Computer Science

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.

<table>
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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>30094</td>
<td>Lecture</td>
<td>AL1</td>
<td>04:00 PM - 04:50 PM</td>
<td>W</td>
<td>100 - Noyes Laboratory</td>
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Meets 04-Oct-17 - 13-Dec-17.
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 10/04/17

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>
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Quantitative Reasoning II course.
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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Quantitative Reasoning I course.

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Quantitative Reasoning I course.
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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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Quantitative Reasoning I course.
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Quantitative Reasoning I course.

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

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Quantitative Reasoning I course.

65866 Laboratory-Discussion AYR 03:00 PM - 04:50 PM W 1103 - Siebel Center for Comp Sci Chapman, W

Quantitative Reasoning I course.

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

69488 Laboratory-Discussion AYT 01:00 PM - 02:50 PM T 1214 - Siebel Center for Comp Sci Chapman, W

Quantitative Reasoning I course.

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

69489 Laboratory-Discussion AYU 03:00 PM - 04:50 PM T 1214 - Siebel Center for Comp Sci Chapman, W

Quantitative Reasoning I course.

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

69490 Laboratory-Discussion AYV 05:00 PM - 06:50 PM T 1214 - Siebel Center for Comp Sci Chapman, W

Quantitative Reasoning I course.
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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Instructor Approval Required
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).

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.

<table>
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</table>
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).

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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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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 in Computer Science**  credit: 0 TO 5 hours.
Topics vary. Approved for Letter and S/U grading. May be repeated.

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Credit Hours: 1 hours
Intro Pedagogy Practicum
Instructor Approval Required
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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Credit Hours: 1 hours
Pedagogy Practicum
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.
Credit Hours: 1 hours
Applied Cloud Computing

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.
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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Quantitative Reasoning II course. Not intended for Computer Engineering or Electrical Engineering major(s).

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Quantitative Reasoning II course.

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Quantitative Reasoning II course.

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Quantitative Reasoning II course.

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

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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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</tr>
</tbody>
</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.
CS 242  **Programming Studio**  credit: 3 hours.
Intensive programming lab intended to strengthen skills in programming. Prerequisite: CS 241.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</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 Undergrad - Urbana-Champaign.

<table>
<thead>
<tr>
<th>CRN</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).

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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<th>Location</th>
<th>Instructor</th>
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Restricted to Undergrad - Urbana-Champaign.
Honors Section 25 is for students registered in CS 225 Data Structures.
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>
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</table>

Restricted to Computer Science major(s).

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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.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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</table>
**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.

<table>
<thead>
<tr>
<th>CRN</th>
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### CS 397  Individual Study  
**credit:** 1 TO 3 hours.
May be repeated. Prerequisite: Consent of instructor.

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

### CS 398  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. May be repeated in the same or separate terms if topics vary.

<table>
<thead>
<tr>
<th>CRN</th>
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Credit Hours: 4 hours  
Introduction to Data Science

### 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>
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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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<th>Days</th>
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Credit Hours: 4 hours  
Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.
This course is only for students that are in the Computer Science MCS-DS 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>
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<th>Days</th>
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Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-UIC, NDEG:Grad Nondegree-CE-UIC, NDEG:Undergrad Nondeg-CE-UIC, or MCS: Computer Sci Online-UIC. Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.

<table>
<thead>
<tr>
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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
Instructor Approval Required
This section is an overflow section for the the main lecture. Students will watch the lectures online and take the exams with the main lecture. Instructor approval is required to registered for this section.

<table>
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<tr>
<th>CRN</th>
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Credit Hours: 4 hours
Instructor Approval Required
Restricted to Graduate - Urbana-Champaign.
This section is an overflow section for the the main lecture. Students will watch the lectures online and take the exams with the main lecture. Instructor approval is required to registered for this section.

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>
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<th>Days</th>
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<th>Instructor</th>
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<tr>
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Credit Hours: 3 hours
Instructor Approval Required
Overflow section for Students in this section will complete this course completely online except for the following which must be completed on-campus: Exams (will be completed in the classroom with the instructor/TA), Homework/exam sessions

<table>
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<th>CRN</th>
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Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS:Mechanical Engineerng -UIUC, MS: Aerospace Engr-Online/UIUC, NDEG:Grad Nondegree-CE/UIUC, NDEG:Undergrad Nondeg-CE/UIUC, or MCS: Computer Sci Online-UIUC. Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.

Credit Hours: 3 hours

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

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<td>MWF</td>
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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>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
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Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/. Students should register for 3 or 4 credit hours.

**CS 420 Parallel Progrmng: 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.
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.

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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 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.
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.

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Credit Hours: 4 hours

Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.

This course is only for students that are in the Computer Science MCS-DS Program. Additional Coursera ID verification and ProctorU fees may apply.

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Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.

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Credit Hours: 3 hours

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Credit Hours: 4 hours

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Credit Hours: 3 hours

Instructor Approval Required

Overflow section for Students in this section will complete this course completely online except for the following which must be completed on-campus: Exams (will be completed in the classroom with the instructor/TA), Homework/exam sessions

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</table>
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.

<table>
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Credit Hours: 3 hours

43356  Lecture-Discussion  N4  12:30 PM - 01:45 PM  TR  1302 - Siebel Center for Comp Sci  Evans, G

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

36107  Lecture-Discussion  S4  02:00 PM - 03:15 PM  MW  1404 - Siebel Center for Comp Sci  Rosu, G

Credit Hours: 4 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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Credit Hours: 3 hours

Restricted to Graduate - Urbana-Champaign.

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.

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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 436  **Computer Networking Laboratory**  credit: 3 OR 4 hours.

Same as ECE 435. See ECE 435.
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Credit Hours: 3 hours
Design, application, analysis, and evaluation of the communication network protocols and software systems that make up modern cloud and network infrastructures. Emphasis on identifying problems, proposing alternative solutions, and hands-on construction and experimentation with real-world implementations. Multiple programming team projects. Prerequisite: CS 241

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Credit Hours: 4 hours
Design, application, analysis, and evaluation of the communication network protocols and software systems that make up modern cloud and network infrastructures. Emphasis on identifying problems, proposing alternative solutions, and hands-on construction and experimentation with real-world implementations. Multiple programming team projects. Prerequisite: CS 241

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

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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.
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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Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see [http://engineering.illinois.edu/online/courses/](http://engineering.illinois.edu/online/courses/).

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Credit Hours: 3 hours

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

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Credit Hours: 3 hours

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

CS 445  **Computational Photography**  credit: 3 OR 4 hours.
Computer vision techniques to enhance, manipulate, and create media from photo collections, such as panoramic stitching, face morphing, texture synthesis, blending, and 3D reconstruction. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 225, MATH 225, and MATH 231.

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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
Instructor Approval Required
Overflow section for Students in this section will complete this course completely online except for the following which must be completed on-campus: Exams (will be completed in the classroom with the instructor/TA), Homework/exam sessions

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Credit Hours: 4 hours
Instructor Approval Required
Overflow section for Students in this section will complete this course completely online except for the following which must be completed on-campus: Exams (will be completed in the classroom with the instructor/TA), Homework/exam sessions

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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Credit Hours: 3 hours

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Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
CS 447  **Natural Language Processing**  credit: 3 OR 4 hours.
Part-of-speech tagging, parsing, semantic analysis and machine translation. Relevant linguistics concepts from morphology (word formation) and lexical semantics (the meaning of words) to syntax (sentence structure) and compositional semantics (the meaning of sentences). 3 undergraduate hours. 3 or 4 graduate hours. Credit is not given for both CS 447 and LING 406. Prerequisite: CS 374.

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Credit Hours: 3 hours

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

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.

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Credit Hours: 3 hours

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

CS 461  **Computer Security I**  credit: 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. 4 undergraduate hours. 4 graduate hours. Prerequisite: CS 241 or ECE 391.

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**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.

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Credit Hours: 4 hours

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User Interface Design Studio

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Credit Hours: 4 hours

Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.

CS 468  Tech and Advertising Campaigns  credit: 3 hours.
Same as ADV 492. See ADV 492.

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Restricted to Computer Science major(s). Restricted to students with Junior or Senior class standing.

CS 475  Formal Models of Computation  credit: 3 OR 4 hours.
Finite automata and regular languages; pushdown automata and context-free languages; Turing machines and recursively enumerable sets; linear-bounded automata and context-sensitive languages; computability and the halting problem; undecidable problems; recursive functions; Chomsky hierarchy; computational complexity. Same as MATH 475. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 373.

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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 374 or MATH 414.

<table>
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Credit Hours: 3 hours

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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.

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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.
3 or 4 hours.

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

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

CS 484  **Parallel Programming**  credit: 3 OR 4 hours.
Techniques for the programming of all classes of parallel computers and devices including shared memory and distributed memory multiprocessors, SIMD processors and co-processors, and special purpose devices. Key concepts in parallel programming such as reactive and transformational programming, speculation, speedup, isoefficiency, and load balancing. Synchronization primitives, libraries and languages for parallel programming such as OpenMP and MPI, performance monitoring, program tuning, analysis and programming of numerical and symbolic parallel algorithms. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 241.

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Credit Hours: 3 hours
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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<td>69569</td>
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Credit Hours: 1 hours
Adv Competitive Algorithm Prog
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.

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.

Credit Hours: 1 hours
Functional Programming Language
Instructor Approval Required
Topic: Functional Programming Languages and related mathematical constructs
Topic: Tradecraft for Coders Introduces fundamental software tools and code management skills for coders, including Unix command-line tools; version control; tools for writing and building code (including libraries, debugging, and profiling); cluster computing and basic cloud computing; LaTeX; and data and workflow management. Targeted towards juniors through first-year MS students; others please contact instructor.

CS 493  **Senior Project II, ACP**  credit: 3 hours.
Continuation of CS 492. Identical to CS 494 except for an additional writing component. See CS 494. 3 undergraduate hours. No graduate credit. Credit is not given for both CS 493 and a project course in another engineering department for the same project. Prerequisite: CS 492.
This course satisfies the General Education Criteria for a:
Advanced Composition

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<tr>
<th>CRN</th>
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<th>Time</th>
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<td>Woodley, M</td>
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</table>

Credit Hours: 3 hours
Advanced Composition course.
Restricted to Computer Science major(s).

CS 494  **Senior Project II**  credit: 3 hours.
Continuation of CS 492. 3 undergraduate hours. No graduate credit. Credit is not given for both CS 494 and a project course in another engineering department for the same project. Prerequisite: CS 492.

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

Credit Hours: 3 hours
Restricted to Computer Science major(s).

CS 497  **CS Team Project**  credit: 1 TO 3 hours.
Student teams work with CS faculty to complete a significant project requiring advanced knowledge of CS principles. Project topics vary. 1 to 3 undergraduate hours. No graduate credit. May be repeated in the same term up to 6 hours, if topics vary; may be repeated in separate terms. Prerequisite: For majors only; junior or senior standing required.

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Instructor Approval Required

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>
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<th>CRN</th>
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**Digital Forensics**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Days</th>
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</table>

**Credit Hours: 4 hours**

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/

<table>
<thead>
<tr>
<th>Course Code</th>
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**Credit Hours: 3 hours**

Applied Cryptography

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<th>Section Type</th>
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<th>Time</th>
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**Credit Hours: 4 hours**

Applied Cryptography

Restricted to Computer Science major(s). Restricted to Graduate - Urbana-Champaign.

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**Credit Hours: 4 hours**

Applied Machine Learning

Instructor Approval Required

Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.

This course is only for students that are in the Computer Science MCS-DS Program. Additional Coursera ID verification and ProctorU fees may apply. Description:Techniques of machine learning, with applications to various signal problems. Techniques covered will be: regression including linear regression, multiple regression, regression forests and nearest neighbors regression; classification with various methods including logistic regression, support vector machines, nearest neighbors, simple boosting and decision forests; clustering with various methods including basic agglomerative clustering and k-means; resampling methods, including cross-validation and the bootstrap; model selection methods, including AIC, stepwise selection and the lasso; hidden Markov models; model estimation in the presence of missing variables; and neural networks, including deep networks. The course is intended to support students who wish to apply machine learning methods, and will focus on tool-oriented and problem-oriented exposition. Application areas include computer vision, natural language, interpreting accelerometer data, and understanding audio data.
<table>
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<tr>
<th>Code</th>
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Credit Hours: 4 hours
Theory II

Credit Hours: 3 hours
Intro to Online Learning Sys
Restricted to students with Junior or Senior class standing.
In this project-based course, students will learn about online learning systems as they develop questions and tools for an existing online learning platform. Students will learn core educational theories about how to make effective online learning systems including perspectives from statistics, cognitive science, and motivational research.

Credit Hours: 4 hours
Intro to Online Learning Sys
Restricted to Graduate - Urbana-Champaign.
In this project-based course, students will learn about online learning systems as they develop questions and tools for an existing online learning platform. Students will learn core educational theories about how to make effective online learning systems including perspectives from statistics, cognitive science, and motivational research.

Credit Hours: 3 hours
The Art of Web Programming

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

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

Software systems are becoming increasingly complex and there is a growing awareness that software testing is needed to deal with this growing complexity. This course explores foundational concepts and practical techniques and tools for testing software and assuring its quality. Topics focus on testing of code, but will also cover analysis of software models and their use in testing. Topics cover software testing at the unit, module, subsystem, and system levels, automatic and manual techniques for generating and validating test data, the testing process, functional testing, security testing, performance testing, and regression testing. Students will have opportunities to improve testing skills by using advanced industrial tools.

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<th>Course Code</th>
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</table>

**Credit Hours: 3 hours**

Software Testing

Restricted to MS: Civil Engr - Online - UIUC, MCS:Computer Sci Online -UIUC, MS: Mechanical Engineering -UIUC, MS: Aerospace Engr-Online-UIC, or NDEG:Grad Nondegree-CE-UIC.

Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. For more details on this course section, please see [http://engineering.illinois.edu/online/courses/](http://engineering.illinois.edu/online/courses/).

<table>
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**Credit Hours: 3 hours**

**Wireless Network Lab**

Wireless networks are everywhere in our world, one laptops, smartphones, sensor and the new IoT devices popping up everywhere. Understanding how wireless networks work and why they break is the key to their successful deployment and integration. In the first half of this class, we focus on the basics of wireless networking, from the physical transmission of radio signals to the impact of lossy communication on higher layer routing and transport protocols. The second half of the class is dedicated to student led topics, including sensor networks, IoT, security and privacy, energy conservation and general performance improving techniques. Over the course of the semester, students design and implement a group project using a variety of wireless devices and technologies, ending with a project report and a poster presentation of their work.

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**Credit Hours: 3 hours**

**Wireless Network Lab**

Restricted to Graduate - Urbana-Champaign.

Wireless networks are everywhere in our world, one laptops, smartphones, sensor and the new IoT devices popping up everywhere. Understanding how wireless networks work and why they break is the key to their successful deployment and integration. In the first half of this class, we focus on the basics of wireless networking, from the physical transmission of radio signals to the impact of lossy communication on higher layer routing and transport protocols. The second half of the class is dedicated to student led topics, including sensor networks, IoT, security and privacy, energy conservation and general performance improving techniques. Over the course of the semester, students design and implement a group project using a variety of wireless devices and technologies, ending with a project report and a poster presentation of their work.

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**Credit Hours: 4 hours**

**Wireless Network Lab**

Restricted to Graduate - Urbana-Champaign.

Wireless networks are everywhere in our world, one laptops, smartphones, sensor and the new IoT devices popping up everywhere. Understanding how wireless networks work and why they break is the key to their successful deployment and integration. In the first half of this class, we focus on the basics of wireless networking, from the physical transmission of radio signals to the impact of lossy communication on higher layer routing and transport protocols. The second half of the class is dedicated to student led topics, including sensor networks, IoT, security and privacy, energy conservation and general performance improving techniques. Over the course of the semester, students design and implement a group project using a variety of wireless devices and technologies, ending with a project report and a poster presentation of their work.

**CS 499  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 course. Instructor Approval Required. Students must see the CS Department to receive the appropriate CRN for the instructor.

CS 510 **Advanced Information Retrieval**  credit: 4 hours.
Advanced concepts, models, and algorithms in information retrieval and major recent developments in the field, including historical milestones in information retrieval research, evaluation methodology, vector space retrieval model, probabilistic retrieval models, learning to rank algorithms, probabilistic topic models, information retrieval systems, text analytics, and topics of research frontiers in information retrieval. 4 graduate hours. No professional credit. Prerequisite: One of CS 410, CS 412, CS 446 or LING 406.

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.

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.
Theory of concurrency and concurrent programming languages. Formal models of concurrent computation such as process algebras, nets, and actors; high level concurrent programming languages and their operational semantics; methods for reasoning about correctness and complexity of concurrent programs. Prerequisite: CS 422; CS 475 or CS 476.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Section</th>
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<td>40477</td>
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<td>Agha, G</td>
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</tbody>
</table>

Restricted to Graduate - Urbana-Champaign.

**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.

<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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<tr>
<td>41597</td>
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<td>ARRANGED -</td>
<td>-</td>
<td>-</td>
<td>Hsieh, C</td>
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</table>

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 MSAE, online MSME, and online MSCE students. For more details on this course section, please see http://engineering.illinois.edu/online/courses/.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<td>Marinov, D</td>
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Restricted to Graduate - Urbana-Champaign.

**CS 536  Fault-Tolerant Dig Syst Design**  credit: 4 hours.
Same as ECE 542. See ECE 542.

<table>
<thead>
<tr>
<th>CRN</th>
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<td>Iyer, R</td>
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</table>

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

**CS 544  Optimiz in Computer Vision**  credit: 4 hours.
Applications of continuous and discrete optimization to problems in computer vision and machine learning, with particular emphasis on large-scale algorithms and effective approximations: gradient-based learning; Newton's method and variants, applied to structure from motion problems; the augmented Lagrangian method and variants; interior-point methods; SMO and other specialized algorithms for support vector machines; flows and cuts as examples of primal-dual methods; dynamics programming, hidden Markov models, and parsing: 0-1 quadratic forms, max-cut, and Markov random-fields solutions. Prerequisite: CS 450 and CS 473.
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.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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Restricted to Graduate - Urbana-Champaign.

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.

<table>
<thead>
<tr>
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<th>Type</th>
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<td>223 - Gregory Hall</td>
<td>Hummel, J</td>
</tr>
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</table>

Restricted to Graduate - Urbana-Champaign.
Meets with PSYC/PHIL 357.

CS 554  **Parallel Numerical Algorithms**  credit: 4 hours.
Numerical algorithms for parallel computers: parallel algorithms in numerical linear algebra (dense and sparse solvers for linear
systems and the algebraic eigenvalue problem), numerical handling of ordinary and partial differential equations, and numerical
optimization techniques. Same as CSE 512. Prerequisite: One of CS 450, CS 457, CS 555.

<table>
<thead>
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<th>Type</th>
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</table>

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

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.
<table>
<thead>
<tr>
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<th>Days</th>
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<td>1109 - Siebel Center for Comp Sci</td>
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Restricted to Graduate - Urbana-Champaign.

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

<table>
<thead>
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Undergraduate students may register with approval. For more information go to room 313 AH. Students from the following programs must contact the Director of Graduate Studies in Mathematics to request permission to register for the course: Restricted to Graduate - Urbana-Champaign. Not intended for MS:Economics:Policy Econ -UIUC, MS:Economics:Policy Econ -UIUC, MS: Financial Engineering, MENG:Mechanical Engineering - UIUC, MENG:Elec & Computer Eng - UIUC, or MENG:Engineering:Comp Eng - UIUC

**CS 584 Embedded System Verification** credit: 4 hours.
Same as ECE 584. See ECE 584.

<table>
<thead>
<tr>
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**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>
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Credit Hours: 1 hours
Advanced Compiler Technology
Restricted to Graduate - Urbana-Champaign.
Topic: Advanced Compiler Technology. Prerequisite: CS 426.

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Credit Hours: 1 hours
<table>
<thead>
<tr>
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<td>35974</td>
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<td>11:00 AM - 11:50 AM</td>
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<td>43828</td>
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<td>35957</td>
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<td>41614</td>
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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. Undergrad student must have permission of the instructor to register. This seminar will meet in 4405 SC.

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
Scientific Computing Seminar
Restricted to Graduate - Urbana-Champaign.

Credit Hours: 1 hours
PHD Orientation Seminar
Restricted to Computer Science major(s). Restricted to Graduate - Urbana-Champaign.
Topic: Orientation for new PhD students.

Credit Hours: 1 hours
Security Reading Seminar
Restricted to Graduate - Urbana-Champaign.
Topic: Security Reading Seminar. Prerequisite: A prior course in security or CS423 or consent of instructor.
<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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<tr>
<td>49716</td>
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<td>ARR - Siebel Center for Comp Sci</td>
<td>Marinov, D, Misailovic, S, Xie, T</td>
</tr>
</tbody>
</table>

Credit Hours: 1 hour
Software Engineering Seminar
Restricted to Graduate - Urbana-Champaign.
Topic: Software Engineering Research Seminar. This seminar is about software engineering research, not focusing on practice. Most meetings discuss recent or seminal research papers. If interested in the seminar, please sign up to the soft-eng mailing list from http://wiki.cites.illinois.edu/wiki/display/SoftEng

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Location</th>
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<td></td>
<td>Zhai, C</td>
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</tr>
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</table>

Credit Hours: 2 hours
Text Mining Seminar
Topic: Text Information Management and Analysis Text data are rich in semantic content and often contain valuable information such as human opinions and preferences. They play an important role in all big data applications. Text mining is the process of converting big unstructured text data into actionable knowledge to support user tasks and decision making. CS 591txt is a seminar on current topics in the text mining field, which is closely related to data mining, natural language processing, information retrieval, and machine learning. Students will read, discuss, and analyze the latest research in text mining techniques and applications.

**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.

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

Instructor Approval Required
Students must see the CS Department to receive the appropriate CRN for the 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>
<thead>
<tr>
<th>CRN</th>
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<th>Section</th>
<th>Time</th>
<th>Days</th>
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<td>Lecture-Discussion</td>
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<td>MW</td>
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</table>

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

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

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

<table>
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<td>02:00 PM - 03:15 PM</td>
<td>WF</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours
Fast Algorithms & Intrgl Equat
Restricted to Graduate - Urbana-Champaign.
Fast Algorithms & Integral Equations Near-linear-complexity ("fast") numerical algorithms and related numerical methods, mainly
for the numerical solution of elliptic partial differential equations, such as Laplace, Helmholtz, Stokes, Maxwell's, or elasticity.
Numerical rank, complexity/accuracy trade-offs, notions of convergence. Multi-level compression schemes. Tree codes, Fast
Multipole Methods. Potential Theory and Integral Equations. Quadrature. Fast, compression-based, linear-time direct solvers based,
randomized linear algebra. Fast function transforms: Uniform and non-uniform FFTs, Butterfly algorithms. Prerequisites: Linear
Algebra, programming experience, some exposure to Partial Differential Equations.

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Schedule</th>
<th>Instructor</th>
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</table>

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

<table>
<thead>
<tr>
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<th>Instructor</th>
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Credit Hours: 4 hours
Advanced Bayesian Modeling
Restricted to Graduate - Urbana-Champaign. Restricted to MCS:Computer Sci Online -UIUC or NDEG:Computer Science Onl-UIUC.
Restricted to online MCS-DS students. Additional ID Verification Coursera and ProctorU fees may apply. For more details on this
course section, please see http://engineering.illinois.edu/online/courses/. Non-Degree seeking students may enroll on a space-
available basis with consent. To request enrollment, please complete the "Non-Degree Enrollment Request Form" here: https://illinois.edu/fb/sec/9478165 Sections (and CRNs) for on-campus, degree-seeking students are: STAT 578 A1 (30959). Equivalency: CS 598 section DSO (CRN 69343) is equivalent to STAT 578 section DSO (CRN 48733). This is not true for all sections of CS 598
and STAT 578: it only applies to these specific sections in the fall 2017 term. Since this is not an official cross-listing, they might not automatically be recognized as equivalent for your degree audit. To determine whether extra steps need to be completed for either section to count towards your degree, contact your advisor. For up-to-date information about statistics course registration, please see our registration update pages: go.illinois.edu/StatisticsRegistration

**TOPIC: Advanced Bayesian Modeling**

Description: This class meets with CS 598 section DSO (CRN 69343). Practical methods and models for Bayesian data analysis. Topics include Bayesian fundamentals, prior selection, posterior inference tools, hierarchical models, methods of Bayesian computation, model evaluation, and ordinary and generalized regression models. Emphasis on computational implementation. Prerequisites: STAT 420 and knowledge of R.

<table>
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<td>Sundaram, H</td>
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</table>

Credit Hours: 4 hours

**Adv Social&Information Network**

Restricted to Graduate - Urbana-Champaign.

Topic: Advanced Social & Information Networks

This is a deep dive into classic and recent, exciting results in network analysis, with particular emphasis on behavioral models. We shall discuss cascades, influence maximization, strategic behavior on networks, and mechanism design.

<table>
<thead>
<tr>
<th>Course Code</th>
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<td>-</td>
<td>De, S Sundaram, H</td>
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</table>

Credit Hours: 4 hours

**Social (Media + Signals)**

Restricted to Graduate - Urbana-Champaign.

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

We do this by examining existing social signaling systems (e.g., Reddit reputation, Facebook) and by creating new online social signaling systems. Upon completion of this course, students will have an up-to-date understanding of the design of social media interfaces with incentive structures from social signaling theory.

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<tr>
<th>Course Code</th>
<th>Lecture-Discussion</th>
<th>Credits</th>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
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<td>42378</td>
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<td>KGK</td>
<td>09:30 AM - 10:45 AM</td>
<td>1105 - Siebel Center for Comp Sci</td>
<td>Karahalios, K</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours

**Algorithms for 1D Structures**

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

Potential topics include topological graph theory; homotopy, homology, and other topological invariants; specialized algorithms for shortest paths, maximum flows, and minimum cuts; efficient approximation schemes for NP-hard problems; and applications in VLSI design, computer graphics, computer vision, motion planning, geographic information systems, and other areas of computing. Specific topics will depend on the interest and expertise of the students. Students in all areas of computer science, mathematics, and related disciplines are welcome. CS 473 and/or Math 525 are recommended as prerequisites, but not required; necessary background material will be introduced as needed.

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<th>Credits</th>
<th>Time</th>
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<td>09:30 AM - 10:45 AM</td>
<td>1105 - Siebel Center for Comp Sci</td>
<td>Karahalios, K</td>
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</tbody>
</table>
### Credit Hours: 4 hours

**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 have been made in multimedia data, systems and networks over the last 10 years to enable next generation multimedia applications such as Skype, YouTube, Flickr and others. We will take the end-to-end approach and explore an integrated view of multimedia systems ranging from 2D and 3D video and audio, advanced compression techniques H.264, MPEG4 and MPEG-7, new multimedia transport protocols, Quality of Service preservation for mobile multimedia, HDTV broadcasting systems, Content Distribution and Peer-to-Peer networks to multi-modal synchronization, storage, services such as Voice-over-IP, Video Conferencing, Video-on-Demand, and subjective and objective Quality of Experience evaluation methods for next generation multimedia applications.

### Credit Hours: 4 hours

**Pseudorandomness**

**Restricted to Graduate - Urbana-Champaign.**

**Title:** Pseudorandomness  
**Description:** Pseudorandomness is the study of efficiently constructing objects that share desirable features of random objects, yet require no randomness to describe. The theory of pseudorandomness influences and draws from areas in computer science such as computational complexity, algorithms, and cryptography; as well as areas of mathematics such as combinatorics and number theory. This course will explore the core aspects of pseudorandomness by constructing foundational pseudorandom objects such as expander graphs, error-correcting codes, randomness extractors and pseudorandom generators, as well as presenting key techniques such as spectral graph theory, (derandomized) concentration bounds, and the polynomial method.  
**Prerequisites:** basic familiarity with probability, linear algebra, algorithms, and computational complexity

### Credit Hours: 4 hours

**Mach Lrng for Signal Processng**

**Restricted to Graduate - Urbana-Champaign.**

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

### Credit Hours: 4 hours

**Real Time Systems**

**Restricted to Graduate - Urbana-Champaign.**

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

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<tr>
<th>CRN</th>
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<th>Section</th>
<th>Time</th>
<th>Days</th>
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<td>Sinha, S</td>
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</table>

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

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<td>1214 - Siebel Center for Comp Sci</td>
<td>Telgarsky, M</td>
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</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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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.