## 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.

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<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>63912</td>
<td>Lecture-Discussion</td>
<td>AGP</td>
<td>09:30 AM - 10:45 AM</td>
<td>MW</td>
<td>1103 - Siebel Center for Comp Sci</td>
<td>Parameswaran, A</td>
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Credit Hours: 4 hours  
Human-in-the-loop Data Mgmt  
Restricted to Graduate - Urbana-Champaign.  
The course explores two complementary roles for humans as applied to interactive data analytics: one, where humans are the analysts performing or supervising the analysis; here, the emphasis is on building usable tools for these analysts, and second, where humans are the crowdsourced workers assisting with the computation and analysis; here, the emphasis is on having humans process as little data as possible while gaining maximum benefit. Students will read a number of papers – both important landmark papers as well as cutting-edge papers, act as a discussant for a paper at least once, and complete a semester-long implementation project. Familiarity with basic databases, machine learning, and algorithms expected.

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<td>62086</td>
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Credit Hours: 4 hours  
Cyber-Physical-Human Systems  
Restricted to Graduate - Urbana-Champaign.  
This course is oriented to engineering and computer science students who would like their research on interactive systems and technologies to be informed by relevant research in the social, behavioral and cognitive sciences, and to students in these sciences who would like their research to be relevant to technology or engineering design. The format will combine group projects and seminar discussions based on readings to be provided from the "Oxford Handbook of Cognitive Engineering" (J.D. Lee & A. Kirlik, 2013, NY: OUP), whose table of contents (list of topics to be covered) can be found on OUP and related websites. Open to graduate students and to senior undergraduates by permission of instructor.

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<td>69375</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-UlUC.  
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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Credit Hours: 4 hours  
Fast Algorithms & Intrgl Equat  
Restricted to Graduate - Urbana-Champaign.  
Fast Algorithms & Integral Equations Near-linear-complexity ("fast") numerical algorithms and related numerical methods, mainly for the numerical solution of elliptic partial differential equations, such as Laplace, Helmholtz, Stokes, Maxwell's, or elasticity.

Credit Hours: 4 hours
Secure Processor Design
Restricted to Graduate - Urbana-Champaign.
Secure Processor Design and Foundations in Applied Cryptography With the emergence of systems such as ARM Trustzone and Intel Software Guard Extensions, secure processors have become one of the next frontiers in secure systems design. Secure processors allow emerging applications (e.g., computation outsourcing) to be realized with a significantly smaller trusted computing base and/or significantly reduced performance overheads, relative to a "pure software" solution. This course will bring students to the cutting-edge in secure processor architecture by examining the interplay between hardware, software and applied cryptography in these systems. The course day-to-day will be readings and discussion of top papers in the field. Course assignments will give students hands-on experience with the Intel Software Guard Extensions (SGX) SDK, building secure applications and evaluating their security. The end of semester will culminate in an original research project.

Credit Hours: 4 hours
Advanced Bayesian Modeling
Restricted to Graduate - Urbana-Champaign. Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC. Restricted to online MCS-DS students. Additional ID Verification Coursera and ProctorU fees may apply. For more details on this course section, please see http://engineering.illinois.edu/online/courses/. Non-Degree seeking students may enroll on a space-available basis with consent. To request enrollment, please complete the "Non-Degree Enrollment Request Form" here: https://illinois.edu/lf/sec/9478165 Sections (and CRNs) for on-campus, degree-seeking students are: STAT 578 A1 (30959). Equivalency: CS 598 section DSO (CRN 69343) is equivalent to STAT 578 section DSO (CRN 48733). This is not true for all sections of CS 598 and STAT 578: it only applies to these specific sections in the fall 2017 term. Since this is not an official cross-listing, they might not automatically be recognized as equivalent for your degree audit. To determine whether extra steps need to be completed for either section to count towards your degree, contact your advisor. For up-to-date information about statistics course registration, please see our registration update pages: go.illinois.edu/StatisticsRegistration TOPIC: Advanced Bayesian Modeling Description: This class meets with CS 598 section DSO (CRN 69343). Practical methods and models for Bayesian data analysis. Topics include Bayesian fundamentals, prior selection, posterior inference tools, hierarchical models, methods of Bayesian computation, model evaluation, and ordinary and generalized regression models. Emphasis on computational implementation. Prerequisites: STAT 420 and knowledge of R.

Credit Hours: 4 hours
Adv Social&Information Network
Restricted to Graduate - Urbana-Champaign.
Topic: Advanced Social & Information Networks This is a deep dive into classic and recent, exciting results in network analysis, with particular emphasis on behavioral models. We shall discuss cascades, influence maximization, strategic behavior on networks, and mechanism design.

Credit Hours: 4 hours
Adv Social&Information Network
Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-Uluc, or NDEG:Grad Nondegree-CE-Uluc.
## Algorithms for 1D Structures

Credit Hours: 4 hours

**Algorithms for 1D Structures**

This course will be a broad introduction to algorithms for curves and graphs embedded in the plane or other surfaces. Algorithmic questions about curves have been a driving force in topology since its inception more than a century ago. Planar and near-planar graphs have long been fertile ground for algorithms research, both because they naturally model many classes of networks that arise in practice, and because they admit simpler and faster algorithms than more general graphs. There is a rich interplay between these two domains, drawing on a common pool of techniques from geometry, topology, and combinatorics.

Potential topics include topological graph theory; homotopy, homology, and other topological invariants; specialized algorithms for shortest paths, maximum flows, and minimum cuts; efficient approximation schemes for NP-hard problems; and applications in VLSI design, computer graphics, computer vision, motion planning, geographic information systems, and other areas of computing.

Specific topics will depend on the interest and expertise of the students. Students in all areas of computer science, mathematics, and related disciplines are welcome. CS 473 and/or Math 525 are recommended as prerequisites, but not required; necessary background material will be introduced as needed.

**Lecture-Discussion**

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## Social (Media + Signals)

Credit Hours: 4 hours

**Social (Media + Signals)**

As the Internet has become an infrastructure for social life and society itself, our ability to measure and represent that society is also transforming. Most signaling systems to date attempt to address the “authenticity” of messages via a proxy. In this course, via design, machine learning, and game theory, we interrogate the signals (and their proxies) used in widespread networked computation to quantify, analyze, explain, and navigate our relationships to social institutions and each other. We do this by examining existing social signaling systems (e.g., Reddit reputation, Facebook) and by creating new online social signaling 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.

**Lecture-Discussion**

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<td>Nahrstedt, K</td>
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## Advanced Multimedia Systems

Credit Hours: 4 hours

**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 have been made in multimedia data, systems and networks over the last 10 years 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, Quality of Service preservation for mobile multimedia, HDTV broadcasting systems, Content Distribution and Peer-to-Peer networks to multi-modal synchronization, storage, services such as Voice-over-IP, Video Conferencing, Video-on-Demand, and subjective and objective Quality of Experience evaluation methods for next generation multimedia applications.

**Lecture-Discussion**

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<td>Forbes, M</td>
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## Pseudorandomness

Credit Hours: 4 hours

**Pseudorandomness**

This course will explore the core aspects of pseudorandomness by constructing foundational pseudorandom objects such as expander graphs, error-correcting codes, randomness extractors and pseudorandom generators, as well as presenting key techniques such as spectral graph theory, (derandomized) concentration bounds, and the polynomial method. Prerequisites: basic familiarity with probability, linear algebra, algorithms, and computational complexity.
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Credit Hours: 4 hours
Mach Lrng for Signal Processng
Restricted to Graduate - Urbana-Champaign.
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).

Credit Hours: 4 hours
Real Time Systems
Restricted to Graduate - Urbana-Champaign.
Modern Real Time Systems The landscape of real time computing has changed greatly. IoTs, robots, self-driving cars, drones and smart cities are coming. Sensors and actuators drivers are now integrated into miniature computers, and multicore chips with GPU are already in the market. • What are the application models and platform technologies assumed by existing real time computing technologies? • What are existing technology's limitations in i) supporting the new needs and ii) exploiting capabilities of new platforms? • How do we bring an existing technology, e.g., real time computing, into a new era? In the 90's, the instructor's team brought the then older state of the art real time computing technology into the then modern era, winning IEEE's 2016 Simon Ramo Medal that awards members with exceptional achievements in system engineering and science. Let's identify the opportunities offered by the "new continent" known as modern real time computing. This class is more about how to do research than a technology deep diving.

Credit Hours: 4 hours
Advance Bioinformatics
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 unsustainable 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.

Credit Hours: 4 hours
Heterogeneous Systems
Restricted to Graduate - Urbana-Champaign.
Topic: Application-Customized Heterogeneous Systems Future design will likely focus on integrating multiple accelerators (IP components) to obtain application-customized systems. These components will likely be connected with a deep communication hierarchy spanning components on a single chip to within the cloud. Design methods that allow seamless integration of such components will be critical to sustainably achieving cost and performance goals for new applications. This course will cover the hardware and software challenges and application drivers of such heterogeneous system design. Topics will include accelerator
architectures, heterogeneous memory and communication systems, scheduling, programming (e.g., domain specific languages and frameworks), the hardware-software interface (e.g., virtual instruction sets), and requirements of several application domains (e.g., virtual reality, machine learning, robotics, big data, and human-centric computing). Students will be required to present and critique research papers and perform a substantial team project. Pre-requisites: CS 433 or equivalent or permission of the instructor.

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Credit Hours: 4 hours
Machine Learning Theory
Restricted to Graduate - Urbana-Champaign.
This course will cover both basic material and certain advanced topics in machine learning theory. The core of the course will investigate the standard statistical learning theory model, along with its usual decoupling into representation, optimization, and generalization. The course will also touch on other learning models, for instance active learning and online learning. Specific material will include neural networks, linear regression, SVMs, boosting, consistency, VC dimension, Rademacher complexity, dimensionality reduction, and k-means. Grades will be based on homework and a final project. Prerequisites: basic probability, basic linear algebra.