## Class Schedule - Fall 2020

### 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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<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 MCS:Computer Sci Online -UIUC.
- This course is only for students that are in the online Computer Science MCS/MCS-DS Program. Additional ProctorU fees may apply.

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<td>TR</td>
<td>1302 - Siebel Center for Comp Sci</td>
<td>Li, B</td>
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Credit Hours: 4 hours

- Adversarial Machine Learning
- Restricted to Graduate - Urbana-Champaign.
- Restricted to Computer Science or Bioinformatics major(s).

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<td>TR</td>
<td>1304 - Siebel Center for Comp Sci</td>
<td>Telgarsky, M</td>
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</table>

Credit Hours: 4 hours

- Deep Learning Theory
- Restricted to Graduate - Urbana-Champaign.
- Restricted to Computer Science or Bioinformatics major(s).
- This course will overview deep learning theory, with a goal of providing students everything they need to consume and produce research in the field. Topics will include (but are not limited to): approximation, generalization, and optimization properties of deep networks. The course will provide very brief background in learning theory (e.g., an overview of Rademacher complexity); students are expected to have taken probability, linear algebra, and an introductory course in machine learning. Evaluation is based both on homeworks (in the first 50-70% of lectures, presented by the instructor), and on an in-depth course presentation. For up-to-date information about CS course restrictions, please see the following link: [http://go.cs.illinois.edu/csregister](http://go.cs.illinois.edu/csregister)

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<td>67234</td>
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<td>MW</td>
<td>1131 - Siebel Center for Comp Sci</td>
<td>Solomonik, E</td>
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</table>

Credit Hours: 4 hours

- Tensor Computations
- Restricted to Graduate - Urbana-Champaign.
- Restricted to Computer Science or Bioinformatics major(s).
- The applications and numerical methods for problems involving tensors have grown widely in recent years. Tensor contractions and decompositions are prevalent in scientific computing (especially in computational chemistry and physics) as well as data mining and machine learning. This course will go into depth on core fundamentals in numerical linear algebra and numerical optimization relevant to tensors. We will introduce diagrammatic notation to study tensor networks and tensor decomposition algorithms. Further, the course will provide algebraic formulations of graph and combinatorial algorithms using sparse matrices and tensors. The use of tensors for algorithmic analysis will also be studied, including bilinear algorithms for matrix multiplication and convolution. Going beyond computational complexity, the course will analyze algorithms in terms of arithmetic intensity, parallelism, and communication
Credit Hours: 4 hours
ML for Sys, Networks & Security
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
In recent years, machine learning has significantly extended the capabilities of data-driven methods to solve new problems in System, Networking, and Security domains. Exciting progress has been made in various machine learning applications ranging from vulnerability discovery and security defense to network protocol design, software testing, and system optimization. In this class, we will examine the most creative and “crazy” ideas of applying machine learning to solve system and security problems. The focus will be on exploring new research directions and understanding the limitations and potential risks of this approach. Students will be expected to read, present, and discuss research papers, and work on an original research project. The goal of the project is to extend machine learning techniques to new problems and produce real and publishable results. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

Credit Hours: 4 hours
Info Extr and Knowledge Acq
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
This is an advanced research-centric course to introduce the most up-to-date techniques in Information Extraction and Knowledge Acquisition, which aim to create the next generation of information access in which humans can communicate with computers in any natural language beyond keyword search, and computers can discover accurate, concise, and trustable information and knowledge embedded in big data from heterogeneous sources. We will select ten trending topics such as deep neural networks for Information Extraction, never-ending knowledge acquisition, zero-shot learning for cross-domain transfer, and give a comprehensive overview for each topic. We will review where we have been (the most successful methods in literature), and where we are going (the remaining challenges, and novel methods to tackle these challenges). The target audience of this course is PhD students who do thesis research related to these topics. We also expect to invite several top researchers in this field to give guest lectures. The goal is for each student to have at least one solid paper submission ready at the end of this course. We will select classic papers about each topic and ask students to duplicate the core algorithms and even advance state-of-the-art with new ideas. We also aim to strengthen everyone’s presentation and writing skills, so we will do peer review on the presentations and paper submissions. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

Credit Hours: 4 hours
High-Speed/Programmable Networks
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Topic: Emerging Programming Paradigms. A new generation of applications is changing the nature of programming with the need for scalability, parallelism, distribution, and mobility. Moreover, web applications require context awareness; cloud computing requires balancing availability, consistency and reliability; sensor networks use broadcast messages and have limited computational resources; and cyberphysical systems must also specify real-time control. The course will cover actor languages and related programming paradigms to address these challenges.

Credit Hours: 4 hours
Algorithms for 1D Structures
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

| 65089 | Lecture-Discussion | JP | 11:00 AM - 12:15 PM | MW | 1109 - Siebel Center for Comp Sci | Peng, J |

Credit Hours: 4 hours
Machine Learning Computation Bio
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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

| 64618 | Lecture-Discussion | JT | 12:30 PM - 01:45 PM | WF | 1131 - Siebel Center for Comp Sci | Torrellas, J |

Credit Hours: 4 hours
Energy-Efficient Computer Architecture
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 For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

| 40108 | Lecture-Discussion | JTE | 12:30 PM - 01:45 PM | WF | 1131 - Siebel Center for Comp Sci | Torrellas, J |

Credit Hours: 4 hours
Energy-Efficient Computer Architecture
Restricted to Graduate - Urbana-Champaign.
Restricted to Electrical & Computer Engr 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 Restricted to ECE graduate students.

Credit Hours: 4 hours
Listening to Social Universe
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

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 Experience evaluation methods for next generation multimedia applications. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister
### Improving Your Research Skills

**Credit Hours:** 4 hours  
**Restricted to:** Graduate - Urbana-Champaign.  
Improve your research skills by staying up-to-date with research trends, estimating the value of potential research topics, giving presentations, writing papers, establishing a personalized creative process, and creating a well-structured research agenda.  
**Class Website:** [https://wiki.illinois.edu/wiki/pages/viewpage.action?spaceKey=cs598lrs&title=Home](https://wiki.illinois.edu/wiki/pages/viewpage.action?spaceKey=cs598lrs&title=Home)  

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### Methods for Building Autonomous Vehicles

**Credit Hours:** 4 hours  
**Restricted to:** Graduate - Urbana-Champaign.  
Instructor Approval Required  
Restricted to Electrical & Computer Engr major(s).  
Graduate and undergraduate student interested in taking CS 598 MAV / MAE need to attend the first class. This includes ECE students interested in the course. MAE is restricted to MENG students. For up-to-date information about CS course restrictions, please see the following link: [http://go.cs.illinois.edu/csregister](http://go.cs.illinois.edu/csregister)  

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<td>WF</td>
<td>0216 - Siebel Center for Comp Sci</td>
<td>Forsyth, D</td>
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### Stat Reinforcement Learning

**Credit Hours:** 4 hours  
**Restricted to:** Graduate - Urbana-Champaign.  
**Description:** Theory of reinforcement learning, with a focus on sample complexity analyses. The course will provide the necessary background and the mathematical tools for understanding the statistical properties of RL algorithms and the challenges. Specific topics include: (1) MDP basics, (2) finite sample analyses of batch RL (tabular and func approx), (3) state abstractions, (4) importance sampling, (5) PAC exploration (tabular and func approx), (6) Intro to POMDPs and PSRs. Prerequisites: probability and statistics, linear algebra, and basic concepts of machine learning. Some familiarity with Markov chains and numerical analysis are also recommended.  
For more info, refer to the course website for Fall 2018 (on instructor's homepage). For up-to-date information about CS course restrictions, please see the following link: [http://go.cs.illinois.edu/csregister](http://go.cs.illinois.edu/csregister)  

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<td>Jiang, N</td>
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### Machine Learning for Signal Processing

**Credit Hours:** 4 hours  
**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 Python, but all languages are welcome). For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

| Course Code | Course Title                                      | Credits | Restrictions                                                                 | 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 Python, but all languages are welcome). Restricted to ECE graduate students.
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<td>Lecture-Discussion PSE</td>
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<td>Restricted to Graduate - Urbana-Champaign. Restricted to Electrical &amp; Computer Engr major(s).</td>
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|             | Lecture-Discussion                              |         | 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 Python, but all languages are welcome). Restricted to ECE graduate students.
|             | Lecture-Discussion                              |         | 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 Python, but all languages are welcome). Restricted to ECE graduate students.
|             | Lecture-Discussion                              |         | 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 Python, but all languages are welcome). Restricted to ECE graduate students.
| 70683       | Online PSO ARRANGED                             |         | Liang, F                                                                    | Practical Statistical Learning
|             | Lecture-Discussion                              |         | Restricted to Graduate - Urbana-Champaign. Restricted to Electrical & Computer Engr major(s). |
| 70200       | Lecture-Discussion                              |         | Restricted to Graduate - Urbana-Champaign. Restricted to Electrical & Computer Engr major(s). |
|             | Lecture-Discussion                              |         | Description: The field of game theory analyses organizations/settings where rational selfish agents interact, like voting, (spectrum) auctions, social networks, mediations, and bargaining. For such organizations, it aims to study their stable outcomes, designing rules to achieve good stable outcomes, welfare loss, dynamics, etc.. Algorithmic game theory studies computational aspects of each of these aspects, e.g., how fast we can compute the solutions. The goal of this course is to expose students to three main objectives of algorithmic game theory: (i) analysis and algorithms for stable outcomes (games, equilibria, and computation), (ii) efficient rule design to achieve good stable outcomes (mechanism design and fair-division), and (iii) analysis of welfare loss and dynamics (selfish routing and price-of-anarchy). A research/survey project will be a major part of this course. Being a theory course, CS 473 or equivalent is recommended as a pre-requisite. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister
| 66867       | Lecture-Discussion                              |         | Restricted to Graduate - Urbana-Champaign. Restricted to Electrical & Computer Engr major(s). |
|             | Lecture-Discussion                              |         | Restricted to Graduate - Urbana-Champaign. Restricted to Electrical & Computer Engr major(s). |
|             | Lecture-Discussion                              |         | Restricted to Graduate - Urbana-Champaign. Restricted to Electrical & Computer Engr major(s). |

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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

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<th>Time</th>
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<td>46042</td>
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<td>11:00 AM - 12:15 PM</td>
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<td>1103 - Siebel Center for Comp Sci</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. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister

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<tr>
<td>70199</td>
<td>Lecture-Discussion</td>
<td>TMC</td>
<td>11:00 AM - 12:15 PM</td>
<td>WF</td>
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<td>1131 - Siebel Center for Comp Sci</td>
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Credit Hours: 4 hours
Fine-Grained Algorithms
Restricted to Graduate - Urbana-Champaign.
Restricted to Computer Science or Bioinformatics major(s).
Algorithms from the Fine-Grained Perspective In undergraduate algorithms classes, you have studied classical problems such as all-pairs shortest paths, longest common subsequence, edit distance, 3SUM, subset sum, triangles in graphs, etc. Have you ever wondered whether the textbook algorithms you have learned could be improved, or whether they are in fact the best possible? Here, we are interested not just in determining whether the problems are polynomial-time solvable, but in their "fine-grained" complexity (quadratic time? cubic time? etc.). We will describe the latest theoretical techniques for obtaining (slightly) improved algorithms for these classical problems and their variants (in general as well as important special cases). We will also prove conditional lower bounds via reductions that relate the fine-grained complexity of one problem to another. For up-to-date information about CS course restrictions, please see the following link: http://go.cs.illinois.edu/csregister