Class Schedule - Fall 2016

Computer Science
Computer Science
Head of Department: Rob A. Rutenbar
Department Office: 2232 Siebel Center, 201 N. Goodwin Avenue, Urbana
Phone: 333-3426
www.cs.uiuc.edu

CS 100 Freshman Orientation credit: 1 hours.
Introduction to Computer Science as a field and career for computer science majors. Overview of the field and specific examples of problem areas and methods of solution.

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<tr>
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<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tr>
<td>30094</td>
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<td>100 - Noyes Laboratory</td>
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Meets 28-Sep-16 - 07-Dec-16.
Restricted to First Time Freshman students.
Restricted to Computer Science or Statistics & Computer Science or Math & Computer Science or Computer Sci & Anthropology or Computer Sci & Astronomy or Computer Sci & Chemistry or Computer Sci & Linguistics major(s). Restricted to Undergrad - Urbana-Champaign.
First day of instruction for this course is 09/28/16

CS 101 Intro Computing: Engrg & Sci credit: 3 hours.
Fundamental principles, concepts, and methods of computing, with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; use of computers in solving engineering and scientific problems. Intended for engineering and science majors. Prerequisite: MATH 220 or MATH 221.

Students must register for one lab-discussion and one lecture section. Engineering students must obtain a dean's approval to drop this course after the second week of instruction.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II

<table>
<thead>
<tr>
<th>CRN</th>
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Quant Reasoning II course.
Restricted to Undergrad - Urbana-Champaign.

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**CS 105  Intro Computing: Non-Tech  credit: 3 hours.**

Computing as an essential tool of academic and professional activities. Functions and interrelationships of computer system components: hardware, systems and applications software, and networks. Widely used application packages such as spreadsheets and databases. Concepts and practice of programming for the solution of simple problems in different application areas. Intended for non-science and non-engineering majors. Prerequisite: MATH 112.

Students must register for one lab-discussion and one lecture section.

This course satisfies the General Education Criteria for a: Quantitative Reasoning I
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<td>35843</td>
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</table>
CS 125  Intro to Computer Science  credit: 4 hours.
Basic concepts in computing and fundamental techniques for solving computational problems. Intended as a first course for computer science majors and others with a deep interest in computing. Prerequisite: Three years of high school mathematics or MATH 112.

Students must register for one lab-discussion and one lecture section. Engineering students must obtain a dean's approval to drop this course after the second week of instruction.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning I

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Quant Reasoning I course.

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Quant Reasoning I course.

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Credit Hours: 3 hours
Instructor Approval Required

CS 126  **Software Design Studio**  credit: 3 hours.
Fundamental principles and techniques of software development. Design, documentation, testing, and debugging software, with a significant emphasis on code review. Credit is not given for both CS 242 and CS 126. Prerequisite: CS 125. For majors only.

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Credit Hours: 3 hours
Instructor Approval Required

CS 173  **Discrete Structures**  credit: 3 hours.
Discrete mathematical structures frequently encountered in the study of Computer Science. Sets, propositions, Boolean algebra, induction, recursion, relations, functions, and graphs. Credit is not given for both CS 173 and MATH 213. Prerequisite: One of CS 125, ECE 220; one of MATH 220, MATH 221.
Students must register for a lecture and discussion section.
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Restricted to Undergrad - Urbana-Champaign.
### CS 196  Freshman Honors  
credit: 1 hours.
Offered for honors credit in conjunction with other 100-level computer science courses taken concurrently. A special examination may be required for admission to this course. May be repeated. Prerequisite: Concurrent registration in another 100-level computer science course (see Schedule).

<table>
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Restricted to Undergrad - Urbana-Champaign.
SECTION 25 is for students registered in CS 125. This course will remain closed until the first day of class.

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Credit Hours: 1 hours  
Restricted to Undergrad - Urbana-Champaign.  
SECTION 73 is for students registered in CS 173.
Restricted to James Scholars Program students.

CS 199  **Undergraduate Open Seminar**  credit: 1 TO 5 hours.
May be repeated.

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Credit Hours: 4 hours
Problem Solving W/Data Struct
Not intended for Computer Engineering or Computer Science or Electrical Engineering or Statistics & Computer Science or Math & Computer Science or Computer Sci & Anthropology or Computer Sci & Astronomy or Computer Sci & Chemistry or Computer Sci & Linguistics major(s).

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Credit Hours: 2 hours
Instructor Approval Required
Meets 17-Oct-16 - 07-Dec-16.
This course is for students that have dropped CS 225, this helps prepare the student to re-take CS 225 next semester.

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Credit Hours: 1 hours
De-Bug your Brain
Meets 04-Sep-16 - 07-Dec-16.
Topic: De-Bug Your Brain: Thinking about Computer Science is designed for students enrolled in CS 125 who are new to programming and are looking for extra help in a small classroom setting. Classes meet weekly for 2 hours. This one credit course shows how to analyze algorithms, solve computational problems, debug and write complete working programs. Examples will be drawn from material covered in CS 125. Requires concurrent enrollment in CS 125.

<table>
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Credit Hours: 3 hours
Hypergraphics
Camp Honors/Chanc Schol course.
Special Topic: Hypergraphics, 3 hours. This section for Chancellor's Scholars only (not restricted by major or year); other students may only enroll with consent of instructor and the Campus Honors Program. This section of CS 199 meets with Math 198, Section G1H.
Restricted to Chancellor's Scholar-CHPHonors students.

CS 210  **Ethical & Professional Issues**  credit: 2 hours.
Ethics for the computing profession. Ethical decision-making; licensing; intellectual property, freedom of information, and privacy. Credit is not given for both CS 210 and ECE 316. Prerequisite: CS 225. Junior standing required.

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<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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</table>
CS 225  Data Structures  credit: 4 hours.

Data abstractions: elementary data structures (lists, stacks, queues, and trees) and their implementation using an object-oriented programming language. Solutions to a variety of computational problems such as search on graphs and trees. Elementary analysis of algorithms. Prerequisite: CS 125 or ECE 220; CS 173 or MATH 213.

Students must register for one lecture-discussion and one lecture section.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II

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Quant Reasoning II course.

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LAPTOP LAB SECTION -- Student are required to bring their own computer to this lab section.
Quant Reasoning II course.
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Quant Reasoning II course.
LAPTOP LAB SECTION -- Student are required to bring their own computer to this lab section.

CS 233  *Computer Architecture*  credit: 4 hours.
Fundamentals of computer architecture: digital logic design, working up from the logic gate level to understand the function of a simple computer; machine-level programming to understand implementation of high-level languages; performance models of modern computer architectures to enable performance optimization of software; hardware primitives for parallelism and security. Prerequisite: CS 125 and CS 173; credit or concurrent enrollment in CS 225.

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<td>Time</td>
<td>Days</td>
<td>Location</td>
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<td>0218 - Siebel Center for Comp Sci</td>
<td>Angrave, L</td>
</tr>
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</table>

CS 241  **System Programming**  credit: 4 hours.  
Basics of system programming, including POSIX processes, process control, inter-process communication, synchronization, signals, simple memory management, file I/O and directories, shell programming, socket network programming, RPC programming in distributed systems, basic security mechanisms, and standard tools for systems programming such as debugging tools. Credit is not given for both CS 241 and ECE 391. Prerequisite: CS 225; credit or concurrent registration in CS 233.  
Students must register for one lecture and one discussion section.
<table>
<thead>
<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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<td>Angrave, L</td>
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**CS 242  Programming Studio**  credit: 3 hours.
Intensive programming lab intended to strengthen skills in programming. Prerequisite: CS 241.
CS 296  **Honors Course**  credit: 1 hours.

Group projects for honors credit in computer science. Sections of this course are offered in conjunction with other 200-level computer science courses taken concurrently. A special examination may be required for admission to this course. May be repeated. Prerequisite: Concurrent registration in another 200-level computer science course (see Schedule).

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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Restricted to Undergrad - Urbana-Champaign.
Honors Section 25 is for students registered in CS 225 Data Structures

<table>
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Credit Hours: 1 hours
Restricted to Undergrad - Urbana-Champaign.
Honors section 33 is for students registered in CS 233 Computer Architecture

<table>
<thead>
<tr>
<th>CRN</th>
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Credit Hours: 1 hours
Restricted to Undergrad - Urbana-Champaign.
Honors Section 41 is for students registered in CS 241 System Programming

CS 357  **Numerical Methods I**  credit: 3 hours.

Fundamentals of numerical methods for students in science and engineering; floating-point computation, systems of linear equations, approximation of functions and integrals, the single nonlinear equation, and the numerical solution of ordinary differential equations; various applications in science and engineering; programming exercises and use of high quality mathematical library routines. Same as MATH 357. Credit is not given for CS 357 if credit for CS 450 has been earned. (Counts for advanced hours in LAS). Prerequisite: A 100-level computer science course; MATH 225 or MATH 415; MATH 241.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Instructor</th>
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<td>1404 - Siebel Center for Comp Sci</td>
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</table>
CS 361  Probability & Statistics for Computer Science  credit: 3 hours.
Introduction to probability theory and statistics with applications to computer science. Topics include: visualizing datasets, summarizing data, basic descriptive statistics, conditional probability, independence, Bayes theorem, random variables, joint and conditional distributions, expectation, variance and covariance, central limit theorem. Markov inequality, Chebyshev inequality, law of large numbers, Markov chains, simulation, the PageRank algorithm, populations and sampling, sample mean, standard error, maximum likelihood estimation, Bayes estimation, hypothesis testing, confidence intervals, linear regression, principal component analysis, classification, and decision trees. Same as STAT 361. Credit is not given for both CS 361 and ECE 313. Prerequisite: MATH 220 or 221; credit or concurrent registration in MATH 225. For majors only.

CS 374  Introduction to Algorithms & Models of Computation  credit: 4 hours.
Analysis of algorithms, major paradigms of algorithm design including recursive algorithms, divide-and-conquer algorithms, dynamic programming, greedy algorithms, and graph algorithms. Formal models of computation including finite automata and Turing machines. Limitations of computation arising from fundamental notions of algorithm and from complexity-theoretic constraints. Reductions, undecidability and NP-completeness. Same as ECE 374. Prerequisite: CS 225; MATH 225 or MATH 415.
### CS 397  Individual Study  
credit: 1 TO 3 hours.
May be repeated. Prerequisite: Consent of instructor.

<table>
<thead>
<tr>
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<th>Type</th>
<th>Section</th>
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<th>Days</th>
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</table>
Instructor Approval Required
Students must see the CS Department to receive the appropriate CRN for the instructor.

CS 410 **Text Information Systems**  credit: 3 OR 4 hours.
Theory, design, and implementation of text-based information systems. Text analysis, retrieval models (e.g., Boolean, vector space, probabilistic), text categorization, text filtering, clustering, retrieval system design and implementation, and applications to web information management. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Days</th>
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<td>-</td>
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</table>

Credit Hours: 4 hours
Restricted to MCS: Computer Sci Online - UIUC.
This course is only for students that are in the Computer Science MCS-DC Program. Additional Coursera ID verification and ProctorU fees may apply.

CS 411 **Database Systems**  credit: 3 OR 4 hours.
Examination of the logical organization of databases: the entity-relationship model; the hierarchical, network, and relational data models and their languages. Functional dependencies and normal forms. Design, implementation, and optimization of query languages; security and integrity; concurrency control, and distributed database systems. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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Credit Hours: 3 hours

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</table>

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 412 **Introduction to Data Mining**  credit: 3 OR 4 hours.
Concepts, techniques, and systems of data warehousing and data mining. Design and implementation of data warehouse and on-line analytical processing (OLAP) systems; data mining concepts, methods, systems, implementations, and applications. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225.

<table>
<thead>
<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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Credit Hours: 3 hours
Students registered in this section will watch the regular CS 412 lecture, online. This is an overflow accommodation for the course. Students in this section would take any exams with the regular section of CS 412.
<table>
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<tr>
<th>CRN</th>
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Credit Hours: 3 hours

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

**CS 413  Intro to Combinatorics**  credit: 3 OR 4 hours.
Same as MATH 413. See MATH 413.

<table>
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<td>11:00 AM - 11:50 AM</td>
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Credit Hours: 3 hours

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Credit Hours: 4 hours
Departmental Approval Required

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Credit Hours: 3 hours

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</table>

Credit Hours: 4 hours
Departmental Approval Required

**CS 418  Interactive Computer Graphics**  credit: 3 or 4 hours.
Basic mathematical tools and computational techniques for modeling, rendering, and animating 3-D scenes. Same as CSE 427. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225; MATH 225 or MATH 415; MATH 241.
Students will register for a lecture and a discussion section.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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<th>Days</th>
<th>Location</th>
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<tr>
<td>51480</td>
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<td>1111 - Siebel Center for Comp Sci</td>
<td>Shaffer, E</td>
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</table>
CS 420  Parallel Progrmg: Sci & Engrg  credit: 3 OR 4 hours.

Fundamental issues in design and development of parallel programs for various types of parallel computers. Various programming models according to both machine type and application area. Cost models, debugging, and performance evaluation of parallel programs with actual application examples. Same as CSE 402 and ECE 492. 3 undergraduate hours. 3 or 4 graduate hours. 
Prerequisite: CS 225.

<table>
<thead>
<tr>
<th>CRN</th>
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Restricted to online 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/. Students should register for 3 or 4 credit hours.
OCE Tuition $1034.00 per Bill Hour, and OCE Fees $50.00 per Bill Hour.
CS 421  **Progrmg Languages & Compilers**  credit: 3 OR 4 hours.
Structure of programming languages and their implementation. Basic language design principles; abstract data types; functional languages; type systems; object-oriented languages. Basics of lexing, parsing, syntax-directed translation, semantic analysis, and code generation. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 233 and CS 373.

<table>
<thead>
<tr>
<th>CRN</th>
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Credit Hours: 3 hours

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<th>Instructor</th>
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<td>Gunter, E</td>
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Credit Hours: 4 hours

Restricted to Graduate - Urbana-Champaign.

CS 424  **Real-Time Systems**  credit: 3 OR 4 hours.
Supervisory control aspects of Cyber Physical Systems (CPS): fundamentals of reliability analysis, real-time scheduling, simple feedback control, software fault tolerance architecture, wireless networking and energy saving, principles of safety critical system engineering. Student groups design and demonstrate supervisory control architecture for a robot. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241.

<table>
<thead>
<tr>
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<th>Type</th>
<th>Section</th>
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<th>Days</th>
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Credit Hours: 3 hours

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<th>Location</th>
<th>Instructor</th>
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</table>

Credit Hours: 4 hours

Restricted to Graduate - Urbana-Champaign.

CS 425  **Distributed Systems**  credit: 3 OR 4 hours.
Protocols, specification techniques, global states and their determination, reliable broadcast, transactions and commitment, security, and real-time systems. Same as ECE 428. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241 or ECE 391.
CRN | Type | Section | Time | Days | Location | Instructor
---|---|---|---|---|---|---
67394 | Online | DSO | ARRANGED - | | - | Gupta, I

Credit Hours: 4 hours
Restricted to MCS: Computer Sci Online - UIUC.
This course is only for students that are in the Computer Science MCS-DC Program. Additional Coursera ID verification and ProctorU fees may apply.

62170 | Online | ONL | ARRANGED - | | - | Gupta, I
Wang, H

Restricted to online 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.

36091 | Lecture-Discussion | P3 | 02:00 PM - 03:15 PM | TR | 1320 - Digital Computer Laboratory | Gupta, I
Credit Hours: 3 hours

57769 | Lecture-Discussion | P4 | 02:00 PM - 03:15 PM | TR | 1320 - Digital Computer Laboratory | Gupta, I
Credit Hours: 4 hours

CS 426 Compiler Construction credit: 3 OR 4 hours.
Compiler structure, syntax analysis, syntax-directed translation, automatically constructed recognizers, semantic analysis, code generation, intermediate language, optimization techniques. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 421.

CRN | Type | Section | Time | Days | Location | Instructor
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43355 | Lecture-Discussion | N3 | 12:30 PM - 01:45 PM | TR | 1302 - Siebel Center for Comp Sci | Adve, V
Credit Hours: 3 hours

43356 | Lecture-Discussion | N4 | 12:30 PM - 01:45 PM | TR | 1302 - Siebel Center for Comp Sci | Adve, V
Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 427 Software Engineering I credit: 3 OR 4 hours.
Software process, analysis and design. Software development paradigms, system engineering, function-based analysis and design, and object-oriented analysis and design. Course will use team-projects for hands-on exercises. Same as CSE 426. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225 and CS 373.
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Credit Hours: 3 hours

Restricted to Graduate - Urbana-Champaign.

**CS 431  **Embedded Systems  **credit: 3 or 4 hours.**
A survey of sampled data systems and embedded architecture; key concepts in common embedded system applications; signal processing and control; embedded microprocessor and device interface; time-critical I/O handling; data communications; real-time operating systems and techniques for the development and analysis of embedded real-time software; hands-on laboratory projects. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241 or ECE 391.

Students must register for one lab and one lecture section.

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<tr>
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<td>Caccamo, M</td>
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Lab sections for CS 431 will meet in 2325 Siebel Center.

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Lab sections for CS 431 will meet in 2325 Siebel Center.

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Lab sections for CS 431 will meet in 2325 Siebel Center.

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Lab sections for CS 431 will meet in 2325 Siebel Center.

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Credit Hours: 3 hours

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Credit Hours: 4 hours
CS 433  **Computer System Organization**  credit: 3 OR 4 hours.
Computer system analysis and design. Organizational dependence on computations to be performed; speed and cost of parts and overall machines; instruction set design; pipeline and vector machines; memory hierarchy design. Same as CSE 422. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 233.

<table>
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<tr>
<th>CRN</th>
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Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign.

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 438  **Communication Networks**  credit: 3 OR 4 hours.
Layered architectures and the OSI Reference Model; design issues and protocols in the transport, network, and data link layers; architectures and control algorithms of local-area, point-to-point, and satellite networks; standards in networks access protocols; models of network interconnection; overview of networking and communication software. Same as ECE 438. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241 or ECE 391; one of ECE 313, MATH 461, MATH 463.

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Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign.

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 439  **Wireless Networks**  credit: 3 OR 4 hours.
Same as ECE 439. See ECE 439.

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Credit Hours: 3 hours
CS 440  **Artificial Intelligence**  credit: 3 OR 4 hours.
Major topics in and directions of research in artificial intelligence: AI languages (LISP and PROLOG), basic problem solving techniques, knowledge representation and computer inference, machine learning, natural language understanding, computer vision, robotics, and societal impacts. Same as ECE 448. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225 or ECE 391.

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OCE Tuition $1034.00 per Bill Hour, and OCE Fees $50.00 per Bill Hour.

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Credit Hours: 3 hours

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Credit Hours: 4 hours

Restricted to Graduate - Urbana-Champaign.

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Credit Hours: 3 hours

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Credit Hours: 4 hours

Restricted to Graduate - Urbana-Champaign.

CS 446  **Machine Learning**  credit: 3 OR 4 hours.
Theory and basic techniques in machine learning. Major theoretical paradigms and key concepts developed in machine learning in the context of applications such as natural language and text processing, computer vision, data mining, adaptive computer systems and others. Review of several supervised and unsupervised learning approaches: methods for learning linear representations; on-line
learning, Bayesian methods; decision-trees; features and kernels; clustering and dimensionality reduction. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 373 and CS 440.

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**CS 450  Numerical Analysis**  credit: 3 or 4 hours.

Linear system solvers, optimization techniques, interpolation and approximation of functions, solving systems of nonlinear equations, eigenvalue problems, least squares, and quadrature; numerical handling of ordinary and partial differential equations. Same as CSE 401, ECE 491, and MATH 450. 3 undergraduate hours. 3 or 4 graduate hours. Credit is not given for both CS 450 and CS 457. Prerequisite: CS 101 or CS 125; CS 357 or MATH 415; MATH 285.

<table>
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**CS 461  Computer Security I**  credit: 0 to 4 hours.

Fundamental principles of computer and communications security and information assurance: ethics, privacy, notions of threat, vulnerabilities, and risk in systems, information warfare, malicious software, data secrecy and integrity issues, network security, trusted computing, mandatory and discretionary access controls, certification and accreditation of systems against security standards. Security mechanisms: authentication, auditing, intrusion detection, access control, cryptography, security protocols, key distribution. Same as ECE 422. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241 or ECE 391.
CS 465  User Interface Design  credit: 3 OR 4 hours.
A project-focused course covering fundamental principles of user interface design, implementation, and evaluation. Small teams work on a term-long project that involves: analysis of the problem domain, user skills, and tasks; iterative prototyping of interfaces to address user needs; conducting several forms of evaluation such as cognitive walkthroughs and usability tests; implementation of the final prototype. Non-technical majors may enroll as non-programmers who participate in all aspects of the projects with the possible exception of implementation. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225.
CS 466  **Introduction to Bioinformatics**  credit: 3 OR 4 hours.
Algorithmic approaches in bioinformatics: (i) biological problems that can be solved computationally (e.g., discovering genes, and interactions among different genes and proteins); (ii) algorithmic techniques with wide applicability in solving these problems (e.g., dynamic programming and probabilistic methods); (iii) practical issues in translating the basic algorithmic ideas into accurate and efficient tools that biologists may use. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225.

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Credit Hours: 3 hours

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 476  **Program Verification**  credit: 3 OR 4 hours.
Formal methods for demonstrating correctness and other properties of programs. Invariant assertions; Hoare axiomatics; well-founded orderings for proving termination; structural induction; computational induction; data structures; parallel programs; overview of predicate calculus. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225; CS 373 or MATH 414.

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Credit Hours: 3 hours

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 477  **Formal Software Devel Methods**  credit: 3 OR 4 hours.
Mathematical models, languages, and methods for software specification, development, and verification. Same as ECE 478. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225; CS 373 or MATH 414.

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<tr>
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Credit Hours: 3 hours

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<th>Days</th>
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</table>

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.

CS 481 **Stochastic Processes & Applic**  credit: 3 OR 4 hours.
Same as IE 410. See IE 410.

<table>
<thead>
<tr>
<th>CRN</th>
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Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign.

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</table>

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
3 or 4 hours.

CS 483 **Applied Parallel Programming**  credit: 4 hours.
Same as CSE 408 and ECE 408. See ECE 408.

<table>
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<tr>
<th>CRN</th>
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</table>
CS 491  Seminar  credit: 0 TO 4 hours.
Seminar on topics of current interest as announced in the Class Schedule. 0 to 4 undergraduate hours. 0 to 4 graduate hours.
Approved for S/U grading only. May be repeated in the same or separate terms if topics vary to a maximum of 4 hours. Prerequisite: As
specified for each topic offering, see Class Schedule or departmental course description.

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<tr>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
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</table>

Credit Hours: 1 hours
Intro Pedagogy Practicum
Instructor Approval Required
Topic: Introductory Pedagogy Practicum
Prerequisite: High scores in CS 125 and a strong desire to help others with Introduction to Computer Science
Investigate approaches to learning and teaching introductory computer science topics through research, discussion and course
development. Implement and test new ideas in a classroom format, via online videos, lab section and one-on-one
instruction and web-delivered media and apps for introductory computer science students.

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<tr>
<th>CRN</th>
<th>Type</th>
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</table>

Credit Hours: 1 hours
Intro Competitive Programming
Title: Introduction to Competitive Algorithmic Programming
This course introduces the algorithms and concepts necessary to compete effectively in the ACM International Collegiate Programming Contest (ICPC) and similar contests. It is highly recommended for students intending to compete in the 2016 ICPC Mid-Central Regional contest. The course requires participation in practice contests and weekly completion of short problem sets. Topics covered include standard library classes and data structures useful for programming contest problems, basic complexity analysis, dynamic programming, graph algorithms, number theory, combinatorics, computational geometry, combinatorial games, and competitive programming contest strategy. Prerequisites: Must have programming competency in Java or C++ and preferably have taken CS 225 Data Structures.

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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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<th>Instructor</th>
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</table>

Credit Hours: 2 hours
Cyber Security Scholar Program
Instructor Approval Required
Topic: Information Assurance and Trust Seminar.
This course is an undergraduate seminar for students admitted to the Illinois Cyber Security Scholar Program. In addition, this course would be open and serve as an orientation seminar to all college of engineering undergraduate student interested in topics of information assurance and trust. The seminars will feature information assurance subject matter expert guest speakers from industry and government, community leaders, distinguished external researchers, faculty, and students discussing both the technical challenges and limitations of IA. Standard information assurance topics such as authentication, data integrity, ethics, and cyber security will be covered.

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<tr>
<th>CRN</th>
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<th>Section</th>
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<th>Days</th>
<th>Location</th>
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</table>
Pedagogy Practicum
Instructor Approval Required
Pedagogy Practicum Prerequisite: High scores in CS 241 and a strong desire to help others with Introduction to Computer Science.
Investigate approaches to learning and teaching computer science topics through research, discussion and course development.
Implement and test new ideas in a classroom format, via online videos, lab section and one-on-one instruction and web-delivered media and apps for introductory computer science students.

CS 492 Senior Project I credit: 3 hours.
First part of a project course in computer science. Students work in teams to solve typical commercial or industrial problems. Work involves planning, design, and implementation. Extensive oral and written work is required both on-campus and possibly off-campus at sponsors’ locations. CS 492 must be taken as a sequence with either CS 493 or CS 494. 3 undergraduate hours. No graduate credit.
Credit is not given for both CS 492 and a project course in another engineering department for the same project. Prerequisite: For Computer Science majors with senior standing.

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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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Restricted to Computer Science or Statistics & Computer Science or Math & Computer Science or Computer Sci & Anthropology or Computer Sci & Astronomy or Computer Sci & Chemistry or Computer Sci & Linguistics major(s). Restricted to students with Senior class standing. Restricted to Undergrad - Urbana-Champaign.

CS 498 Special Topics credit: 1 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. 1 to 4 undergraduate hours. 1 to 4 graduate hours.
May be repeated in the same or separate terms if topics vary.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<td>1302 - Siebel Center for Comp Sci</td>
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</table>

Credit Hours: 4 hours
Digital Forensics
Digital forensics concerns the acquisition and investigation of evidence from all devices capable of storing digital data and is often related to the prosecution of cyber crime and fraud. The class introduces the process of forensic investigation, chain of custody, forensics analysis, court proceedings and the legal justice system. It includes examination of digital storage and network traffic from personal computers, enterprise systems, embedded devices, and mobiles. Laboratory student exercises will use the tools and techniques of digital forensics investigators. Prerequisite: a basic knowledge of computer science concepts including
operating systems and networking. Information about pre-requisites and the self-assessment quiz can be seen at this link - http://publish.illinois.edu/digitalforensics1/prerequisite/

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<tr>
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</table>

AI for Computer Games
Artificial intelligence is becoming an important component of modern computer games. Example applications of AI include increasing the subtly, sophistication, and intelligent behavior of non-player characters, enhancing the realism of the game world's dynamics, and adapting game play to fit the user. In the context of computer games, fundamental AI methods for learning, planning, inference, and intelligent control can often be greatly strengthened compared to their real world counterparts. This course focuses on AI methods in a game setting which will be contrasted with AI in the real world. Students will develop an understanding of the methods rooted in this foundational difference and develop an appreciation for the state of the art. Grading is based on written and programming homework, and in particular on a sequence of implementation projects. An understanding of AI concepts and a solid facility in programming are required. Prerequisite CS 440 / ECE 448

Social & Information Networks
Topic: Networks are to be found everywhere: from your familiar social networks to buyer-seller markets to protein-protein interactions. This class is an introduction to network science and we shall cover a broad range of concepts including: random graphs; networks and social contexts, networks and game theory, information diffusion and community detection. We shall discuss both classic questions about networks (how to model the spread of disease, what kinds of networks support decentralized search?) as well as more recent questions on networks with attributes and how to analyze massive networks efficiently.

Social & Information Networks
Restricted to Graduate - Urbana-Champaign.

Restricted to online 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/. Can be taken for 3 or 4 credit hours. OCE Tuition $1034.00 per Bill Hour, and OCE Fees $50.00 per Bill Hour.
## Intro to Data Science

Credit Hours: 4 hours  
Intro to Data Science  
Course Description: This course is intended to introduce students to modern programs and technologies that are useful for organizing, manipulating, analyzing, and visualizing data. We start with an overview of the R language, which will become the foundation for your work in this class. Then we’ll move on to other useful tools, including working with regular expressions, basic UNIX tools, XML, and SQL. We’ll also cover supervised and unsupervised statistical learning techniques made possible by recent advances in computing power. This course is very computer-oriented, so it’s very important to take the time outside of class to learn by doing – to explore the software we’ll be covering in class, and try out new skills on real datasets in the homework assignments.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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## The Art of Web Programming

Credit Hours: 3 hours  
The Art of Web Programming  

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## The Art of Web Programming (Restricted)

Credit Hours: 4 hours  
The Art of Web Programming  
Restricted to Graduate - Urbana-Champaign.

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## Fundamentals of Virtual Reality

Credit Hours: 3 hours  
Virtual Reality  
Fundamentals of virtual reality systems, including geometric modeling, transformations, graphical rendering, optics, the human vision system, the vestibular system, interface design, human factors, developer recommendations, and technological issues. Implementation exercises and a final project are included. Extensive programming background not required.

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## Fundamentals of Virtual Reality (Restricted)

Credit Hours: 4 hours  
Virtual Reality  
Restricted to Graduate - Urbana-Champaign.

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<td>Yershova, G</td>
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## Senior Thesis

Credit: 3 hours.  
Research and thesis development experience in computer science underguidance of a faculty member. Literature search, oral presentation, analysis and implementation, paper preparation, and completion of a written thesis. 3 undergraduate hours. No graduate credit. May be repeated to a maximum of 6 hours. Prerequisite: Consent of instructor.

This course satisfies the General Education Criteria for a:  
Advanced Composition
CS 519  **Scientific Visualization**  credit: 4 hours.
Visualization techniques useful in analysis of engineering and scientific data. Physical models; methods of computational science; two- and three-dimensional data types; visual representation schemes for scalar, vector, and tensor data; isosurface and volume visualization methods; visual monitoring; interactive steering. Same as CSE 527. Prerequisite: CS 418.

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<th>CRN</th>
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</tbody>
</table>

Restricted to Graduate - Urbana-Champaign.

CS 523  **Advanced Operating Systems**  credit: 4 hours.
Advanced concepts in operating system design and coverage of recent research directions. Resource management for parallel and distributed systems. Interaction between operating system design and computer architectures. Process management, virtual memory, interprocess communication, context switching, parallel and distributed file system designs, persistent objects, process and data migration, load balancing, security, protection. Term projects. Prerequisite: CS 423, CS 425, and CS 433.

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Restricted to Graduate - Urbana-Champaign.

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<td>-</td>
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Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-UIUC, NDEG:Grad Nondegree-CE-UIUC, MCS: Computer Sci Online-UIUC, or MENG:Mech Engineering Onl-UIUC. Restricted to online grad non-degree, online MCS, online MSME and online MSCEE students. Counts toward a certificate in Computer Science. 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.

CS 527  **Topics in Software Engineering**  credit: 4 hours.
Fault-tolerant software, software architecture, software patterns, multi-media software, and knowledge-based approaches to software engineering. Case studies. Prerequisite: CS 428 or CS 429.

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<th>CRN</th>
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CS 541  **Computer Systems Analysis**  credit: 4 hours.
Same as ECE 541. See ECE 541.

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<th>Section</th>
<th>Time</th>
<th>Days</th>
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</table>

CS 548  **Models of Cognitive Processes**  credit: 4 hours.
Formal models and concepts in automated cognition; integrating machine learning and prior knowledge; current approaches and detailed analyses of the role of reasoning in the learning process; computational complexity and fundamental tradeoffs between expressiveness and tractability; implications for state-of-the-art artificial intelligence areas such as automated planning, the semantic web, relational learning, structured prediction, latent models, structure learning, theory formation, etc.; philosophical and psychological aspects of integrating analytic and empirical evidence. Same as ECE 548. Prerequisite: CS 440 or CS 446.

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<tr>
<th>CRN</th>
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CS 549  **Seminar in Cognitive Science**  credit: 2 OR 4 hours.
Same as PSYC 514, ANTH 514, EPSY 551, LING 570, and PHIL 514. See PSYC 514.

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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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<td>48226</td>
<td>Lecture-Discussion</td>
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<td>03:30 PM - 04:50 PM</td>
<td>TR</td>
<td>319 - Gregory Hall</td>
<td>Hummel, J</td>
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</tbody>
</table>

CS 556  **Iterative & Multigrid Methods**  credit: 4 hours.
Comprehensive treatment of algebraic and multigrid iterative methods to solve systems of equations, primarily linear equations arising from discretization of partial differential equations. Same as CSE 511.
CS 563  Advanced Computer Security  credit: 4 hours.
Current research trends in computer and network security. Privacy, tamper-resistance, unwanted traffic, monitoring and surveillance, and critical infrastructure protection. Subtopics will vary depending upon current research trends. Students work in teams in close coordination with the course instructor to develop one of the topics in depth by carrying out background research and an exploratory project. Same as ECE 524. Prerequisite: CS 461 or CS 463.

CS 571  Combinatorial Mathematics  credit: 4 hours.
Same as MATH 580. See MATH 580.

CS 591  Advanced Seminar  credit: 0 TO 4 hours.
Seminar on topics of current interest as announced in the Class Schedule. Approved for S/U grading only. May be repeated in the same or separate terms if topics vary. Prerequisite: As specified for each topic offering, see Class Schedule or departmental course description.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Time</th>
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<td>35943</td>
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<td>46417</td>
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<td>04:00 PM - 04:50 PM</td>
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<td>67431</td>
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<td>35957</td>
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</table>

Credit Hours: 1 hours
Advanced Compiler Technology
Restricted to Graduate - Urbana-Champaign.
Topic: Advanced Compiler Technology. Prerequisite: CS 426.

Credit Hours: 1 hours
Cloud Computing Research
Restricted to Graduate - Urbana-Champaign.
Topic: Cloud Computing Research.

Credit Hours: 1 hours
Formal Methods Seminar
Restricted to Graduate - Urbana-Champaign.

Credit Hours: 1 hours
Human-Computer Interaction
Restricted to Graduate - Urbana-Champaign.
Topic: Seminar in Human-Computer Interaction. Course restricted to PhD Students only.

Credit Hours: 1 hours
Distributed Systems Seminar
Instructor Approval Required
Restricted to Graduate - Urbana-Champaign.
Topic: Advanced Seminar in Distributed Systems. Prerequisite: CS 598IG or CS 425 or any basic course on distributed systems.

Credit Hours: 1 hours
Theory Teaching Studio
Instructor Approval Required
Topic: Discussion, practice, and feedback on best practices for teaching upper division theory courses. Aimed at teaching assistants in CS 374, but open to other students interested in teaching. Contact Jeff Erickson for details. Prerequisite: Instructor permission
Class will meet in 3405 Siebel Center.

Credit Hours: 1 hours
Scientific Computing Seminar
<table>
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<tr>
<th>CRN</th>
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<th>Time</th>
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<td>ARR - Siebel Center for Comp Sci</td>
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<td>-</td>
<td>Geigle, C Massung, S Zhai, C</td>
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</table>

CS 597 **Individual Study**  credit: 2 TO 16 hours.

Individual study or reading in a subject not covered in normal course offerings. May be repeated. Prerequisite: Consent of instructor.
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>
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<td>TR</td>
<td>1302 - Siebel Center for Comp Sci</td>
<td>Bates, A</td>
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</table>

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.

<table>
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<tr>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
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<td>58261</td>
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<td>12:30 PM - 01:45 PM</td>
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<td>1131 - Siebel Center for Comp Sci</td>
<td>Kirlik, A</td>
</tr>
</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>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
<th>Days</th>
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<td>4070 - Electrical &amp; Computer Eng Bldg</td>
<td>Miller, A</td>
</tr>
</tbody>
</table>

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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<th>CRN</th>
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</table>
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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Delivery Method</th>
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<th>Instructor(s)</th>
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</tr>
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</table>

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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<th>Course Code</th>
<th>Delivery Method</th>
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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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<tr>
<th>Course Code</th>
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<th>Section</th>
<th>Instructor(s)</th>
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<td>09:30 AM - 10:45 AM</td>
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</table>

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>
<th>Course Code</th>
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<th>Section</th>
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<td>64618</td>
<td>Lecture-Discussion</td>
<td>JT</td>
<td>09:30 AM - 10:45 AM</td>
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</tbody>
</table>

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
<table>
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<th>Course Code</th>
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<th>Location</th>
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<td>09:30 AM - 10:45 AM</td>
<td>WF</td>
<td>1105 - Siebel Center for Comp Sci</td>
<td>Sha, L</td>
<td>Improving Your Research Skills</td>
</tr>
</tbody>
</table>

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/ponwvb04ga2msjgba6). 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.

<table>
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<tr>
<th>Course Code</th>
<th>Lecture-Discussion</th>
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<th>Days</th>
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<td>Kale, L</td>
<td>Parallel Programming</td>
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</table>

Restricted to Graduate - Urbana-Champaign.

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.

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<th>Lecture-Discussion</th>
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<th>Time</th>
<th>Days</th>
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<td>11:00 AM - 12:15 PM</td>
<td>TR</td>
<td>1131 - Siebel Center for Comp Sci</td>
<td>Viswanathan, M</td>
<td>Modeling of Probabilistic Syst</td>
</tr>
</tbody>
</table>

Restricted to Graduate - Urbana-Champaign.

This course will 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.

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<tr>
<th>Course Code</th>
<th>Lecture-Discussion</th>
<th>Location</th>
<th>Time</th>
<th>Days</th>
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<td>03:30 PM - 04:45 PM</td>
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<td>1109 - Siebel Center for Comp Sci</td>
<td>Koyejo, O</td>
<td>Graphical Models</td>
</tr>
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</table>

Restricted to Graduate - Urbana-Champaign.

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.
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.

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<tr>
<th>CRN</th>
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<th>Section</th>
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<th>Days</th>
<th>Location</th>
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<td>WF</td>
<td>ARR - Siebel Center for Comp Sci</td>
<td>Telgarsky, M</td>
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</tbody>
</table>

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.

CS 599 Thesis Research credit: 0 TO 16 hours.
Approved for S/U grading only. May be repeated.

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<th>CRN</th>
<th>Type</th>
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Instructor Approval Required
Restricted to Computer Science major(s). Restricted to Graduate - Urbana-Champaign.
Students must see the CS Department to receive the appropriate CRN for the instructor.