Class Schedule - Fall 2019

Computer Science

CS 598  Special Topics  credit: 2 TO 4 hours.
Subject offerings of new and developing areas of knowledge in computer science intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

<table>
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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tr>
<td>69375</td>
<td>Online</td>
<td>AO2</td>
<td>ARRANGED -</td>
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Credit Hours: 4 hours
Foundations of Data Curation
Restricted to Graduate - Urbana-Champaign.
Restricted to MCS:Computer Sci Online - UIUC or NDEG:Computer Science Onl-UIUC.
This course is for students that are in the Computer Science MCS-DS Program. NON-DEGREE SEEKING STUDENTS MAY ENROLL ON A SPACE-AVAILABLE BASIS WITH THE CONSENT OF THE DEPARTMENT. TO REQUEST ENROLLMENT, PLEASE COMPLETE THE "NON-DEGREE ENROLLMENT REQUEST FORM" HERE: https://illinois.edu/fb/sec/9478165 Additional Coursera ID verification and ProctorU fees may apply. To register for this course you must use the Computer Science CRN 69375 / CS 598 AO2

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<th>CRN</th>
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<th>Time</th>
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<td>64616</td>
<td>Lecture-Discussion</td>
<td>APK</td>
<td>02:00 PM - 03:15 PM</td>
<td>WF</td>
<td>1109 - Siebel Center for Comp Sci</td>
<td>Kloeckner, A</td>
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</table>

Credit Hours: 4 hours
Languages and Abstractions for High-Performance Scientific Computing This practically-oriented class considers programming language tooling for the construction of high-performance numerically-based software targeting distributed-memory GPU and wide-vector multi-core machines. Topics covered include: Machine Abstractions and Hardware Realities, Kernels and the Anatomy of High-Performance Code, Measuring and Understanding Performance (Types of measurements, performance counters and derived quantities, instrumentation and measurement error), Construction and Design of Domain-Specific Languages (array and scalar languages, parallel primitives, intermediate representations, metaprogramming), Translation and Compilation Techniques (symbolic manipulation, interfacing with computer algebra, kernel fusion, polyhedral representation and transformation), Code Generation and Just-in-Time Compilation, Performance Modeling and Tuning. Prerequisites: Knowledge of C and Python, interest in numerical applications, prior exposure to GPU programming and elementary compiler concepts.

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Credit Hours: 4 hours
Adversarial Machine Learning
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Machine learning has seen a remarkable rate of adoption in recent years across a broad spectrum of industries and applications. Many applications of machine learning techniques are adversarial in nature, insofar as the goal is to understand adversarial strategies and therefore detect or defend against attacks. Forensic analysis of malware, which incorporates clustering, anomaly detection, and even vision systems in autonomous vehicles, are all potentially subject to attack. In response to these concerns, there is an emerging literature on adversarial machine learning, which spans both the analysis of vulnerabilities in machine learning algorithms and algorithmic techniques which yield more robust learning. In this class, we will survey an array of these issues and techniques from both the cybersecurity and machine learning research areas. In particular, we consider the problems of adversarial evasion, where the attacker changes behavior to escape being detected, and poisoning, where training data itself is corrupted. We discuss both the evasion and poisoning attacks and the associated defensive techniques in deep neural networks and other machine learning models. We also consider techniques and applications of generative adversarial networks (GANs). Prerequisites:
This course is restricted to students with machine learning and deep learning background. The students should be comfortable implementing and training standard deep neural networks in standard frameworks like pytorch or tensorflow.

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Credit Hours: 4 hours  
Deep Learning  
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Restricted to Computer Science or Bioinformatics major(s).

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Credit Hours: 4 hours  
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Restricted to Computer Science or Bioinformatics major(s).

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Credit Hours: 4 hours  
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Credit Hours: 4 hours  
Software Testing for All  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Topic: Software Testing for All  
Description: If you develop or study any kind of software, you should consider taking a course on software testing for fun and profit. Testing is by far the most widely used method for improving software quality in practice. The importance of testing is growing as software controls increasingly many domains, e.g., self-driving cars, cryptocurrency, medical devices, or Internet of Things, to name just a few. This course aims to help students improve their testing skills, be it for practice or research. The course will be seminar style, including projects tailored for each student.

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Data Mining Capstone  
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Restricted to Computer Science or Bioinformatics major(s).  
Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.

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Credit Hours: 4 hours  
Advanced Bayesian Modeling  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Additional Coursera ID verification and ProctorU fees may apply. This is a pilot course and no additional seats will be released.

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</table>

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).

This course focuses on modern machine learning techniques in computational biology, including probabilistic modeling, feature selection, graphical models, approximate inference and learning, Monte Carlo methods and neural networks. Students will learn the development of the theoretical concepts for these methods and the applications of these methods to a variety of problems in computational biology. This course is appropriate for graduate students in computer science, bioengineering, mathematics and statistics. Familiarity with basic statistics, probability and algorithms is expected.

Credit Hours: 4 hours
Energy-Efficient Comp Architec
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).

Topic: Energy-Efficient Computer Architecture
This course will discuss recent issues and research trends in designing computer architectures for energy efficiency. The course will start with an analysis of process variation and wear-out, which constrains and affects energy efficiency. We will examine models and techniques for variation tolerance at different levels. They include body biasing, processors with timing speculation, and variation-aware application scheduling. We will then focus on low-voltage computer architecture, which is our best hope for energy efficiency. We will examine how to reduce voltage guard-bands and manage voltage droops. Higher-level techniques include pipeline design for low voltage, efficient eDRAM refresh, extensive power gating, and effective on-chip controllers. Next, we will consider 3D architectures and how they can improve energy efficiency. Finally, we will focus on extreme-scale computer architectures, which are designed from the ground up for energy efficiency. They will bring together all of the concepts discussed in the course into a single platform. Pre-requisite courses: Required: CS433 or equivalent; Recommended: CS533 or equivalent

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
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With the emergence and proliferation of social media such as Twitter, Instagram, and Reddit, we are facing a sea change--with a magnitude much like the Web revolution two decades ago--in not only how people express themselves and communicate, but also how we can listen to the world. With their ubiquitous popularity, while social networks have connected people, these social media spread their voices, and thus thoughts and information propagate in a speed and scale unseen before--allowing for our listening to the world with algorithms, at not only a large scale, but also a high precision. This course will study advanced social analytic techniques for discovering and profiling the online social universe.

TOPIC: With the emergence and proliferation of social media such as Twitter, Instagram, and Reddit, we are facing a sea change--with a magnitude much like the Web revolution two decades ago--in not only how people express themselves and communicate, but also how we can listen to the world. With their ubiquitous popularity, while social networks have connected people, these social media spread their voices, and thus thoughts and information propagate in a speed and scale unseen before--allowing for our listening to the world with algorithms, at not only a large scale, but also a high precision. This course will study advanced social analytic techniques for discovering and profiling the online social universe.

Credit Hours: 4 hours
Social Spaces on the Internet
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Topic: Social Spaces on the Internet Social Spaces on the Internet. The Internet is home to a panoply of varieties of human interaction. Social media, interactive games, telepresence, online environments, and simple text e-mails now mediate our normal experiences of education, medicine, politics, business, sociality, collective action, and more. Unbeknownst to many users, these systems incorporate algorithmic interventions that alter prior expectations. As the Internet has become an infrastructure for social life and society itself, our ability to measure and represent that society is transforming. This class explores the presentation of self, the presentation of collectives, the presentation of news, and social dynamics in these online spaces — and how algorithmic intervention shapes them from the perspective of social signalling theory. Topics covered include: resumes of the 22nd century, why people share “fake” news, the mitigation of trolling, ethics, and bias in social media systems. Upon completion of this course, students will have an up-to-date understanding of the design of social media interfaces with incentive structures from social signaling theory.

Credit Hours: 4 hours
Advanced Multimedia Systems
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Advanced Multimedia Systems Topic: Advanced Multimedia Systems. Multimedia data and underlying systems and networks that service multimedia (multi-modal sensory) data are becoming ubiquitous. In the "Advanced Multimedia Systems" class we will explore major advances that are made in multimedia data, systems and networks to enable next generation multimedia applications such as Skype, YouTube, Flickr and others. We will take the end-to-end approach and explore an integrated view of multimedia systems ranging from 2D and 3D video and audio, advanced compression techniques H.264, MPEG4 and MPEG-7, new multimedia transport protocols and Quality of Service, Content Distribution and Peer-to-Peer networks, multi-modal synchronization, machine learning and deep learning techniques for multi-modal data, services such as Voice-over-IP, Video Conferencing, Video-on-Demand, and subjective and objective Quality of Experiene evaluation methods for next generation multimedia applications.

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Credit Hours: 4 hours  
Mach Lrng for Signal Processng  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Topic: Machine Learning for Signal Processing. Prerequisite: Linear algebra, Probability theory. Today we see an increasing need for machines that can understand complex real-world signals, such as speech, images, movies, music, biological and mechanical readings, etc. In this course we will cover the fundamentals of machine learning and signal processing as they pertain to this goal, as well as exciting recent developments. We will learn how to decompose, analyze, classify, detect and consolidate signals, and examine various commonplace operations such as finding faces from camera feeds, organizing personal music collections, designing speech dialog systems and understanding movie content. The course will consist of lectures and student projects and presentations. Students are expected to have a working knowledge of linear algebra, probability theory, and programming skills to carry an implementation of a final project (preferably in MATLAB, but all languages are welcome).

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<th>70683</th>
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Credit Hours: 4 hours  
Practical Statistical Learning  
Restricted to Graduate - Urbana-Champaign.  
Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.

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Credit Hours: 4 hours  
HCI for ML  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Explores the use of data-driven methods to support creative design processes by examining recent work in human computer-interaction, product design, cognitive science, machine learning, graphics, vision, and natural language processing. Students will read and discuss recent papers from these fields, and work in teams on a multi-week project to build data-driven tools to solve real-world design problems. Practical data mining and machine learning knowledge is emphasized: crowdsourcing and web scraping, model and feature selection, parameter tuning. The course has no formal prerequisites, but students should be algorithmically and programmatically mature.

<table>
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<th>70200</th>
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</table>

Credit Hours: 4 hours  
Algorithmic Game Theory  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Description: Algorithmic game theory has become more relevant than ever before with the advent of online markets, ad auctions, social networks, and recommendation systems, where rational agents interact to achieve selfish goals. The last two decades have witnessed the development of a rich theory in this area and deep mathematical connections have been established. The first half of the course will provide a broad introduction to games and market models, solution concepts, equilibrium computation & complexity, price of anarchy, auctions, and others. The second half will address a selection of advanced topics and research projects.

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<th>Lecture-Discussion</th>
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Credit Hours: 4 hours  
Restricted to Graduate - Urbana-Champaign.  
Restricted to Computer Science or Bioinformatics major(s).  
Topic: Randomized Algorithms. The last two decades have witnessed a tremendous growth in the area of randomized algorithms. During this period, randomized algorithms went from being a tool in computational number theory to finding widespread application in many types of algorithms. Two benefits of randomization have spearheaded this growth: simplicity and speed. This course presents the basic concepts in the design and analysis of randomized algorithms at a level accessible to advanced undergraduates and to graduate students. The aim is to touch upon various branches of the study of randomized algorithms. In the end of this
course, one should be able to design and/or analyze a randomized algorithm for your favorite problem. For topics covered, see class notes from previous semester: http://valis.cs.uiuc.edu/~sariel/teach/notes/rand_alg/notes.pdf

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<th>Course Code</th>
<th>Lectures/Discussion</th>
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Credit Hours: 4 hours
Approx & Probabilistic Comp
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Course Name: Approximate and Probabilistic Computing Across the Stack Course Abstract: The current drive for energy-efficiency has made approximation a key concept in designing and implementing software in various areas, such as data analytics, mobile computing, multimedia processing, and engineering simulations. This course will focus on foundations and system-level techniques for representing uncertainty in program's data and reasoning about profitable tradeoffs between accuracy, reliability, and energy consumption. In addition to selected algorithmic-level approximations, we will study (i) programming languages that natively operate on probabilistic and/or uncertain data, (ii) compilers that automatically approximate programs while verifying or testing the accuracy of optimized programs, and (iii) hardware devices that expose approximate components. The course will include lectures, reading research papers, in-class discussions, and a final research project.

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<td>09:30 AM - 10:45 AM</td>
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Credit Hours: 4 hours
Advance Bioinformatics
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
This course introduces a selection of topics in bioinformatics (mostly genomics) with a focus on probabilistic methods and statistical analysis, as well as basic principles of data science and computational sciences. Who this is for: The course will help graduate students aspiring to become bioinformatics researchers as well as students who are interested in data sciences in general and are looking for interesting applications. The course is less ideal for students interested in a casual exposure to the buzz surrounding bioinformatics. A research project (conceptualization and implementation) is a major component of the course grade, making the course unsuitable for students with little or no programming experience. Syllabus will tentatively include: Basic Molecular Biology, Probability/Statistics (probabilistic modeling, hypothesis testing, sampling), Introduction to Selected Bioinformatics topics (such as sequence alignment, enhancer prediction, epigenomics, modeling of gene expression, modeling of population evolution), and research paper reading on the selected topics.

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Credit Hours: 4 hours
Geometric Approx Algorithms
Restricted to Graduate - Urbana-Champaign.
Not intended for Computer Science or Bioinformatics major(s).
Topic: Geometric Approximation Algorithms We study approximation algorithms in computational geometry -- how to solve problems involving geometric data faster when we do not need exact answers, with provable guarantees on the quality of the solutions. We will examine a variety of problems, about approximating the shape of point clouds (e.g., convex hull, diameter, width, and minimum enclosing ball), proximity (e.g., nearest neighbors, spanners, and minimum spanning trees), range counting, clustering (e.g., k-center), shortest paths in geometric graphs, and geometric versions of NP-hard optimization problems (e.g., set cover, independent set, and traveling salesman). A variety of techniques will be encountered (grids, quadtrees, coresets or sketching, random sampling, separators, linear programming relaxation, dimensionality reduction, etc.). Prerequisite: CS 374 or equivalent.