data from the financial, epidemiological, educational, and other domains. The course provides many case studies and examples of real-world data that students work with using the R programming language as well as the structured query language (SQL). This course consists of two meetings per week. Each meeting includes a lecture, where conceptual material will be presented, followed by lab time where students receive instruction on the use of software tools and apply the concepts by working on data sets. Readings will be assigned as preparation for each class meeting. Several projects will be assigned during the course. The projects provide students with an opportunity to explore the topics in more depth in a specialized domain. Two midterm exams and one final exam will be given. Grades are determined by a combination of class participation including the in-class lab activities, projects, and exam scores. Software: The R software for statistical analysis (www.r-project.org). This course does not satisfy requirements for the CS major. Prerequisites: COMPSCI 121 and PSYCH 240 (or OIM 240, or STAT 240, or STAT 515, or RES ECON 212, or SOCIOL 212) both with a C or better. 3 credits.

INFO 397G Special Topics - Creative Game Design and Development

INSTRUCTOR(S): Joshua Newman

3 Credits

In this class, we will explore, through a series of projects, the fundamental questions of game design. What are the common features of hopscotch, Skyrim, boxing, Farmville, poker, and Tic-Tac-Toe? How do you create an engrossing, challenging, vivid, or surprising environment of play? How do you determine the value of skill, chance, cooperation, and competition in game play? What effect does the social, sexual, gender, political, and economic environment of the game's creation have on the play of the game? This course will introduce students to theoretical structures and demonstrate their implementation through the development of several small physical and digital games, ending with a group digital game project. Students will be evaluated based on class participation, process papers, and the creation of their own games. Not for CS Major/Minor Requirements. 3 credits.

INFOSEC 690F Fraud Detection

INSTRUCTOR(S): Marc Liberatore

3 Credits

This course provides an introduction to the principles and practice of fraud detection across a variety of problem domains such as money laundering, credit card fraud, telecommunications fraud, and computer and network intrusion. The key topics of this course include defining fraud in various domains; the interactions between fraud prevention and fraud detection; data collection and management; statistical tests and statistical power; methods for statistical fraud detection, including numerical validation, outlier detection, supervised and unsupervised classification methods, and application of Benford's Law. The course includes homework assignments and exams. The assignments will include practical exercises involving fraud detection on nontrivial datasets using software such as Excel, R, and Python. 3 credits.