### 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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<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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<tbody>
<tr>
<td>67237</td>
<td>Lecture-Discussion</td>
<td>AB</td>
<td>03:30 PM - 04:45 PM</td>
<td>TR</td>
<td>1302 - Siebel Center for Comp Sci</td>
<td>Bates, A</td>
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</tbody>
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Credit Hours: 4 hours  
**Comp Security - Physical World**  
Restricted to Graduate - Urbana-Champaign.  
Computer Security in the Physical World: As the world becomes increasingly connected and driven by computing, failures of secure design have tremendous real world impact. Infrastructure is tied to computing, and understanding how the practices of computer security have real-life, real-world implications is important to secure software and hardware design. From lockpicking to cyber-physical systems, from cell phones to radios, this course will examine recent work in security that influences a wide variety of physical world phenomena, sometimes in unexpected ways. The course readings will come from top security conferences, featuring both seminal and late-breaking papers in the field.

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<tr>
<td>58261</td>
<td>Lecture-Discussion</td>
<td>ACK</td>
<td>12:30 PM - 01:45 PM</td>
<td>TR</td>
<td>1131 - Siebel Center for Comp Sci</td>
<td>Kirlik, A</td>
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</tbody>
</table>

Credit Hours: 4 hours  
**Cyber-Physical-Human Systems**  
Restricted to Graduate - Urbana-Champaign.  
Topic: Research on the analysis and design of cyber-physical systems (CPS) has grown rapidly in recent years, with one of the latest developments being an expansion in scope to include consideration of the roles humans perform in these systems. Cyber-physical-human system (CPHS) applications include healthcare and medicine, intelligent vehicles and highways, aerospace systems, human-robot interaction, home and workplace automation, and many others. Core research issues concern how best to partition computation or cognition between human and machine, designing synergistic CPHS that outperform either humans or technology acting alone, system safety and security, supporting individual and group situation awareness, and CPHS interface design principles and technologies.

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<tr>
<td>67396</td>
<td>Lecture</td>
<td>AM</td>
<td>11:00 AM - 12:15 PM</td>
<td>TR</td>
<td>4070 - Electrical &amp; Computer Eng Bldg</td>
<td>Miller, A</td>
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Credit Hours: 4 hours  
**Cryptocurrency Security**  
Restricted to Graduate - Urbana-Champaign.  
Prerequisites: ECE 428 / CS 425 (Distributed Systems) or equivalent, or consent of instructor.  
Decentralized cryptocurrencies, such as Bitcoin and Ethereum, have gained rapid popularity, attracting the attention of academics, entrepreneurs, economists, and policy-makers. They promise to create new disruptive markets, and revolutionize how we think of money and financial infrastructure. The goal of this course is to introduce students to current research in cryptocurrencies. We’ll cover the technical background of applied cryptography and incentive mechanisms. The bulk of the course will consist of reading and discussion of recent research papers from top security conferences. Assignments will involve hands-on practice with cryptocurrency tools, such as sending and receive cryptocurrency payments, and programming smart contracts. The course will culminate with an original research project.

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<tr>
<td>67506</td>
<td>Lecture</td>
<td>CX1</td>
<td>ARRANGED -</td>
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<td>Zhai, C</td>
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Credit Hours: 4 hours  
**Advance Information Retrieval**
This is an overflow section for CS 598 CXZ - student will watch the lectures videos but will be responsible for turning in all homework and taking exams with the on campus class.

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<tr>
<th>Course Code</th>
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<th>Location</th>
<th>Instructor</th>
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<tr>
<td>50499</td>
<td>Online</td>
<td>CXO</td>
<td>ARRANGED</td>
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<td>Geigle, C Zhai, C</td>
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Credit Hours: 4 hours
Advanced Information Retrieval
Restricted to online grad non-degree, online MCS, online MSAE, online MSME, and online MSCE students. Center for Innovation in Teaching & Learning (CITL) restrictions and assessments apply, see https://online.illinois.edu. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.
OCE Tuition $1034.00 per Bill Hour, and OCE Fees $50.00 per Bill Hour.

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<tr>
<td>35989</td>
<td>Lecture-Discussion</td>
<td>CXZ</td>
<td>09:30 AM - 10:45 AM</td>
<td>WF</td>
<td>1109 - Siebel Center for Comp Sci</td>
<td>Zhai, C</td>
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</table>

Credit Hours: 4 hours
Advanced Information Retrieval
Restricted to Graduate - Urbana-Champaign.
Topic: Advanced Topics in Information Retrieval. Advanced concepts, models, and algorithms in information retrieval and text mining, including both historical milestones and major recent developments in the field. Topics include information retrieval models, statistical language models, information retrieval evaluation, applications of machine learning in information retrieval and text mining, and other emerging new topics.

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<td>67234</td>
<td>Lecture-Discussion</td>
<td>EVS</td>
<td>09:30 AM - 10:45 AM</td>
<td>MW</td>
<td>1214 - Siebel Center for Comp Sci</td>
<td>Solomonik, E</td>
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Credit Hours: 4 hours
Comm Cost Analys of Algorithms
Restricted to Graduate - Urbana-Champaign.
Title: Communication cost analysis of algorithms Description: Efficiency and parallel scalability of data-intensive applications are most often constrained by data movement in the memory hierarchy and the network. This course will focus on analysis of algorithms through the lens of communication and synchronization models. We will survey both communication lower bounds and algorithms that attain them for fundamental combinatorial and numerical problems. The course will emphasize theoretical results with practical implications, discussing both recent developments and open questions. Course projects targeting applications or ongoing research will be encouraged. Prerequisites: familiarity with parallel programming, numerical linear algebra, and algorithms (e.g. CS 420, 450, 473)

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<tr>
<td>64618</td>
<td>Lecture-Discussion</td>
<td>JT</td>
<td>09:30 AM - 10:45 AM</td>
<td>TR</td>
<td>1131 - Siebel Center for Comp Sci</td>
<td>Torrellas, J</td>
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Credit Hours: 4 hours
Energy-Efficient Comp Architec
Restricted to Graduate - Urbana-Champaign.
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
### 66318

**Lecture-Discussion**  
**LRS**  
**09:30 AM - 10:45 AM**  
**WF**  
**1105 - Siebel Center for Comp Sci**  
**Sha, L**

**Credit Hours: 4 hours**  
**Improving Your Research Skills**  
Restricted to Graduate - Urbana-Champaign.  
This class aims at improving graduate students' research skills including: 1) how to identify and formulate high impact research problems; 2) how to create a research agenda and carry it out; and 3) how to give presentations and write papers. For an overview, see Elements of successful research (https://uofi.box.com/s/ponvwpb04ga2msjgb6a). Guest lectures on research methods were contributed by Professors Jia-Wei Han, Klara Nahrstedt, P. R. Kumar, Tarek Abdelzaher, Indy Gupta, Kevin Chang, and Y. Y. Zhou and from former students who took this class before. Class projects can be based on your current research.

### 55918

**Lecture-Discussion**  
**LVK**  
**09:30 AM - 10:45 AM**  
**TR**  
**1109 - Siebel Center for Comp Sci**  
**Kale, L**

**Credit Hours: 4 hours**  
**Parallel Programming**  
Restricted to Graduate - Urbana-Champaign.  
Topic: Parallel programming with migratable objects. This course will teach and explore a method for parallel programming that can be used to program multicore desktop (with and without accelerators), small clusters, as well as petascale/exascale computers, with the same programming model. The model is based on the idea of over-decomposing the computation into a large number of interacting objects, mostly independent of the number of processors, and to empower an intelligent runtime system decide where and when the objects execute. Pre-requisite: No specific course requirements. Good sequential programming experience in C++ and/or Java.

### 66327

**Lecture-Discussion**  
**MHV**  
**11:00 AM - 12:15 PM**  
**TR**  
**1131 - Siebel Center for Comp Sci**  
**Viswanathan, M**

**Credit Hours: 4 hours**  
**Modeling of Probabilistic Syst**  
Restricted to Graduate - Urbana-Champaign.  
Title: Modeling and Verification of Probabilistic Systems Topic: The aim of this course is to address the compositional modeling and the automated verification (i.e., model checking) of probabilistic models. These models are important for addressing performance aspects, they are the key to randomised distributed algorithms, and have applications in systems biology as well as security, to mention a few. This course is about: - How to describe models for complex systems that involve random aspects? - How to verify in a fully algorithmical manner, whether such models satisfy basic properties, such as reachability probabilities? - Can we make these models smaller to enable or simplify verification? - What kind of practical problems can be treated in this manner? Topics: Markov chains, Markov decision processes, probabilistic automata, probabilistic programs, interactive Markov chains, model checking, probabilistic temporal logic (CTL and LTL), bisimulation, compositional modeling, concurrency, compositional minimisation.

### 66832

**Lecture-Discussion**  
**OOK**  
**03:30 PM - 04:45 PM**  
**TR**  
**1109 - Siebel Center for Comp Sci**  
**Koyejo, O**

**Credit Hours: 4 hours**  
**Graphical Models**  
Restricted to Graduate - Urbana-Champaign.  
Topic: Probabilistic Graphical Models are efficient representations of joint distributions using graphs, with a range of applications to machine learning, computer vision, natural language processing and computational biology, among other fields. The course will cover the fundamentals of probabilistic graphical models, including techniques for inferring properties of the distribution given the graph structure and parameters, and for learning the graphical model from data. The course will also cover selected special topics such as approximate inference, and learning high dimensional models subject to sparsity assumptions. Prerequisites: Students are expected to have background in basic probability theory, statistics, linear algebra, programming, algorithm design and analysis. Requirements: Students will be expected to complete a research project.

### 66867

**Lecture-Discussion**  
**SM**  
**02:00 PM - 03:15 PM**  
**TR**  
**1109 - Siebel Center for Comp Sci**  
**Misailovic, S**
Credit Hours: 4 hours
Approx & Probabilistic Comp
Restricted to Graduate - Urbana-Champaign.
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.

| 67236 | Lecture-Discussion | TEL | 11:00 AM - 12:15 PM | WF | ARR - Siebel Center for Comp Sci | Telgarsky, M |

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.