Graduate Program Manual 2009

Department of Computer Science
University of Illinois at Chicago

UIC

www.cs.uic.edu

GRADUATE PROGRAM MANUAL

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF ILLINOIS AT CHICAGO

2009

For additional information call or write:

Department of Computer Science (M/C 152)
University of Illinois at Chicago
Attn: Student Affairs Office
851 South Morgan Street, Room 905 SEO
Chicago, Illinois 60607-7053

Computer Science General Information:	312-996-3422
Computer Science Student Affairs Office:	312-996-2290 / 312-413-4950
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Computer Science Web site:	www.cs.uic.edu

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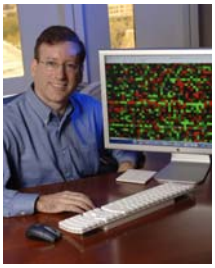
Department Head Message



Computer science changes and shapes our world. It pervades every facet of modern society. Organizations large and small, private and public, from virtually all sectors of society from agriculture, health care, education, and transportation, to entertainment, defense, finance, manufacturing and telecommunications, are all critically dependent on the field of computer science. Computer science remains both an excellent source of good jobs, and a powerful way to change the real world. Here at UIC, we have built a high-quality department with diverse educational and research opportunities for our students. Our interests and expertise span the broad field of computer science.

Admissions to our B.S., M.S. and Ph.D. programs are highly competitive. Our high-caliber students are served by an innovative curriculum, advanced computing laboratories and an energetic and knowledgeable faculty.

The combined expertise of our thirty faculty members is extraordinary. Four are professional society fellows, fifteen hold chief editorial positions or sit on boards of professional journals, an extraordinary five are recipients of UIC's top teaching excellence award and perhaps most notably eight have received prestigious National Science Foundation CAREER awards. Our faculty has grown; 11 have been hired since 2001. Additionally, our faculty is augmented by adjunct faculty appointments from other UIC departments including Bioengineering; Electrical and Computer Engineering; and Mathematics, Computer Science and Statistics.

We see the value in fostering relationships with industry and actively procuring state and federal agency grants. As a result, our department is one of the leading research units at UIC, with annual research funding exceeding $6 million.

We emphasize the discovery and application of core computer science knowledge areas such as theory, artificial intelligence, databases, computer systems, software engineering and computer-aided design, to applying computer science in advanced applications such as bioinformatics, learning environments, manufacturing, and transportation systems.

We also actively engage in interdisciplinary, multi-institutional collaboration. For example, we conduct interdisciplinary research in computer graphics, human/computer interfaces, and advanced networking to create globally-connected visualization display hardware and software that enables collaboration among remote teams of scientists, engineers, industrial designers, and artists—positioning UIC as a leading university worldwide in high-performance computing research and education.

We are proud to be a resource for the surrounding business and academic community, but most importantly, we serve the students who come to UIC seeking a quality education and access to advanced computing resources. Our academic programs are designed to prepare students for successful careers in a rapidly evolving discipline.

We invite you to explore all the Department of Computer Science has to offer.

Robert H. Sloan
Professor and Head

FACULTY

John Bell, Lecturer
PhD (1990), University of Wisconsin-Madison
Office: 1035 SEO; phone: 413-9054; e-mail: jbell@uic.edu

Virtual reality.

Tanya Berger-Wolf, Assistant Professor
PhD (2002), University of Illinois, Urbana-Champaign
Office: 1136 SEO, phone: 413-8719; e-mail: tanyabw@uic.edu

Application of discrete modelling and analysis techniques to various areas of computational biology.

Daniel J. Bernstein, Research Professor
PhD (1995), Berkeley
Office: 410 SEO, phone: 413-9322; e-mail: koobera@uic.edu

Computational number theory, computational commutative algebra, cryptography, computer security.

Ugo Buy, Associate Professor
PhD (1990), University of Massachusetts
Office: 1139 SEO, phone: 413-2296; e-mail: buy@uic.edu

Software engineering, digital government.

Isabel F. Cruz, Professor
PhD (1994), University of Toronto
Office: 1134 SEO, phone: 355-1141; e-mail: ifcruz@uic.edu

Databases, geographic information systems, semantic web, information visualization, visual languages, graph drawing, multimedia, information retrieval, security.

Bhaskar DasGupta, Associate Professor
PhD (1995), University of Minnesota, Minneapolis
Office: 933 SEO; phone: 355-1319; e-mail: bdasgup@uic.edu

Bioinformatics, computational biology, neural networks, machine learning, optical networks, combinatorial algorithms.

Thomas DeFanti, Distinguished Professor Emeritus
PhD (1973), Ohio State University
E-mail: tom@uic.edu

Virtual reality, computer networks, computer graphics.

Barbara Di Eugenio, Associate Professor
PhD (1993), University of Pennsylvania
Office: 916 SEO, phone: 996-7566; e-mail: bdieugen@uic.edu

Natural language processing, intelligent agents, collaborative and tutoring systems.

Jakob Eriksson, Assistant Professor
PhD (2006), University of California, Riverside
Office: 1135 SEO, phone: 996-0481; e-mail: jakob@uic.edu

Self-organizing wireless networks, open wifi connectivity, intelligent public transport.

Piotr Gmytrasiewicz, Associate Professor
PhD (1992), University of Michigan at Ann Arbor
Office: 935 SEO, phone: 355-1320; e-mail: piotr@uic.edu

Artificial intelligence, multi-agent systems, intelligent agents, knowledge representation, uncertainty reasoning, automated decision-making, decision and game theories, intelligent coordination and communication, cognitive modeling.

Robert Grossman, Professor
PhD (1985), Princeton University
Office: 727 SEO, phone: 413-2176; -mail: grossman@uic.edu

Data mining, internet technologies, high performance computing and networking, distributed computing.

Andrew Johnson, Associate Professor
PhD (1994), Wayne State University
Office: 2032 ERF; phone: 996-3002; e-mail: ajohnson@uic.edu

Computer graphics, collaborative environments, visualization, virtual reality, learning environments, user interfaces.

Robert Kenyon, Professor
PhD (1978), University of California, Berkeley
Office: 1133 SEO, phone: 996-0450; e-mail: kenyon@uic.edu

Human-Computer interaction, computer graphics.

Ajay Kshemkalyani, Associate Professor
PhD (1991), Ohio State University
Office: 915 SEO, phone: 355-1309; e-mail: ajay@uic.edu

Distributed computing, computer networks, sensor networks, mobile ad-hoc networks, concurrent systems.

Jason Leigh, Associate Professor
PhD (1998), University of Illinois at Chicago
Office: 2032 ERF; phone: 996-3002; e-mail: spiff@uic.edu

Amplified collaboration environments, advanced networking, realtime computer Graphics, virtual Reality, video game design and development.

John Lillis, Associate Professor
PhD (1996), University of California, San Diego
Office: 936 SEO, phone: 355-1317; e-mail: lillis@uic.edu

CAD for VLSI, combinatorial optimization.

Bing Liu, Professor
PhD (1989), University of Edinburgh
Office: 931 SEO; phone: 355-1318; e-mail: liub@uic.edu

Data mining and knowledge discovery, Web and text mining, Bioinformatics.

Leilah Lyons, Assistant Professor
PhD (2008), University of Michigan
Office: 1132 SEO; phone: 355-1310; e-mail: llyons@uic.edu

Human-Computer Interaction (HCI), Computer-Supported Collaborative Learning (CSCL), Interactive Museum Exhibit Design.

Thomas Moher, Associate Professor
PhD (1983), University of Minnesota, Minneapolis
Office: 3009 ERF; phone: 996-4562; e-mail: moher@uic.edu

Learning Environments, human-computer interaction.

Tadao Murata, Distinguished Professor Emeritus
PhD (1966), University of Illinois at Urbana-Champaign
Office: 1107 SEO, phone: 996-2307; e-mail: murata@uic.edu

Petri nets, design, modeling, and analysis of concurrent systems.

Peter Nelson, Professor and Dean
PhD (1988), Northwestern University
Office: 838 SEO, phone: 996-3259; e-mail: nelson@uic.edu

Artificial intelligence, intelligent transportation systems,manufacturing optimization, high-availability clustering, heuristic search.

Dale Reed, Lecturer
PhD (1995), Northwestern University
Office: 917 SEO; phone: 413-9478; e-mail: reed@uic.edu

Uses of technology in education, artificial intelligence.

Sol Shatz, Professor and Associate Dean for Research and Graduate Studies
PhD (1983), Northwestern University
Office: 817 SEO, phone: 355-3317; e-mail: shatz@uic.edu

Software engineering, distributed computing.

A. Prasad Sistla, Professor
PhD (1983), Harvard University
Office: 1033 SEO, phone: 996-8779; e-mail: sistla@uic.edu

Formal methods in concurrent and distributed systems, semantics and verification of concurrent programs, database management systems.

Robert Sloan, Professor and Department Head
PhD (1989), Massachusetts Institute of Technology
Office: 1112 SEO; phone: 996-2369; e-mail: sloan@uic.edu

Algorithms and complexity theory, especially applied to artificial intelligence problems, security, computer science education.

Jon Solworth, Associate Professor
PhD (1987), New York University
Office: 4224B SEL; phone: 996-0955; e-mail: solworth@uic.edu

Computer Systems Security, Networking, Operating Systems, and Distributed Systems.

Mitchell Theys, Visiting Assistant Professor
PhD (1999), Purdue University
Office: 941 SEO; phone: 413-9267; e-mail: mtheys@uic.edu

Distributed computing, heterogeneous computing, VHDL design, networking.

Patrick Troy, Lecturer
MS (1990), Pennsylvania State University
Office: 919 SEO; phone: 996-8521; e-mail: troy@uic.edu

Computer science education.

Jeffrey Tsai, Professor
PhD (1985), Northwestern University
Office: 1115 SEO, phone: 996-9324; e-mail: tsai@uic.edu

Software engineering, intelligent systems, bioinformatics, multimedia systems, agent-based systems.

V.N. Venkatakrishna, Assistant Professor
PhD (2004), Stony Brook University
Office: 1131 SEO, phone: 996-4860; e-mail: venkat@uic.edu

Computer security, network security.

Ouri Wolfson, Richard and Loan Hill Professor
PhD (1984), New York University
Office: 1137 SEO, phone: 996-6770; e-mail: wolfson@uic.edu

Database systems, distributed systems, transaction processing, mobile computing.

Clement Yu, Professor
PhD (1973), Cornell University
Office: 1100 SEO, phone: 996-2318; e-mail: cyu@uic.edu

Database management, information retrieval and knowledge base management, multimedia retrieval.

Philip S. Yu, Professor and Wexler Chair in Information Technology
PhD (1978), Stanford University
Office: 1138 SEO, phone: 996-0498; e-mail: psyu@uic.edu

Data mining, database and web.

Lenore Zuck, Associate Professor
PhD (1987), Weizmann Institute of Science, Rehovot, Israel
Office: 1140 SEO, phone: 355-1339; e-mail: zuck@uic.edu

Theorem proving, formal methods, translation validation, formal analysis of security protocols.

Adjunct Faculty

Prashant Banerjee, Professor, Mechanical and Industrial Engineering
PhD (1990), Purdue University
Office: 3029 ERF; phone: 996-5599; e-mail: banerjee@uic.edu
Research: Industrial applications of virtual reality

Prith Banerjee, Adjunct Distinguished Professor
PhD (1984), University of Illinois at Urbana-Champaign
Research: VLSI Computer aided design, parallel computing, and compilers

Jezekiel Ben-Arie, Professor, Electrical and Computer Engineering
PhD (1986), Israel Institute of Technology
Office: 1101 SEO; phone: 996-2648; e-mail: benarie@uic.edu
Research: Computer vision, image processing and neural networks

Sabri Cetinkunt, Professor, Mechanical and Industrial Engineering
PhD (1987), Georgia Institute of Technology
Office: 3003 ERF; phone: 996-9611; e-mail: scetin@uic.edu
Research: Mechatronics, control systems, automation and robotics, instrumentation.

Yang Dai, Associate Professor, Bioengineering
PhD (1991), University of Tsukuba, Tsukuba, Japan
Office: 233 SEO; phone: 413-1487; e-mail: yangdai@uic.edu
Research: Efficient algorithms for combinatorial optimization, global optimization and machine learning.

Houshang Darabi, Associate Professor, Mechanical and Industrial Engineering
PhD (2000), Rutgers University
Office: 2055 ERF; phone: 996-6593; e-mail: hdarabi@uic.edu
Research: Supervisory control of discrete event systems, automated manufacturing information systems, workflow management systems, computer integrated manufacturing.

Wenxuan (Amy) Ding, Assistant Professor, Information and Decision Sciences
PhD, Carnegie Mellon University
Office: 2408 UH; phone: 996-2679; e-mail: wxding@uic.edu
Research: Artificial intelligence, information systems, and cognitive science

Urmila Diwekar, Professor, Bioengineering
PhD, Indian Institute of Technology, Bombay, India
Office: 213 SEO; phone: 413-1649; e-mail: urmila@uic.edu
Research: Stochastic modeling, optimization under uncertainty.

Shantanu Dutt, Associate Professor, Electrical and Computer Engineering
PhD (1990), University of Michigan, Ann Arbor
Office: 930 SEO; phone: 355-1314; e-mail: dutt@uic.edu
Research: VLSI CAD, reconfigurable computing, fault-tolerant systems and chips and parallel computing.

Stephen Eick, Adjunct Professor, Computer Science
PhD (1990), University of Minnesota at Minneapolis, 1985
Phone: 996.5420; e-mail: eick@uic.edu
Research: Information and Geospatial Visualization, Location-based Services, Data Mining

Daniel Graupe, Professor, Electrical and Computer Engineering
PhD (1963), University of Liverpool, England
Office: 1117 SEO; phone: 996-3085; e-mail: graupe@uic.edu
Research: Neural networks

Mark Grechanik, Adjunct Assistant Professor, Computer Science
PhD (2006), University of Texas, Austin
Office: 1120 SEO; e-mail: drmark@uic.edu

Ashfaq Khokhar, Professor, Electrical and Computer Engineering
PhD (1993), University of Southern California
Office: 1013 SEO; phone: 413-9460; e-mail: ashfaq@uic.edu
Research: Distributed multimedia databases and networks, data mining and OLAP, parallel computation, architectures, and software systems

Der-Tsai Lee, Distinguished Research Fellow
PhD (1978), University of Illinois, Urbana-Champaign
Research: Computational geometry, design and analysis of algorithms, VLSI/CAD systems, parallel and distributed computing

Gyungho Lee, Professor, Electrical and Computer Engineering
PhD (1986), University of Illinois at Urbana-Champaign
Office: 1032 SEO; phone: 413-9657; e-mail: gylee@ece.uic.edu
Research: Computer architecture, microprocessor and networking hardware design, compiler optimization, and computer system security

Jie Liang, Professor, Bioengineering
PhD (1994), University of Illinois
Office: 234 SEO; phone: 355-1789; e-mail: jliang@uic.edu
Research: Structural bioinformatics, cheminformatics and drug discovery, data mining, computational biology

Andreas Linninger, Associate Professor, Chemical Engineering and Bioengineering
PhD (1992), Vienna University of Technology
Office: 211 CEB; phone: 996-2581; e-mail: linninge@uic.edu
Research: Process synthesis wit ecological considerations under uncertainty, computer-assisted model generation and simulation of chemical and biological systems, hybrid simulation and analysis of large scale differential-algebraic systems

Derong Liu, Professor, Electrical and Computer Engineering
PhD (1994), University of Notre Dame
Office: 1023 SEO; phone: 355-4475; e-mail: derong@uic.edu
Research: Wireless communications, wireless networks, adaptive and learning systems, control systems

Dhruv Mubayi, Professor, Math, Statistics, and Computer Science
PhD (1998), University of Illinois at Urbana-Champaign
Office: 610 SEO; phone: 996-8036; e-mail: mubayi@uic.edu
Research: Combinatorics, extremal problems of graphs and hypergraphs with applications to the theoretical computer science

Stellan Ohlsson, Professor, Psychology
PhD (1980), University of Stockholm
Office: 1050C BSB; phone: 996-6643; e-mail: stellan@uic.edu
Research: Insight & discovery, deep learning, skills & errors, cognition, technology & real life

M. Aris Ouksel, Associate Professor, Information and Decision Sciences
PhD (1985), Northwestern University
Office: 2411 UH; phone: 996-0771; e-mail: aris@uic.edu.
Research: Information technology strategic planning, business process reengineering, organizational learning, and Information Technology Diffusion in Minority and Female-owned businesses

Vera Pless, Professor Emeritus
PhD (1957), Northwestern University
Office: 507 SEO; phone: 413.2177; e-mail: vpless@uic.edu
Research: Coding theory, combinatorics

Charles K. Rhodes, Albert E. Michelson Professor, Physics
PhD (1969), Massachusetts Institute of Technology
Office: 2136 SES; phone: 996-4868; e-mail: rhodes@uic.edu
Research: Experimental and theoretical components in computational physics

Dan Schonfeld, Professor, Electrical and Computer Engineering
PhD (1990), The Johns Hopkins University
Office: 1104 SEO; phone: 996-5847; e-mail: dans@uic.edu
Research: Multimedia and communication networks; multimedia compression, storage, and retrieval; signal, image, and video processing; image analysis and computer vision; pattern recognition and medical imaging

Boaz Super, Adjunct Associate Professor
PhD (1992) University of Texas, Austin
E-mail: super@uic.edu
Research: Computer vision, biological vision, computer graphics, multimedia retrieval

Michael Tanner, Professor, Provost and Vice Chancellor for Academic Affairs
PhD (1971), Stanford University
Office: 2832 UH; phone; 413-3450; e-mail: rmtanner@uic.edu
Research: Coding and information theory, computer simulation models, educational uses of information technology, and intellectual property

Gyorgy Turan, Professor, Math, Statistics and Computer Science
PhD (1981), Joszef A. University (Hungary)
Office: 425 SEO; phone: 413-2151; e-mail: gyt@uic.edu
Research: Complexity theory, computational learning theory; combinatorics; logic

Jennifer Wiley, Associate Professor, Psychology
PhD (1996), University of Pittsburgh
Office: 1054D BSB; phone: 355-2501; e-mail: jwiley@uic.edu
Research: Contexts that promote successful comprehension and problem solving

Lelan Wilkinson, Adjunct Professor, Computer Science
PhD (1975), Yale University
Phone: 312-651-3270; e-mail: lelandw@uic.com
Research: Statistical graphics, statistical computing

Oliver Yu, Research Assistant Professor, Electrical and Computer Engineering
PhD (1997), University of British Columbia
Office: 1108 SEO; phone: 996-2308; e-mail: oyu@uic.edu
Research: Telecommunications and mobile communications networking

Milos Zefran, Associate Professor, Electrical and Computer Engineering
PhD (1996), University of Pennsylvania
Office: 1028 SEO; phone: 996-6495; e-mail: mzefran@uic.edu
Research: Robotics, haptic interfaces, control

Instructional Computing Facilities

The Computer Science Department maintains an instructional computing facility and remote servers, which serve its students' computing needs for CS coursework.

The facility consists of the following machines:

* 72 Red Hat 5.2 Enterprise Linux workstations
* 2 HP printers (ICL1 and ICL2)
* 3 LCD monitors for student collaboration

Remote Servers:

* bert.cs.uic.edu
* ernie.cs.uic.edu

Each new student is assigned a CS account which expires one year after graduation. The login names are posted in the lab and passwords are initially set to the student's UIN. **We highly encourage users to change their passwords after their initial login. Please visit http://www.cs.uic.edu/~consult for instructions on how to change your password.**

*** Grad students are given a space quota of 80MB and print quota of 600 pages/semester.**
*** Undergrad students are given a space quota of 70MB and print quota of 500 pages/semester.**

Accounts can be accessed by logging on to the lab workstations or remote servers, allowing students the flexibility to complete their course work from the lab, home or work.

The instructional laboratory is located on the 2nd floor of SEL (rooms 2250 and 2254).

The labs are open Monday - Friday 9am - 9pm during the Fall and Spring semesters and the Summer session.

In case of problems or error, please contact the lab consultant on duty or email consult@cs.uic.edu.

For more detailed information about our labs and services, please visit http://www.cs.uic.edu/~consult

Department Computer Policy

All users have the responsibility to use any CS computing services in an efficient, ethical and legal manner. Users of the CS computer facilities are expected to abide by the system, protect the work of students, staff, and faculty and preserve the right to access networks to which the University is connected.

You will be assigned a CS computer account to access CS facilities. An individual password will access your account and it is against departmental policy to allow any other person to use your account. In addition, it is your responsibility to protect your account from unauthorized use by changing passwords periodically and using passwords that are not easy to "crack". The University and authorized department representatives reserves the right to access your account and the system at any time at its sole discretion.

The department requires you to identify yourself clearly and accurately in all electronic communications. Concealing or misrepresenting your name or affiliation to mask irresponsible or offensive behavior is a serious abuse. Using identifiers of other individuals as your own constitutes fraud.

You are expected to take proper care of the equipment in CS facilities. Food, drink and smoking are not allowed in CS labs. Report any malfunction to the consultant on duty or send e-mail to consult@cs.uic.edu**.** Do not attempt to move, repair, reconfigure, modify or attach external devices to the systems. Please note that CS computer laboratories can post additional operational rules and restrictions that are considered part of the CS computer policy. You are responsible for reading and abiding by these additional restrictions.

Accept responsibility for your own work by learning appropriate uses of software to maintain the integrity of what you create. Keep archives and backup copies of important work. Learn and properly use the features for securing or sharing access to your files on any computer you use.

While great effort is made to keep the contents of what you create, store and set to be seen only by those to whom you intend or give permission, the University cannot and does not guarantee the security of electronic files in its computer systems. These systems can sometimes be breached. Additionally, as specified above, the University reserves the right to access its computer systems, including your account, if it deems appropriate.

You are expected to refrain from engaging in deliberate wasteful practices such as sending chain letters through electronic mail, printing unnecessary computations or unnecessarily holding public terminals for long periods of time when others are waiting to use these resources.

Computer use for course-related assignments takes priority over exploratory use. In addition, the department may restrict access to certain programs for security or administrative purposes. Users are responsible for complying with program restrictions, which may be amended at any time.

Unauthorized transfer of copyrighted materials to or from the CS computer system without express consent of the owner is a violation of federal law. In addition, use of the Internet for commercial gain or profit is not allowed from an educational site.

Use of electronic mail and other network communications facilities to harass, offend or annoy other users of the network is forbidden. All users need to be aware that obscene, defamatory or any other material that violates University policy on non-discrimination will not be tolerated on the CS computer system. The department will take whatever action is needed to prevent, correct or discipline behavior that violates this policy.

Any attempt to circumvent system security, guess other passwords or in any way gain unauthorized access to local or network resources is forbidden. Distributing passwords or otherwise attempting to evade, disable or "crack" passwords or other security provisions threatens the work of many others and is therefore grounds for immediate suspension of your privileges and possible expulsion from the department. You may not develop programs or use any mechanisms to alter or avoid accounting for the use of computing services or to employ means by which the facilities and systems are used anonymously or by means of an alias.

Violations of policy will be treated as academic, civil or criminal misconduct. In disciplining computer services and facilities violations, the department reserves the right to pursue all academic disciplinary measures available. Disciplinary measures may include warnings, suspension of computer privileges (temporary or permanent) or expulsion from the University. The department also reserves the right to immediately suspend user privileges for potential violations of these guidelines. Such action will be taken to protect the security and integrity of the CS computer system and will take precedence over its impact on an individual's work.

The department will investigate apparent or alleged violations of these guidelines. When appropriate and at the discretion of the department, cases of apparent abuse will be reported to the Vice Chancellor of Student Affairs (student cases) or the Vice Chancellor for Human Resources (faculty and staff cases). These offices are responsible for determining any further disciplinary actions. The University may also pursue civil and/or criminal charges if it deems appropriate.

Issues concerning these guidelines or allegations of harassment or other irresponsible use of computing resources should be brought to the attention of the CS computer lab consultants or the CS computer support staff.

Master of Science Admission Requirements

Admission decisions are based on the overall academic record, grade point averages, Graduate Record Exam (GRE) scores (for financial aid applicants and all foreign students), letters of recommendation and other information provided in the application. While no strict rules exist for the decision to admit a student, there are guidelines for what constitutes acceptable GRE scores and grade point averages. Applicants should have a four-year undergraduate degree in Computer Science or Computer Engineering or in a related area with substantial coursework in Computer Science. Applicants should have a cumulative grade point average of at least 3.5 on a 4.0 scale, and a total score of 1200 or above on the GRE General Exam (500+ on verbal, 700+ on quantitative, and 4.5+/6.0 on analytical). These numbers are generally considered minimum requirements, but do not guarantee admission if met or denial of admission if not met. If they are not met, however, it is unlikely that admission will be granted without special considerations.

All international applicants are required to take the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System) exam. For the TOEFL a minimum score of 230 CBT (570 PBT) is required for admission, although average scores of admitted students have been over 250 CBT (600 PBT). TOEFL iBT scores are valid for admission consideration. The required minima for the four subsections on the iBT TOEFL, as well as the total score are: Reading 19, Speaking 20, Listening 17, Writing 21, and Total 80. *For the IELTS exam, a minimum of 6.0 on every subscore and a minimum total score of 6.5 is required.*

Students may request a TOEFL waiver provided they have completed a minimum of two years of full-time, transferable study at the secondary or collegiate level in a country where English is the primary language as well as the language of instruction, or worked full-time in the United States for one year. Requests for a TOEFL waiver must be made in writing and mailed directly to the Office of Admissions and Records along with the application materials. Employment related waiver requests must be accompanied by a letter from a supervisor certifying that the applicant has English proficiency and verifying the length of employment.

GRE Requirement

All graduates from a foreign institution are required to submit General GRE scores for admission consideration. Applicants planning to seek a University Fellowship or other financial support (department fellowship/TA/RA/TFW) must submit general GRE scores. All GRE scores must be sent via ETS to institution code 1851. Graduates of non-English-speaking countries requesting TA consideration may submit a TSE (Test of Spoken English) score, although it is not required. The minimum TSE score accepted is 50.

Applicants who are U.S. graduates are encouraged to take the GRE exam if they feel their scores will enhance their admission or financial aid prospects. Any official GRE score submitted by a student will be used in reviewing their application for admission.

Limited Standing

At the discretion of the admissions committee, highly promising applicants who do not meet all of the above requirements may be admitted on a limited standing status. Graduates of other scientifically oriented curricula must show substantial evidence of their ability to successfully complete the CS graduate program. Depending on individual qualifications and academic history, such applicants will be required to complete one or a series of deficiency courses. Applicants whose undergraduate preparation is inadequate may develop a background equivalent to an undergraduate degree in Computer Science in order to improve admission chances.

For comparison purposes, incoming graduate students are expected to have completed the equivalent of the following UIC Computer Science courses (see descriptions under Courses):

- CS 101 Introduction to Computing
- CS 102 Introduction to Programming
- CS 201 Data Structures and Discrete Mathematics I
- CS 202 Data Structures and Discrete Mathematics II
- CS 266 Computer Architecture I: Logic and Computer Structures

- CS 301 Languages & Automata
- CS 340 Software Design
- CS 366 Computer Architecture II: Hardware-Software Interface
- CS 385 Operating System Concepts & Design
- CS 401 Computer Algorithms I

Students with strong academic backgrounds who have not completed the equivalent of this set of courses may be admitted on **Limited Standing** status. Ordinarily, this option is restricted to students who are missing at most two or three courses from the list above. Students who are admitted on Limited Standing will be required to complete a set of specific **deficiency courses** in order to be elevated to **Full Standing** graduate status. Students must complete their deficiency courses within their first year in the CS graduate program, and must receive grades of A or B in these courses in order to continue in the graduate program. Substitutions for deficiency courses will not be permitted.

Once the limited standing requirements have been met, it is the student's responsibility to request a status change from limited to full. Requests are to be made in the Student Affairs Office as soon as the limited standing conditions have been satisfied and prior to the semester the student intends to graduate.

Applicants who need to take a considerable number of undergraduate CS deficiency courses should consider applying to our undergraduate program in the College of Engineering as a second-degree student; or as non-degree student. Admission to non-degree program does not obligate the CS department or the Graduate College to later admit a student to a degree program.

Supplemental Materials/Letters of Recommendation

Applicants who wish to submit supplemental materials (i.e., request for financial support, letters of recommendation, statement of purpose and resume) must send them directly to the CS department:

University of Illinois at Chicago
Department of Computer Science (M/C 152)
Attn: Student Affairs Office
851 South Morgan Street, Room 905 SEO
Chicago, IL 60607-7053

Three letters of recommendation are required for students who wish to be considered for department and university awarded financial support. Both original and the pre-formatted forms that are available to download on-line are acceptable. *Electronic letters of recommendation are not accepted*. All letters of recommendation must be signed and sealed by the recommender and may arrive separate from other supplemental materials. Supplemental materials should contain the applicants first and last name as it appears on the application along with their date of birth or UIN.

Application Deadlines

All application deadlines are listed on the university website http://www.uic.edu/. Click on “Admissions” and “Application Deadlines” for a complete updated listing of all upcoming application deadlines.

The Office of Admissions and Records must receive an application and fee by the deadlines indicated. Applications received after the deadlines will be cancelled. Application fees are non-refundable. Deadlines are not negotiable. Students are encouraged to submit all applications materials well ahead of the published deadlines to ensure they are processed in time for admission to the specified term. The CS department is not able to request deadline extensions for any student. All students are required to follow the specified deadlines by the university and graduate college.

Applicants on any kind of visa are considered international irrespective of where they currently reside and must follow the international application deadlines. Permanent residents with foreign credentials are encouraged to comply with the international application/credentials deadline.

The Computer Science department does not admit any degree-seeking students to the Summer term.

Master of Science Degree Requirements

- Complete 36 credit hours of graduate course and research work. Curriculum must include a total of 28/32 hours of graduate (400 level and 500 level) coursework, as well as an MS Project or MS Thesis.

- Students' coursework must include at least three 500-level Computer Science courses, including at most one 594 Special Topics course and excluding independent study, project or thesis research hours (CS 597, 598 or 599). Note that only one 594 offering can be counted toward the MS degree.

- Students electing the MS Project option must register for four (4) hours of CS 597 (Project Research); students electing the MS Thesis option must register for eight (8) hours of CS 598 (M.S. Thesis Research). The remainder of the 36 hours must be satisfied with course work requirement.

- Students are allowed to take courses outside of the department of Computer Science in order to enhance their ability to work with specialists in other domains, a maximum of 8 hours of graduate course work is allowed. The Director of Graduate Studies (DGS) must approve courses outside the department of CS.

- Course selection is undertaken under the supervision of a faculty advisor. Students are assigned temporary faculty advisors at the time of their admission to the program, and should change advisors as they move forward in their programs and identify faculty members whose expertise is in the student's area of interest.

- In addition to the above requirements, students accepted with limited standing status must also complete any deficiency courses identified by the department at the time of their admission.

- Please refer to the section on General Graduation Guidelines.

Additional Requirements

Academic performance. All graduate students are required to maintain a 3.0 (B) grade point average (excluding CS 597 and 598). All individual graduate courses must be satisfied by a C grade or higher. If a student's GPI falls below 3.0 (B), the Graduate College will issue a letter of warning and impose academic probation for a specified period of time. Failure to comply with the terms will likely result in expulsion from the Graduate College. A student on probation or limited standing is ineligible for department awarded financial aid, recommendation letters for F-1 practical training, or graduation.

Time Limitation. All degree requirements must be completed within five years of initial registration in the degree program. Different time allowances apply to students on time-limited visas. Students who fail to graduate within five years will be dismissed from the Graduate College for failure to progress.

Registration. MS students who have completed all course credit requirements, except the thesis or project requirement, are not required to register during regular semesters. Registration is required if a student plans to use any university facilities. Students on a time-limited visa must petition to register for zero hours every semester (excluding summer) until they graduate. Complete details are available in the Office of International Services. Consult the UIC graduate catalog for additional registration regulations.

Residency. At least 24 hours of graduate work required for the MS degree must be earned as a degree candidate at the University of Illinois at Chicago.

Transfer of Credit Hours. After admission to the MS program, students may petition to transfer a maximum of nine semester hours earned outside the university. A transcript showing the courses and grades, and course syllabi must accompany the petition. Upon request, the student must also provide an official letter from the university stating the courses were not used to satisfy any prior degree requirements. Students moving from non-degree to degree status may petition up to 12 semester hours of credit earned at UIC. Only graduate level courses in which a grade of A or B was earned will be eligible for transfer.

Master of Science Thesis Information

The MS Thesis Option is designed for graduate students with an interest in Computer Science research, and is strongly advised for students who are considering going on to pursue the Doctor of Philosophy (PhD) program in Computer Science. Students electing this option conduct original research under the close supervision of a faculty member, culminating in the writing of a Master of Science thesis. At the completion of the thesis, the student presents a thesis defense to a Thesis Committee consisting of at least three faculty members, who are responsible for reviewing and evaluating the research work.

Thesis students are strongly encouraged to publish their original research in professional journals and to present their work at professional conferences.

MS Thesis Guidelines

- Select a thesis advisor and discuss thesis research areas and expectations. All CS assistant, associate, full professors and adjunct faculty are eligible to serve as a primary thesis advisor. The majority of the thesis committee should hold at least a 50% appointment in the CS department, and at least one member of the committee must be a tenured faculty member.

- Under your advisor's direction, register for 8 hours of CS 598 and conduct the thesis research. Students who are required to maintain a minimum number of hours of registration may register for more hours of CS 598, but no more than 8 will be credited toward the degree.

- Select a thesis committee with your advisor and obtain each committee member's agreement to serve on the committee. Provide committee members with a copy of the thesis and arrange a mutually acceptable date for the thesis defense. Submit the Committee Recommendation Form to the Student Affairs Office at least three weeks prior to the scheduled examination date. The form is available on-line at http://grad.uic.edu/pdfs/CommRecForm.pdf.

- The Graduate College will generate an examination report and two thesis certificates of approval (red-bordered forms). The Student Affairs office will inform you upon the receipt of the forms; the forms can then be picked up from Room 905 SEO prior to the defense date. After the defense, see the staff in Room 905 SEO to verify all the graduation requirements have been met.

- See General Graduation Guidelines section for details.

Format Guidelines

Thesis and dissertation format guidelines are described in detail in a Thesis Manual published and available on the Graduate College website (http://grad.uic.edu) under "Graduate Forms & Publications". The defended and approved thesis must be submitted to the department for a format check one week prior to the deadline set by the Graduate College.

Master of Science Project Information

The MS Project Option is designed for graduate students who are interested in demonstrating their training in the form of a substantive, capstone project. The student undertakes the project under faculty supervision, culminating in the development of both the project and a written description of the project in the form of a MS Project report. Both the project work itself and the project report must demonstrate a high level of professional skill. MS projects and project reports are reviewed by a committee of two faculty members (the student's advisor serves as the primary committee member), but do not require a formal presentation or defense of their work.

MS Project Guidelines

- Select a project advisor and discuss project proposals and expectations. All CS lecturers, assistant, associate, full professors and adjunct faculty are eligible to serve as a primary advisor. In general, the secondary committee member should be a regular full-time faculty member at UIC, approved by the primary advisor. One of the committee members should hold at least a 50% appointment in the CS department.

- In the semester the student intends to conduct the project research, the student must register for 4 hours of CS 597 under the advisor's call number listed in the timetable. Students who are required to maintain a minimum number of hours of registration may register for more hours of CS 597, but no more than 4 will be credited towards the degree.

- Submit a final project report and the “Certificate of Approval” form to your advisor at least one week prior to the published deadline. Provide your secondary advisor with a duplicate copy. Both committee members must sign the Certificate of Approval form. The signed form and the final project report should then be submitted to the Student Affairs Office (905 SEO). There are no official format guidelines for project reports.

- Ensure that all incomplete or deferred grades are changed. The instructor who originally assigned the IN or DF must complete a Supplemental Grade Report. Certain cases require a petition.

- See General Graduation Guidelines section for details.

Doctor of Philosophy Admission Requirements

Admission decisions are based on the overall academic record, grade point averages, Graduate Record Exam (GRE) scores (for financial aid applicants and all foreign students), letters of recommendation and other information provided in the application. While no strict rules exist for the decision to admit a student, there are guidelines for what constitutes acceptable GRE scores and grade point averages. Applicants should have a Master of Science degree in Computer Science or Computer Engineering or a graduate degree in a related area with substantial coursework in Computer Science, and a superior academic or professional record with demonstrated ability to pursue individual research investigation. Applicants should have a cumulative grade point average of at least 3.5 on a 4.0 scale, and a total score of 1200 or above on the GRE General Exam (500+ on verbal, 700+ on quantitative, and 4.5+/6.0 on analytical). These numbers are generally considered minimum requirements, but do not guarantee admission if met or denial of admission if not met. If they are not met, however, it is unlikely that admission will be granted without special considerations.

All international applicants are required to take the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System) exam. For the TOEFL a minimum score of 230 CBT (570 PBT) is required for admission, although average scores of admitted students have been over 250 CBT (600 PBT). TOEFL iBT scores are valid for admission consideration. The required minima for the four subsections on the iBT TOEFL, as well as the total score are: Reading 19, Speaking 20, Listening 17, Writing 21, and Total 80. *For the IELTS exam, a minimum of 6.0 on every subscore and a minimum total score of 6.5 is required.*

Students may request a TOEFL waiver provided they have completed a minimum of two years of full-time, transferable study at the secondary or collegiate level in a country where English is the primary language as well as the language of instruction, or worked full-time in the United States for one year. Requests for a TOEFL waiver must be made in writing and mailed directly to the Office of Admissions and Records along with the application materials. Employment related waiver requests must be accompanied by a letter from a supervisor certifying that the applicant has English proficiency and verifying the length of employment.

Direct PhD Admission

Exceptional applicants who have completed a Bachelor of Science degree in Computer Science, or a related field, and wish to pursue a PhD will be considered for "Direct PhD Admission". Such students will pursue the PhD degree without the requirement of first completing a Masters degree. All students seeking this option must submit three letters of recommendation, a resume and statement of purpose. Direct PhD Admission is competitive. For fullest consideration, any student seeking this admission should adhere to the early deadlines listed on the Graduate College website. See the section on Doctor of Philosophy Degree Requirements for details on the course and research graduation requirements.

GRE Requirement

All graduates from a foreign institution are required to submit General GRE scores for admission consideration. Applicants planning to seek a University Fellowship or other financial support (department fellowship/TA/RA/TFW) must submit general GRE scores. All GRE scores must be sent via ETS to institution code 1851. Graduates of non-English-speaking countries requesting TA consideration may submit a TSE (Test of Spoken English) score, although it is not required. The minimum TSE score accepted is 50.

Applicants who are U.S. graduates are encouraged to take the GRE exam if they feel their scores will enhance their admission or financial aid prospects. Any official GRE score submitted by a student will be used in reviewing their application for admission.

Supplemental Materials/Letters of Recommendation
Refer to the MS Admission Requirements section for information.

Application Deadlines
Refer to the MS Admission Requirements section for information.

Doctor of Philosophy Degree Requirements

Complete 108 semester hours beyond the baccalaureate degree.

Coursework requirements

Student admitted with prior master's degree in CS or a related field: Must complete a minimum of 28 hours of credit in graduate course work, 16 hours of which must be CS course work at the 500 level excluding (CS 597, 598, 599). Any course that is nearly equivalent to one taken in the master's program earlier will not earn PhD credit. Credit earned in any 596 (Individual Study) may not be applied toward the PhD degree. Note that at most two 594 offerings can be counted towards the course work requirements, but only one offering of CS 594 can count toward the requirement for 500-level course work. Graduate College provides 32 hours of credit for the prior MS degree.

Student admitted directly after bachelor's degree in CS or a related field: Must complete a minimum of 48 hours of graduate course work with at least 28 hours of which must be CS course work at the 500 level (excluding CS 597, 598, 599). Credit earned in any 596 (Individual Study) may not be applied toward the PhD degree. Note that at most two 594 offerings can be counted towards the course work requirements, but only one offering of CS 594 can count toward the requirement for 500-level course work.

Dissertation hour's requirements
Candidates must earn CS 599 credit of at least 48 hours beyond master's degree and at least 60 hours beyond bachelor's degree

PhD Qualifying Examination
Pass the "Qualifying Exam" within the first three semesters of enrollment. The first attempt must be made by the second semester. If a second attempt is needed, it must be made at the next consecutive offering. Time spent on an approved leave of absence does not forestall the first attempt. Students with a GPA of less than 3.0 (B) are not permitted to appear for the examination. See the PhD Qualifying Exam Information section of the manual for detailed information on this requirement.

Preliminary Examination
Pass an oral preliminary examination on the proposed dissertation topic. This examination is administered by a Graduate College approved faculty committee and chaired by the student's advisor. Students must pass the preliminary examination one-year prior to their final defense.

Demonstrate a capacity for independent research on an original dissertation topic within the major field of study. Research is performed under the supervision of an advisor and orally defended before a faculty committee consisting of at least five members. See the Doctor of Philosophy Additional Requirements section of the manual for detailed information on this requirement.

Registration
Doctoral candidates must register for at least zero credit hours each semester (excluding summer) after passing the preliminary examination until the final defense is made and the dissertation is submitted in compliance with department and Graduate College rules.

PhD candidates are not required to register for zero hours after they successfully defend their dissertation unless registration is required to maintain a specific status (i.e., assistantship, visa, or continued use of university facilities). Until the final defense is presented, all PhD candidates must choose one of the following options:

A. Register for zero hours credit of CS 599 thesis research each semester (excluding summer) until the degree is awarded. Option A must be petitioned each semester. Range IV tuition and fees are assessed, *or*

B. Must petition for each renewal and specify Option B. Only tuition (including tuition differential) for the range IV is charged. No fees are assessed. Students may elect from one to two terms with each petition. Students who elect this option are ineligible for student health insurance, library and laboratory privileges, computer facilities, and loan deferment. The student must also certify to the department that he or she will not use any University facilities throughout the semester if option B is petitioned.

Permission to use either Option A or B will be considered by the Graduate College upon submission of a petition supported by the department or program. Students must refile a petition for Option B by the 10th day of the term (5th for summer).

All students must complete and defend the dissertation by the degree deadline, regardless of which option is chosen.

If a PhD candidate successfully defends the dissertation and submits the final dissertation to the Graduate College after the semester deadline but prior to the fifth day of instruction of the next semester, the degree is conferred in the subsequent semester. Registration for that semester is not required.

Time Limitation
Students admitted with a prior master's degree must complete the degree requirements within seven consecutive calendar years after initial registration as a doctoral student. Students admitted directly after the bachelor's degree must complete degree requirements within nine consecutive calendar years of initial registration as a doctoral student. Students who do not graduate by these deadlines will be dismissed from the Graduate College for failure to progress. Time spent on a leave of absence approved by the program and the Graduate College is not counted toward the degree time limit.

Residency
At least 54 semester hours beyond the master's level or its equivalent must be taken at the University of Illinois at Chicago.

Transfer Credit
After admission to the PhD program, students may petition to transfer a maximum of 9 semester hours earned outside the university. A transcript showing the courses and grades, and course syllabi must accompany the petition. Students must also provide an official letter from the university stating the courses were not used to satisfy any prior degree requirements.

Students moving from non-degree to degree status may petition up to 12 semester hours of credit earned at UIC. Students may also petition to transfer graduate credit that was not used to fulfill course work requirements of their Master's degree. Only graduate level courses in which a grade of A or B was earned will be eligible for transfer

Doctor of Philosophy Additional Regulations

Prior Publication of Research Findings
Students engaged in research may choose to publish certain findings that are later incorporated into the final dissertation. In such cases, appropriate acknowledgment of the earlier publication should be included in the final dissertation. The Graduate College encourages such publication, but the dissertation may not be published in its entirety before all degree requirements, including the defense of the dissertation, have been completed.

Preliminary Examination
The purpose of the Preliminary Examination is to determine the candidate's readiness to undertake dissertation research, and passing it constitutes formal Admission to Candidacy. The examination serves as the last major step toward the PhD degree except for the completion and defense of the dissertation. The examination provides the student with timely feedback of the faculty's views of his/her potential for completing the PhD Program.

The preliminary examination is generally administered during or near the end of the time the student has completed most, though not necessarily all, of the coursework, but has not made a major investment of time and effort towards the dissertation research project. A minimum of one year has to elapse before the defense of the dissertation after passing the preliminary examination. Only students in good academic standing are permitted to take the examination.

The committee for the preliminary examination is appointed by the Dean of the Graduate College upon the recommendation of the department or program. The advisor is the chair of the Committee and must be a full member of the UIC Graduate Faculty. All CS assistant, associate, full professors and adjunct faculty are eligible to serve as an advisor. The composition of the five-member committee should be as follows:

- Consists of at least five (5) members
- At least three (3) are UIC Graduate Faculty with full membership
- Two (2) must be tenured faculty
- Majority of the committee should hold at least a 50% appointment in the CS department.

Graduate programs strive for diversity in the composition of the preliminary examination committee. The appointment of one or two members from outside the degree-granting program or university is encouraged. If the outside member is not a UIC graduate faculty member, his/her curriculum vitae must accompany the Committee Recommendation Form to demonstrate equivalent academic standards.

A Committee Recommendation form, listing the committee members and their affiliations, must be submitted to the Graduate College three weeks prior to the exam date. If human subjects are involved, Institutional Review Board approval is required. If animals are involved, Animal Care Panel approval is required. Upon approval Graduate College will forward an examination report to the department, which has to be signed by each member of the committee after assigning a grade of "pass" or "fail". The timing, content, and nature (written, oral, or both) of the preliminary examination is left at the discretion of the preliminary examination committee. A candidate cannot be passed with more than one "fail" vote.

The committee may require that specified conditions be met before the passing recommendation becomes effective. On the recommendation of the committee, the Dean may permit a second examination. A third examination is not permitted. Failure to complete the degree requirements within five years (departments may specify shorter periods) of passing the preliminary examination requires a new examination.

The Graduate College requires the preliminary examination be given after at least one calendar year of residence and one year prior to the final dissertation defense.

Final Dissertation Defense
Upon completion of all degree requirements and dissertation, the candidate must orally defend the work before the committee. Only students in good academic standing are permitted to defend their dissertation. A new Committee Recommendation form must be filed, listing the dissertation title and committee members. The chairperson (advisor) is considered the primary reader of the dissertation. A second and/or third member of the committee may also be designated as "readers."

The dissertation committee is appointed by the Dean of the Graduate College on the recommendation of the student's department. The Committee Recommendation form is available on-line http://grad.uic.edu/pdfs/CommRecForm.pdf which must be filled and submitted at least three weeks prior to the exam date. The committee composition requirements of the final defense committee are the same as the preliminary committee, except the appointment of one member from outside the degree-granting program is mandatory. The committee composition of the committee is as follows:

- Consists of at least five (5) members
- At least three (3) are UIC Graduate Faculty with full membership
- Two (2) must be tenured faculty
- Majority of the committee should hold at least a 50% appointment in the CS department.
- One member must come from outside the degree-granting program or university. If the outside member is not a UIC graduate faculty member, his/her curriculum vitae must accompany the Committee Recommendation Form.

If human subjects are involved, the Institutional Review Board approval is required. If animals are involved, the Animal Care Panel approval is required. Upon approval Graduate College will forward an examination report and two certificate of approval forms to the department, which have to be signed by each member of the committee after assigning a grade of "pass" or "fail". The timing, content, and nature (written, oral, or both) of the preliminary examination is up to the discretion of the preliminary examination committee. A candidate cannot be passed with more than one "fail" vote.

No Switching to MS Program
The UIC College of Engineering Strategic Plan, adopted in January 2005 and revised from time to time, states that students in a PhD program who have received any financial support from UIC (such as TA, RA, or Tuition and Fee Waiver) cannot transfer into any MS program in the College of Engineering (which includes computer science) "unless the student explicitly petitions to transfer to the MS program and that petition is approved". Such petitions to switch to the MS program are usually denied.

Format Guidelines
Thesis and dissertation format guidelines are described in detail in a thesis manual published and available in the Graduate College. The "Thesis Manual" can be downloaded from their site at http://grad.uic.edu/ under 'Graduate Forms & Publications'. The defended and approved thesis must be submitted to the department for a format check one week prior to the deadline set by the Graduate College.

See General Graduation Guidelines section for details.

Doctor of Philosophy Qualifying Exam Information

The first major "rite of passage" in the PhD program is the PhD Qualifying Examination. **A PhD student must make their first attempt no later than their second semester, and if two attempts are needed, these attempts must be made in consecutive offerings of the exam.** For example, a student starting in Fall 2009 must make their first attempt by Spring 2010 at the latest. A student is required to pass the qualifier in two sittings at most; and must complete this examination by the end of their third semester in the PhD program.

Exams are offered in four areas: Theory & Foundations; Software Systems & Languages; Systems & Networking; and Artificial Intelligence, Graphics & Human Centered Computing. To "pass" the qualifier, a student must pass three areas (as explained later). The 'Theory & Foundations' area is mandatory; a student may choose two from the three remaining areas. In addition, a student can appear in any number of area exams in one sitting; however, (s)he must take at least one area exam by the second semester. Students are welcome to make their first attempt in their first semester, however their second attempt has to be at the next offering (their second semester).

Faculty from each area will decide on the nature of questions in each area exam. Each exam lasts for 2 hours. The syllabus for each area is posted on the department website (www.cs.uic.edu) or a hard copy is available in the CS Student Affairs Office (905 SEO). Each exam is graded as 'full pass', 'conditional pass' or 'fail'. A 'full pass' demonstrating clear competency; a 'conditional pass' demonstrates some competency that can be improved by coursework; and a 'fail' demonstrates low competency. Each area will set its own cut-offs for conditional pass and fail. A conditional pass can be given to students who didn't do well enough to demonstrate clear competency in an area, and should supplement their knowledge through coursework and demonstrate competency through grades.

A student can pass the qualifying exam by either receiving 'three full passes' or 'two full passes and one conditional pass'. If a student received a conditional pass for any area, the qualifying exam committee will examine the students' performance in various topics in that area exam and suggest a 400 level course for the student. If the suggested course has already been taken, an alternate course in 400 or 500 level will be suggested. The student must finish the suggested course by end of the 5th semester and receive an "A" to demonstrate competency. Upon completion of this requirement, a 'full pass' for the area will be granted.

General Regulations

Class registration (minimum one hour) is required to take the qualifying examination.

Students must be on full standing status in order to appear for the competency examination.

Students who pursue a PhD degree part time are required to appear for the competency exam in the semester following completion of 24 semester credit hours. This requirement is equivalent to two semesters of full-time course work.

Students may sit for the qualifying exam only twice. Second attempts must be made in the next consecutive offering of the examination irrespective of when the first attempt is made.

Appeals

Appeals related to the grading or results of the exam should be made by the student's advisor to the Director of Graduate Studies. The DGS will present the appeal to the Graduate Committee for reconsideration and possible re-evaluation.

General Graduation Guidelines

Prior to the completion of your degree requirements, you should request a graduation check from the Student Affairs Office (905 SEO). This will help ensure that you have met all of the requirements necessary to be eligible for graduation. The following are general guidelines to consider when verifying your graduation eligibility:

- Send an e-mail request for a graduation check to the Student Affairs Office, with "Graduation Check" in the subject heading, at least one month prior to the term you intend to graduate. The email should include your name, UIN, program (if MS identify project or thesis) and expected graduation term. The Student Affairs staff will review your file to verify that you have met all course requirements to graduate. You will be informed if you need to take additional courses or if you have other missing requirements. This will provide you with sufficient time to register for the necessary courses during your final semester.

- You will receive emails from the Student Affairs Office during the start of each term regarding graduation deadlines. These emails will contain important information about the necessary paperwork to graduate and deadlines for submission of forms. Please pay careful attention to these deadlines. The Graduate College maintains strict deadlines and exemptions are rarely granted.

- The first step in the graduation process is submitting the "*Intent to Graduate*". Inform your advisor of your intention to graduate. The 'Intent to Graduate' must be submitted on-line, you can submit this via 'UIC Web for Student' within the 'Records' section. The Intent to Graduate may be submitted from the start of registration for your graduation semester until the Friday of the third week of fall and spring semester or second week of the summer semester.

- If you are graduating with a Thesis/Dissertation, you must:
    1. Submit a "*Committee Recommendation Form"* three weeks prior to your defense date. The form is available on-line at http://grad.uic.edu/pdfs/CommRecForm.pdf. The form must be filled out on-line, printed, signed by your advisor and submitted to Room 905 SEO. Hand written forms are not acceptable.
    2. Consult the 'Thesis Manual' (available on the graduate college website at http://grad.uic.edu/ under 'Graduate Forms & Publications') and ensure your thesis is in the approved format.
    3. Schedule your defense date at least one week prior to the thesis submission deadline.
    4. Just prior to or immediately following your defense, e-mail a **PDF** copy of your thesis to the CS Student Affairs Office for a format check.
    5. Make sure you have the correct number of copies and that all the required forms are completed and signed before submitting the thesis to the graduate college. A detailed checklist of the required documents is available in the thesis manual.
    6. Submit a copy of the thesis/dissertation to Student Affairs Office.

- If you are graduating under the MS Project option, make sure your advisor and the second committee member have ample time to read and approve your project. The following must be submitted by the project deadline:
    1. Hard copy of the project report. There is no specific format for this report, but it should be a technically-focused and carefully written document. Check with your advisor as they may have guidelines for formatting or other requirements for the project report.
    2. "Certificate of Approval" form, completed and signed by your advisor and the secondary committee member. The form is available in 905 SEO or can be downloaded from https://grad.uic.edu/pdfs/CertificateofApprovalMAproject.pdf.

- Return all borrowed equipment and keys to Room 1120.

Please note that if you do not graduate in the semester you submitted your 'Intent to Graduate', you submit the request again during the term you intend to graduate. The previous request will NOT be carried over to the next semester automatically.

Course Selection and Regulations

Course Selection
A student's curriculum should be planned with consultation from a faculty advisor. Although students are permitted to take up to 9 hours outside the department, the advisor and the DGS must approve any such courses. New students should note that courses taken and grades obtained in their first semester of enrollment largely determine financial aid awards for the following academic year.

Unless specifically advised otherwise, new graduate students should not enroll in the following courses for their first semester: CS 597 Project Research; CS 598 MS Thesis Research; or CS 599 PhD Thesis Research. Students should take regularly scheduled courses during their first semester.

General guidelines
Some 400 level courses in MCS department overlap with CS lower level courses. Graduate credit in CS is not allowed for such courses. For example, graduate credit is not allowed for MCS 441 Theory of Computation, which is the same as CS 301 (Languages and Automata). Courses in IDS are generally not allowed to count towards graduation. If you are uncertain, please check with the Student Affairs office or your faculty advisor prior to registering for the course.

Students who receive any form of financial aid from the Department (TA, RA, or Tuition and Fee Waiver) are subject to minimum registration requirements, which must be maintained throughout the appointment period. The minimum registration requirements set by the university for assistantships are 50% (8 credit hours), 33% (10 credit hours), and 25% (12 credit hours). Students who have been awarded a TFW must be registered for at least 12 credit hours. Note: If you fall below the required hours, you become ineligible for the TFW and must immediately pay all appropriate fees. The requirement for a Summer TFW is 6 credit hours.

The department requires all students supported by a TA position to register for a minimum of 12 credit hours each semester (except Summer), until they have completed the required coursework. Upon completion of the coursework you can follow the graduate college registration requirements for the appropriate percentage appointment. These minimum hours are the requirement for a student to be considered as full-time. Students supported on fellowships or tuition and fee waivers are already required to have a minimum of 12 credit hours of registration in regular semesters and a minimum of 6 credit hours in summer. Students working on prerequisites should register for additional courses to achieve a 12-hour registration. Students working on MS project, MS thesis or PhD dissertations should register for CS 597, CS 598 or CS 599 hours, respectively.

Adding /Dropping Courses
Students may not add or drop a course after the tenth day of instruction in a semester or the fifth day of instruction in the summer session.

Course Prerequisites:
If your undergraduate degree is not from UIC, please make sure that your course background is equivalent to the recommended course prerequisites. Talk to the instructor of the course if you have any concerns about prerequisites. You are responsible for the course prerequisites and not your instructor. You will not be allowed to drop a course after the drop deadline because you have not met the prerequisites. The drop deadline is two weeks from the start of the Fall and Spring term and one week after the start of classes for the Summer term. This drop deadline is strictly enforced for all courses.

As a general policy, you will not be permitted to drop courses (particularly the 300- and 400- level courses in CS) after the second week in Fall and Spring terms and first week in Summer terms. If permission (from the Director of Graduate Studies) is granted for such a "late drop", it will be reported as a withdrawal (W) on the transcript. A "W" cannot be stricken from your permanent record and cannot be replaced by a new grade should you retake the course and obtain a letter grade.

The following are examples of unacceptable reasons for dropping a course after the deadline: "I have had this material before," "This course will not be useful to me," "I am taking too many courses," "I do not have the prerequisites," "I forgot to drop the course before the drop deadline" or "I have not attended classes for the past few

weeks." It is your responsibility to make sure that you enroll in classes that are appropriate for your academic course load, schedule and that you have met all prerequisites.

Students holding fellowships, assistantships, tuition-and-fee waivers, and student visas must maintain the required number of credit hours or risk loss of their aid for the term. Students whose waivers are revoked due to insufficient credit hours will be billed the full cost of tuition, fees and any late charges that may apply.

Students are allowed to register for a maximum of 20 hours. In order to register for more than 20 hours, the student must have approval from his/her advisor and submit that information to 905 SEO for override permission.

Grades
A - 4 grade points per credit hour
B - 3 grade points per credit hour
C - 2 grade points per credit hour
D - 1 grade points per credit hour (not accepted as degree credit)
F - 0 grade point per credit hour (failure; not accepted as degree credit)

DFR - grade temporarily deferred. Deferred grades may be used for thesis courses, continuing seminar, sequential courses, and certain courses that require extensive independent work beyond the term. At the end of the continuing course sequence the deferred grade for all terms must be converted either to a specific letter grade (A-F), to an I (Incomplete), or to an S or U. No credit is earned until the DFR grade is converted to a permanent grade.

IN - Incomplete. An incomplete grade may be given only if, for reasons beyond the student's control, required work has not been completed by the end of the term. An I must be removed by the end of the next term in which the student is registered (including summer), or within twelve months of the end of the term in which the I was received, whichever occurs sooner. Course instructors may require an earlier deadline. An I that is not removed by the deadline will remain on the student's record as an I, with no credit earned. A course in which an I was received and not removed by the deadline may be repeated for credit only once.

S - Satisfactory; **U** - Unsatisfactory. Used as grades in thesis research courses, in zero-credit courses, and in specifically approved courses. No grade points are earned and the grade is not computed in the cumulative grade point average or the graduate degree grade point average.

In the case of thesis research courses, instructors should assign an S or U grade to the course each term. They may assign a DFR grade each term until after the thesis defense is successfully completed, the thesis committee accepts the format and content of the thesis, and the Graduate College approves the format of the thesis, but this is not recommended. In the latter case, the Graduate College will notify the registrar to change the DFR grade to S. An Unsatisfactory grade can be assigned at any time when the student is not making satisfactory progress in thesis research. If this should occur, the status of the student will be reviewed by the advisor, the director of graduate studies, and the Graduate College, and the student may be dismissed from the Graduate College.

W - Withdrawn. Officially withdrawn from the course without academic penalty; no credit is earned for the course. Assigned if course is dropped after the tenth day of the semester (fifth day in summer) and before the last day of instruction for the term. This grade will remain on the transcript but does not affect the grade point average or Graduate Degree Grade Point Average.

Academic Probation
A student's curriculum should be planned in cooperation with his/her advisor. All graduate students are required to maintain a 3.0 (B) grade point average (GPA). The GPA calculation does not include independent study and research courses (596 through 599).

Graduate course work must by satisfied by a C grade or higher. If a student's GPA falls below 3.0 (B), the Graduate College will issue a letter of warning and impose academic probation for a specified period of time. Failure to comply with the terms will likely result in expulsion from the Graduate College.

A student on probation is ineligible for department awarded financial aid, recommendation letters for F-1 practical training, or graduation.

Financial Aid Information

Financial aid is available in the form of fellowships, teaching assistantships, research assistantships and tuition fee waivers.

Fellowships

Various fellowships are available through the Graduate College and outside foundations. Students and faculty are notified periodically of these fellowships and deadlines. Fellowships available through outside foundations generally require students to be permanent residents or citizens of the US. Consult the 'Funding your Education' part of the graduate college website (grad.uic.edu) for further details.

Fellowships available through the Graduate College are awarded in recognition of scholarly achievement and promise. They enable students to pursue graduate studies and research without a service requirement. The stipends of different fellowships vary. Unless explicitly stated otherwise, all fellows supported by the Graduate College (i.e., University Fellowships, Dean's Scholar, Abraham Lincoln, DFI (formerly IMGIP/ICEOP) are exempt from tuition and the service fee (**Note:** Some colleges have an additional tuition differential that may not be waived. Check with your home department for details). Fellows may engage in additional paid employment only to the extent permitted by the award and approved in writing by the Dean of the Graduate College. UIC students who hold either an internal or external fellowship may be employed for no more than fifty percent time on campus. Employment of more than fifty percent while holding a fellowship will result in loss of the tuition and service fee waiver.

Dean's Scholar Award and Chancellor's Supplemental Graduate Research Fellowship Program are the two most prestigious awards provided by the Graduate College. These are described on the Graduate College website as follows:

Dean's Scholar Award: The Dean's Scholar Award is a one-year, non-renewable award presented by the Dean of the Graduate College in recognition of a student's scholarly achievement. It is intended to provide the most distinguished, advanced-level graduate students with a period of time dedicated solely to the completion of their programs. The Dean's Scholar competition is open to doctoral students who have passed the Graduate-College-required Preliminary Examination at the University of Illinois at Chicago and are well into their dissertation work.

> **Application Procedures**: Upon announcement of the deadlines for the fellowships offered by the graduate college, students interested in applying should talk to their advisor first and with consultation must submit an "Application for Graduate Appointment", statement of purpose, resume with publications and three recommendation letters (one from advisor) to the Student Affairs Office. The Director of Graduate Studies will select from among the applicants and submit nominations for consideration by the Graduate College Awards Committee, which makes the final recommendation to the Dean.

Chancellor's Supplemental Graduate Research Fellowship Program: This program supports increased multidisciplinary scholarship opportunities and exposure to careers in research and creative fields for graduate and professional students. Successful applicants must show exceptional promise for future multidisciplinary research and creative activity in their fields of interest. Funding will allow graduate or professional candidates to supplement existing stipends with a 0% fellowship appointment for the fellowship period. Applications will be evaluated not only on the quality of the prospective student, but also the quality of the proposed project and mentored experience. A faculty mentor will direct the project but it is expected that the student will play the major role in the writing of this application. Consult the graduate college web site for details on the program and application procedure.

Teaching Assistantships for Continuing Students

Teaching Assistantships are awarded to students with outstanding academic records. Students assist in the teaching and grading of CS course work under an assigned professor.

Amount: Current monthly stipend is approximately $1,821 ($1,873 for students who passed the PhD qualifier) and a tuition and service fee waiver. The stipend is subject to change.

Eligibility: Students should be in full standing (if admitted on limited standing, all requirements should be satisfied before applying), GPI should be 3.0 or higher (on 4.0 scale) and graduates of foreign institutions should have SPEAK score above 50. These are the minimum requirements for TA eligibility; many factors determine the offers of TA positions.

Application Procedure: Decisions for the following academic year (fall and spring semesters) are made during the Summer. Students must submit a completed application to their advisor, who should return the application to the Student Affairs Office (905 SEO) by the specified date (usually mid May). TA positions are generally assigned for the academic year (fall and spring); thus very few TA positions are available for the spring semesters.

Applications for the Spring semester should be submitted to Student Affairs Office by mid December.

Registration Requirement: At least 12 hours in Fall and Spring. Students do not need to register in Summer, but must register for at least 3 hours to receive the tuition and service fee waiver.

English Proficiency: Illinois State Law requires all international teaching assistants providing instruction in classroom, discussion group, laboratory, or office hour situations to be certified proficient in speaking and communicating in English. The Department policy concerning TA appointments is as follows: **ALL** graduate students appointed as Graduate Teaching Assistants must demonstrate their English proficiency by taking the TSE or SPEAK test offered through the International Teaching Assistant Program by the university and secure a passing grade as established by the ITA Program. The required score is 50. Graduate students who received their undergraduate degree in the United States or from a country in which the primary language is English are not required to take the test. Information on the ITA program can be obtained from http://www.uic.edu/depts/oaa/spec_prog/ita/.

Tuition and Fee Waiver

A limited number of tuition and fee waivers are available to graduate students. These awards provide an exemption from tuition, service and differential fees only. Students must be registered for 12 hours of study during the semester in which they receive the waiver. A student who drops below the 12-hour requirement will be responsible for all tuition and service fees for the semester.

Eligibility: Students should be in full standing (if admitted on limited standing, all requirements should be satisfied before applying) and GPI should be 3.0 or higher (on 4.0 scale). These are the minimum requirements for TFW eligibility.

Application Procedure: Decisions for the following academic year (Fall and Spring semesters) are made during the Summer. Students must submit a completed application to their advisor, who should return the application to the Student Affairs Office (905 SEO) by the specified date.

Applications for the Spring semester should be submitted to Student Affairs Office by mid December.

Registration Requirement: At least 12 hours in Fall and Spring and 6 hours in Summer.

Research Assistantships

Students are encouraged to contact faculty members, who hold similar research interests, directly. The professor, depending on the availability of grant money, determines the term of the appointment.

Departmental Information for TA/TFW Holders

Once a student has accepted a TA position, he/she must request any changes to their TA appointment at least two weeks prior to the start of classes. Resigning the TA in the last minute or after classes start; and unavailability for TA duties on the first day of classes will reflect negatively for future TA/TFW consideration.

Tuition and Fee waiver assignments cannot be changed after the second week of classes. A Tuition and Fee Waiver award is a significant savings, particularly for non-resident students.

Retroactive appointments for TA's, RA's and TFW's are not permitted.

Illinois State Law requires all international teaching assistants providing instruction in classroom, discussion group, laboratory, or office hour situations to be certified proficient in speaking and communicating in English. The Department policy concerning TA appointments is as follows: **ALL** international graduate students appointed as Graduate Teaching Assistants must demonstrate their English proficiency by taking the TSE or SPEAK test offered through the International Teaching Assistant Program by the university and secure a passing grade as established by the ITA Program. The required score is 50. Graduate students who received their undergraduate degree in the United States or from a country in which the primary language is English are not required to take the test. Information on the ITA program can be obtained from http://www.uic.edu/depts/oaa/spec_prog/ita/.

New student TA's must take the TSE exam as soon as possible and report a passing score by the end of the first semester of their appointment. If you receive a score lower than 50, you are required to take ESL 401 (Teaching/Communicating Strategies for ITAs). As stated by Illinois law, TA's starting in Fall semester must pass the SPEAK exam before the start of the Spring semester or Spring aid will be revoked. Students applying for a TA for the Spring semester must pass the SPEAK test before the deadline to submit the financial aid request form in the department office for the Spring term. This requirement is not satisfied by the TOEFL examination.

Responsibilities as Teaching Assistant

Once the TA assignment has been finalized, the TA should contact the instructor with whom he/she will be working with in order to become familiar with the requirements of the individual instructor and understand the TA duties. Whether you are working as an assistant in a lab, a grader, or an assistant in a course, it is very important that you contact the instructor prior to the start of classes.

About the Course

- Get a copy of course syllabus.
- What text is being used for the course? What chapters will be covered and when? Does the instructor have a copy of the text or a solution manual available for your use?
- How will homework be assigned, collected and graded? Will homework be returned to students during the following class session? Are homework solutions posted and if so, where?
- How many quizzes, tests or exams will be administered throughout the semester? When and where will they take place?
- What is the grading system for the course? How are percentage points divided between the final, homework, class attendance, lab and computer assignments, and class projects?

TA Responsibilities

- What will your teaching responsibilities include for the course?
- How will grading responsibilities be shared between the TA's and the instructor? Are you required to prepare and post the homework solutions? If so, where do you post the homework grades and solutions?
- Will you be required to proctor exams? Are you required to assist the instructor in grading the exams?
- What are you expected to do on the first day of class?
- What are your office hours for the semester? Where is your office located? What is the best way for the instructor and the students to contact you?

- Will you be required to do any work during the exam week and in the assignment of grades?
- Are you required to have regularly scheduled meeting with the instructor? If so, how frequently will you meet and where?

"If there is a Problem"

- What is the best way to reach the professor? By e-mail? Office number and phone? Home phone? When is the best time?

General Information

- Never miss your assigned classes.
- Be professional, polite, considerate and fair to all students.
- Do not mislead your students.
- Keep your office hours. Post any changes to your hours immediately.
- Let the department office know if there is an emergency.
- You will be assigned keys for your office. Do NOT loan your key to anyone. You are responsible for replacing lost keys and the cost may be in excess of a thousand dollars.
- Make safety a priority on and off campus. If you need to use an office or lab while a building is closed, notify someone of your whereabouts.
- Be careful and responsible for equipment in offices and labs. Avoid theft, do not leave offices or labs open.
- Monitor students while they are taking exams or quizzes. If you feel a student may be cheating, report it to the instructor immediately.

Academic Misconduct

- If any TA, RA, TFW holder or grader is caught in an act of cheating, plagiarism, making threats against any person with the intention of affecting academic performance, examination by proxy, grade tampering, or other acts of academic dishonesty, the consequences will be serious.
- Student will be assigned a failing grade in the course.
- Student will forfeit all financial aid from the department in that semester and any future consideration for financial aid from the department.
- If the financial aid is from another unit at UIC, your UIC employer will be informed in writing of any misconduct.
- Student may be dismissed from the university.

It is mandatory for all TA's to be present during TA orientation and ready for TA duties on the first day of classes. TA's who will be away during the December break **must** make arrangements to arrive by these dates.

Academic Honesty

The faculty of the department of Computer Science expects all students to perform their academic work with the high ethical standards of the engineering profession.

Any of the following violations will result in appropriate disciplinary action. Other violations may be added if deemed appropriate:

1. *Cheating*
   Either intentionally using or attempting to use unauthorized materials, information, people, or study aids in any academic exercise, or extending to or receiving any kind of unauthorized assistance on any examination or assignment to or from another person.

2. *Fabrication*
   Knowing or unauthorized falsification, reproduction, lack of attribution, or invention of citation in any academic exercise.

3. *Facilitating academic dishonesty/plagiarism*
   Intentionally or knowingly representing the words or ideas of another as ones's own in any academic exercise.

4. *Bribes, favors, threats*
   Bribing or attempting to bribe, promising favors to or making threats against, any person, with the intention of affecting a record of a grade or evaluation or academic performance. Any conspiracy with another person who then takes or attempts to take action on behalf or at the direction of the student.

5. *Examination by proxy*
   Taking or attempting to take an exam for someone else other than the student is a violation by both the student enrolled in the course and the proxy or substitute.

6. *Grade tampering*
   Any unauthorized attempt to change, actual change of, or alteration of grades or any tampering with grades.

7. *Non-original works*
   Submission or attempt to submit any written work authored, in whole or part, by someone other than the student.

PETITIONS

The Graduate College is quite firm in its deadlines and will not accept petitions and other forms after the specified deadlines. It is the student's responsibility to ensure that petitions are complete; questions regarding them should be directed to (a) Staff in room 905 SEO, (b) the Director of Graduate Studies (DGS), or (c) the Graduate College.

Most forms require the signature of your graduate advisor and the DGS. It is your responsibility to secure these signatures in a timely manner to meet the Graduate College's deadlines. The following procedures should be followed:

1. Obtain the petition (or other form) from the Student Affairs Office (905 SEO) or the Graduate College.

2. Complete the petition and secure the necessary supporting documents. You should begin this process early; in some cases, petitions require students to consult old timetables, or require obtaining letters or transcripts from other institutions.

3. Present the petition to your advisor for his/her signature and comments.

4. After your advisor has signed the petition, submit it to the Student Affairs Office. Do not rely on your advisor to do this for you. It is your responsibility.

5. The DGS will review the petition, indicate approval or disapproval, provide written comments, sign it and return it to the Student Affairs Office. This process will take no more than five working days during regularly scheduled class and examination periods of the academic year.

6. Staff in the Student Affairs Office will submit the petition to the Graduate College, in some cases you might be asked to submit the forms to the Graduate College.

7. The Graduate College will notify you of the decision. If you have questions concerning the petition at this point, please consult the staff in the Student Affairs Office. The staff will try to answer your questions and/or consult the graduate college in trying to resolve your issues.

GRADUATE COLLEGE REGULATIONS

The policies, requirements, and procedures of the Graduate College are outlined in the UIC Graduate College Catalog. Make sure you submit your local address to the Office of Records and Registration by the 10th day of courses, since the Graduate College mails a copy of the UIC Graduate College to all new students at this address. The degree requirements and policies are subject to change, and those in force at the time of matriculation are considered to be the minimal requirements. Listed below are some relevant extracts taken from their website. For additional information please refer to the Graduate College Catalog or web page: http://grad.uic.edu/.

Registration
Registration procedures and class offerings are published in the UIC Schedule of Classes each semester and graduate students are responsible for the complete and accurate processing of their registration according to the guidelines published therein.

Graduate students who fail to register for two terms in a row (excluding summer) without taking an approved leave of absence forfeit their admission to the Graduate College and must re-apply to Graduate College and be re-admitted to the program. Readmission is not guaranteed.

New students may register during the designated period before the beginning of their first term or during the late registration period (days one to ten for fall and spring, days one to five for summer). Currently enrolled students should register during the early registration period in the previous term. Registration information will be mailed to all currently enrolled and new students prior to registration. Continuing students who are not currently enrolled will not be sent registration information and must wait for the open registration period. Students who wait to register at late registration will be assessed a late registration fee and may experience limited course availability.

Registration for Zero Hours
Registration for zero hours is only available to students who have completed all coursework, examinations, and all degree requirements except the thesis or dissertation. Students wishing to register for zero hours must submit a Graduate College petition and receive permission from the program and the Graduate College prior to registration. Once permission is received students may continue to register for zero hours provided they remain in the same program, continue to make satisfactory academic progress, and are within the time frame for degree completion. An option of registration for reduced zero-hour charges (Option B) exists for some doctoral students. Master's students may be required to register for zero hours by their program or INS regulations.

Academic Probation

Academic probation is the Graduate College's mechanism for warning students that their Degree GPA has fallen below the minimum standard of 3.00 (A=4.00). Students have two terms of enrollment (including summer, if registered) after the term in which their Degree GPA falls below 3.00 to remove themselves from probation. Departments may enforce stricter limits on probation, provided the student is informed in writing prior to being placed on probation.

Students who leave the University while on probation, whether through formal withdrawal or through failing to meet the registration requirement, will still be on probation if they are later readmitted to the same program. Students that are admitted to a new program, begin as a new student (i.e., the Degree GPA starts over). Students currently on probation or who left the University on probation will not be admitted to the same program as non-degree students. Readmission as a degree-seeking student is not guaranteed.

Students who fail to raise their average to 3.00 or to otherwise fulfill the terms of their probation within the deadline will be dismissed from the University. The Graduate College issues probation and dismissal notices to students and their program directors. However, failure to receive notice does not change the student's probation or dismissal status, since students are expected to monitor their own progress in light of Graduate College policies.

Students must be on good academic standing in order to graduate, even if all other requirements have been met. Students on probation (Degree Grade Point Average less than 3.0) will not be allowed to graduate unless good academic standing is achieved by raising the Degree GPA to 3.0 or greater.

Leave of Absence
Except for international students whose visas require continuous registration, and doctoral students who have passed their preliminary exams, graduate degree-seeking students may take one semester (fall or spring) plus the summer session off without formal leave approval from the Graduate College. Degree students who desire to take an additional consecutive semester off, for a total maximum of three consecutive terms, must file a *Graduate Petition for Leave of Absence* by the tenth day of the semester for which leave is requested.

International students who hold an F-1, J-1, A-1, A-2, or H-1 visa must register each fall and spring semester due to visa requirements. Such students must file a *Graduate Petition for Leave of Absence* for any fall or spring semester they wish to take off, obtaining written authorization on the petition from the Office of International Services. If remaining in the country, such leaves are rarely granted by that office.

Upon receipt of a leave of absence petition from the department/program, the Graduate College will automatically approve the first leave, up to one year maximum. At least one term as a graduate degree student must be completed before being eligible for a leave. After returning to the program from an approved leave, a second leave is not automatic and will only be granted by the Graduate College for medical or other extraordinary reasons.

Leave will not be granted to doctoral candidates who have passed the preliminary exam, except for students whose programs require a formal off-campus activity (e.g., internship), or for documented medical or other extraordinary reasons. If this situation occurs, a *Graduate Petition for Leave of Absence* must be submitted to the Graduate College, and is not automatic.

Non-degree students are not eligible for a leave of absence.

Time spent on leave approved by the department and the Graduate College does not count towards the time to complete the degree.

Students who have already registered for the term for which leave is requested must complete either a *Cancellation of Registration* before the first day of the term, or a *University Withdrawal* by the tenth day of the semester (fifth day in summer). Students are responsible for filing the appropriate forms and resultant charges; the leave of absence petition itself does not alter existing registration.

Students who are on an approved leave of absence will not be covered by the health and personal accident insurance plan until they return to active registration.

Leave of Absence Petition forms may be obtained from the Student Affairs Office in 905 SEO or the Graduate College, 606 University Hall.

Repetition of Courses
Students can repeat a course for credit if:

1. The course is designated in the *Timetable* with the phrase “May be repeated for credit.”

2. The course is one in which a grade of D, E, F, or U was received. In such cases the course can be repeated only once and counted only once toward the degree requirements; the original grade continues to be included in the computation of the Graduate Degree GPA. The approval of both the instructor who will give the course and the director of graduate studies is required.

3. The course is one in which a student has received a permanent IN (see Grades).

Course Loads

Students who can devote full time to their studies usually enroll for 12 to 16 credit hours each term. In exceptional cases, the advisor and director of graduate studies may permit a student to enroll for up to 20 hours. Registration for more than 20 hours is not recommended. Full-time load is defined by the University as registration of 12 hours or more even if holding an assistantship.

Fellowship Holders: Must register for at least 12 hours of credit per semester of award (6 in summer).

Tuition-and-Service-Fee-Waiver Holders: Must register for at least 12 hours of credit per semester of award (6 in summer).

Assistantship Holders: Must register for at least 8 hours of credit each semester, excluding summer. While summer enrollment is optional, assistants who wish to use their summer tuition and service fee waivers must register for at least 3 hours during that term. Some graduate programs may require registration for more than 8 hours per term and/or summer registration. There are no tuition and service-fee waiver benefits for students employed with less than 25% or more than 67% appointment. Assistants who qualify for a Spring tuition and service fee waiver automatically receive a summer waiver if registered in at least 3 hours in summer unless holding a summer appointment above 67%.

International Students: For purposes of enrollment certification to the Immigration and Naturalization Service of the United States Department of Justice, the Graduate College considers foreign students to be pursuing a minimum full-time program of study if they: (1) enroll for 12 or more hours of credit or (2) hold an appointment as a teaching or research assistant for: (a) one-half time and enroll for at least 8 hours of credit or (b) one-third time and enroll for at least 10 hours of credit.

Students on an F-1 visa may be eligible to register for zero hours if all requirements are complete except for project or thesis, and a petition is submitted to the Graduate College and approved. The petition must be endorsed by the advisor and DGS or head of program and the Office of International Services.

Veterans: To be eligible for full benefits veterans must register for at least 12 hours per semester (6 hours in summer).

Transfer Credit

Transfer credit consideration is given to the following three categories:

• Previous graduate work for which a degree was not awarded.

• Graduate work completed elsewhere after admission to UIC and for which a degree was not awarded. Students considering taking graduate work elsewhere during a leave of absence should consult their advisor and director of graduate studies about such plans and the courses that may be considered for transfer.

• Graduate work completed in the senior year at UIC that was not applied to the baccalaureate.

To be considered for transfer, graduate work must have been completed in an accredited institution approved by one of the regional accreditation associations or by the agencies recognized by the Council on Post-Secondary Education, and must meet the quality and content of courses offered at UIC.

For probation and graduation purposes, transfer credit is not computed in the cumulative grade point average or Graduate Degree GPA unless such credit was earned in courses taken at UIC.

Academic Integrity

The University of Illinois is dedicated to learning and research, and hence is committed to truth and accuracy. Integrity and intellectual honesty in scholarship and scientific investigation are, therefore, of paramount importance. These standards require intellectual honesty in conducting research, writing of research results, and relations with colleagues. Graduate students may be faced with difficult choices regarding academic integrity in their various roles as student, teacher, and researcher. If this is the case, they should seek the advice and experience of their faculty advisors and the Graduate College staff.

The University publishes two documents that contain specific definitions of misconduct (such as plagiarism, falsification of data, etc.), procedures used for investigation of charges, and the consequences of that conduct. Students are governed by the Student Disciplinary Procedures (October 1993) and faculty are governed by the Policies and Procedures for Academic Integrity (June 1989).

Commencement Exercises

Attendance at commencement is voluntary. Every college holds its own ceremony for their graduates; CS graduates (BS, MS and PhD) attend the ceremony held by the College of Engineering. The College of Engineering typically holds commencement on the Saturday following final exam week of the Spring semester. Information on commencement is sent to all students who file for graduation by submitting a "Intent to graduate". Information is available at http://www.vcsa.uic.edu/MainSite/departments/commencement/home/Commencement.htm or the College of Engineering site at http://www.uic.edu/depts/enga/graduation/index.htm.

GENERAL INFORMATION

Optional Practical Training

The Computer Science department will allow you to go for optional practical training and will issue letters for such training either during your program or after completion of your degree. If you plan to go for optional practical training during your program (for example during summer months), you must be on good and full standing to get an optional practical training letter. If you have any prerequisites remaining or your GPA is less than 3.0 (B), you will not be given an optional practical training letter until the requirements have been met. You must start this process very early; start with Office of International Services (OIS) in SSB for the guidelines on the process. The OPT letter required by OIS can be provided only by the staff in the Student Affairs Office. **Letters from advisors will not be acceptable**.

Curricular Practical Training

The College of Engineering will also allow Curricular Practical Training during summer months. Student must be on full standing to get the college approval. Students must have a written offer of a job related to their studies, must be at least 8 semester hours away from graduation (at the time of application for CPT), the employer must contact the College to request employment (a phone call will do), etc. Additionally, either the student advisor or the DGS must approve the proposed employment. Please note that the student must enroll in ENGR 289 for zero hours, and must pay the related tuition and fees.

Interested students should get in touch with the Co-Op office at 312-996-2238 or e-mail engrjobs@uic.edu . Additional information is available in their office Room 818 SEO, or at their website http://www.uic.edu/depts/enga/co-op/contact.htm.

Medical Insurance

All new students who enroll at UIC are automatically enrolled in an insurance plan and the UIC student health care program consisting of two components – the CampusCare, a comprehensive student health insurance program to cover you for loss due to a covered injury or illness, and the UIC Department of Family Medicine provides you, via your health service fee, with coverage for routine care including physical examinations. The CampusCare health insurance provides coverage at a rate of $401* per semester. The required Health Service Fee is an additional $106* per semester. For registered students, coverage is continuous, beginning with the first day of the term until the first day of the next term.

Students have the option to waive the insurance coverage by completing a waiver form and presenting evidence of other comparable insurance coverage (copy of your insurance card). The waiver forms and deadlines are available on the CampusCare website (http://www.uic.edu/hsc/campuscare/). Students who had previously waived the plan will remain waived, but may apply for the CampusCare insurance plan, subject to a determination of eligibility if they desire to be reinstated. Dependents (spouse and children) may be added to the coverage after filling out a Dependent Application, for an additional fee of $1068* (spouse) and $538* (all children).

* The fee rate & information provided is the information available at the time of production of this manual. See the corresponding departments for up to date information on fees and coverage.

Change of Address/Telephone Number/Name

Any changes to your name, address, telephone number or current address have to be reported to the registration office in SSB, the Student Affairs Office of Computer Science, Office of International Services if you are on any kind of visa and the department you are working for as TA/RA/GA. To report changes to the CS department, you can e-mail Elena or Santhi. If you work on campus as TA/RA/GA, go to http://nessie.uihr.uillinois.edu/ and change your address there, so that the W2 for that year is mailed to the right address.

Letters

Graduate students usually request a variety of letters; following is a typical list of requests. Send e-mail to the staff in the Student Affairs Office if you need a letter, he/she will e-mail you back when it is ready. The letters are usually ready in 1-2 working days. Most of you want the letter ASAP, but you have to consider the workload of the staff in the Student Affairs Office too! Send an e-mail, and it will be processed at the earliest convenience – please do not stand in the office and expect it to be done right away.

- Good standing letter - Verifying you are a student in the department
- Graduation Letter - Verifying your graduation or prospective graduation
- OPT Letter - Recommendation for Optional Practical Training
- CPT Letter - Please see Co-Op office in 818 SEO
- Other miscellaneous letters as needed

Mailboxes

TA's, RA's and Fellowship holders have mailboxes in 905 SEO. We usually have them ready by the third week after school starts. If you don't see your mailbox, write a note and leave it in the Student Affairs Office. The faculty and staff mailboxes are located in the Main office (1120 SEO). If you want to drop off something for a faculty or staff – you could ask the staff in the main office to put it in the appropriate box. TA's, RA's and Fellowship holders, be advised that the mailboxes are for the university mail only; it is a privilege and not a right. Please do not have your personal mail sent to this address; the department will **NOT** be responsible for any lost mail.

Other General Information

The individual instructors assign grades. Please check your grades with your instructors. Staff in Room 905 SEO are not authorized to give grades over the phone, via email, or in person.

If you have a grievance related to a particular course, please discuss it with the instructor first and see if the issue can be resolved. Only if you are not satisfied with the response from the instructor, please feel free to make an appointment to speak with the DGS.

Staff in Room 905 SEO is always willing to help you. We would appreciate the staff being treated with courtesy and respect. If you have any unresolved problems, you are welcome to see the DGS or the department head for any problems.

Course Descriptions

Note: The topics and textbooks listed below for courses are for general information only, they may not be completely consistent with topics covered or textbooks used during any specific semester.

CS 100
Computer Literacy
Description: Credit 3. Introduction to computing; the internet; web; file systems; electronic mail; basic tools (such as editors, databases); programming concepts; computer ethics; security and privacy. Computer lab.
Prerequisites: None.
Recent Textbooks: Mark Guzdial, "Intro Computing & Programming w/ Python: A Multimedia Approach", Prentice Hall, Latest Edition.
Topics:

1. Hardware tools
    a. How the computer works
    b. Historical development
    c. Communications
2. Personal computer tools
    a. Spreadsheets
    b. Database
    c. Statistical packages
    d. Word processing
    e. Desktop publishing
3. Software tools
    a. How to write a simple program
    b. Survey of programming languages
4. Overview of computer science fields
5. Ethics, security and privacy

CS 101
Introduction to Computing
Description: Credit 3. Introduction to computing resources and tools. computer access, security and responsibility. Navigation and communication. Networks; internet resources. Applications. Programming languages, concepts and practice. Programming exercises.
Prerequisites: None.
Recent Textbooks: Mark Guzdial, "Intro Computing & Programming w/ Python: A Multimedia Approach", Prentice Hall, Latest Edition.
Topics:

1. Computer access, security and responsibility
2. Navigation and communication
    a. Microcomputer systems
    b. Workstation systems
    c. Local area networks
    d. Wide area networks: Internet browsing
    e. Electronic mail
    f. Compaction, encryption, reconstruction
3. Applications
    a. Text editors & word processors
    b. Drawing, painting, & CAD
    c. Spreadsheets & databases
    d. Multimedia
4. Programming languages
    a. Operating system command languages
    b. Macro languages
    c. High-level programming languages
5. Programming Concepts & Practice
    a. Interface elements
        i. Objects
        ii. Interface design
    b. Scripting languages
        i. Messages
        ii. Inheritance
        iii. Control structures
        iv. Data types
        v. Scope

CS 102
Introduction to Programming
Description: Credit 3. Programming languages and program design; data types and operators; expressions; control structures; procedures and modularity. Language definition and programming laboratory.
Prerequisites: CS 101 or consent of the instructor; and credit or concurrent registration in Math 180.
Recent textbooks: Walter Savitch, "Absolute Java", Addison Wesley.
Topics:

1. Programming languages
    a. Language specification
    b. Overview of language
    c. Program design
    d. Computer system and compiler
2. Language
    a. Syntax, expressions, operators and data types
    b. Control structures
    c. Input/output
    d. Arrays
    e. Strings
    f. Library functions
    g. Procedures and functions
    h. Scoping and recursion
    i. Records and pointers

CS 107
Introduction to Computing and Programming
Description: Credit 4. Access and use of computing resources. Programming and program design. Problem solving, data types, control structures, modularity and information hiding.
Prerequisite: Credit or concurrent registration in Math 180
Recent Textbooks: Walter Savitch, "Absolute Java", Addison Wesley.
Topics:

1. Computer access, security, and responsibility
2. Navigation and communication:
   a. Microcomputer systems
   b. Workstation systems
   c. Compaction, encryption, reconstruction
3. Editing programming and natural languages
4. Compilers versus interpreters
5. Introduction to object technology:
   a. Problem solving and objects
   b. Objects in computer languages
   c. Objects in C++
   d. Objects of C++
6. Basic C++ types and programs:
   a. Syntax, expressions, operators, basic types
   b. Input/output
   c. Strings
7. Describing and declaring classes:
   a. Functions and function prototypes
   b. Class header
   c. UML representation of a class
   d. Design: object-oriented versus structured
8. Control structures
9. Implementing classes
10. Value versus reference parameters
11. Arrays
12. Pointers and dynamic memory
13. Recursion and associated scoping issues

CS 108
Fortran Programming for Engineers with MatLab
Description: Credit 3. Program design using Fortran; data types and operators; control structures; subprograms, file I/O; common storage. Engineering applications: matrices; equation solutions; MatLab environment. Programming assignments.
Prerequisite: Credit or concurrent registration in Math 180
Recent Textbooks: Nyhoff and Leestma, "FORTRAN 90 for Engineers and Scientists", Prentice Hall. D. Ray & E. Ray, "UNIX: Visual Quickstart Guide", Peachpit Press, 2nd Edition.
Topics:

1. Preliminaries
   a. Syntax, program execution, program structure
   b. Variable declarations and simple data types
   c. Assignment and simple I/O statements
2. Control structures
   a. Sequencing
   b. Alternation
   c. Loop constructs
3. File I/O
   a. Format instruction
   b. File operations
4. Arrays
   a. Declaration, initialization, manipulation
   b. Examples of array algorithms
5. Subprograms
   a. Subroutines and functions
   b. Parameter passing and shared storage
6. Applications
   a. Roots of an equation
   b. Integration
   c. Differentiation

CS 109
C/C++ Programming for Engineers with MatLab
Description: Credit 3. Program design using C/C++ data types and operators, control structures, functions, file I/O, arrays and structures. Engineering applications: matrices, equation solution, MatLab. Programming assignments.
Prerequisite: Credit or concurrent registration in Math 180.
Recent Textbooks: Walter Savitch, "Problem Solving with C++: The Object of Programming", Addison-Wesley, 5th Edition.
Topics:

1. Preliminaries
   a. Syntax, program execution, program structure
   b. Variable declarations and simple data types
   c. Assignment and simple I/O statements
2. Control structures
   a. Sequencing
   b. Alteration
   c. Loop constructs
3. File I/O
   a. Formal instruction
   b. File operations
4. Arrays and Structures
   a. Declaration, initialization, manipulation
   b. Examples of algorithms

5. Functions
    a. Syntax and return values
    b. Parameter passing
6. Applications
    a. Roots of an equation
    b. Integration
    c. Differentiation

CS 201
Data Structures and Discrete Mathematics I
Description: Credit 4. Lists, stacks, queues, sets, hash tables, introduction to trees and graphs. Algorithm correctness and complexity, inductive proofs, logic. Programming projects.
Prerequisites: MATH 180; and Grade of C or better in CS 102 or Grade of C or better in CS 107.
Recent Textbooks: Goodridch and Tamassia, "Data Structures and Algorithms in Java", Wiley & Sons, 3rd Edition. Susanna S. Epp, "Discrete Mathematics with Applications", Thomson Learning-Brooks/Cole, 3rd Edition.
Topics:

1. Induction and recursion
    a. Inductive proofs & recursive definitions
    b. An example: merge sort
    c. Recursive programming
    d. Programming style and design
2. The running time of programs
    a. Big-oh notation
    b. Analyzing non-recursive code
    c. Analyzing recursive code (basics)
3. C++ classes
4. Lists
    a. Linked structures
    b. Stacks and queues
    c. Search algorithms
5. Basic set and function theory
    a. Basic definitions and operations on sets
    b. List and characteristics and vector representations
    c. Relations and functions
    d. Pigeonhole principle
    e. Properties of binary relations
    f. Infinite sets
6. Basics of hashing
    a. Chained hash-tables
7. Propositional and predicate logic
8. Introduction to trees and graphs

CS 202
Data Structures and Discrete Mathematics II
Description: Credit 3. Combinatorics; complex data structures: trees, heaps, and graphs. Sorting and searching algorithms. Programming projects.
Prerequisites: Grade of C or better in CS 201.
Recent Textbooks: Goodrich & Tamassia, "Data Structures and Algorithm in Java", Wiley & sons, 4th Edition. Susanna S. Epp, "Discrete Mathematics with Applications", Thomson Learning-Brooks/Cole, 3rd Edition.
Topics:

1. Combinatorics
2. Advanced runtime analysis
3. Multi-lists
4. Trees: programming, data structures, algorithms, traversals
5. Heaps, heap sort, priority queues
6. Additional sorting and searching
7. Balanced tree schemes
8. Hash Tables
9. Graphs: programming, data structures, algorithms

CS 266
Computer Architecture I: Logic and Computer Structures
Description: Credit 4. Architecture from gate level up. Combinational and sequential logic. Logical minimization. Integer number systems, arithmetic. Datapath design. Finite state machines. Register-based architecture. Memory technologies.
Prerequisites: CS 102.
Recent Textbooks: Mano & Kime, "Logic and Computer Design Fundamentals & XILINX 6.3 Student Edition, Prentice Hall.
Topics:

1. Review of boolean algebra
2. Elementary combinational logic: basic gates, logic minimization, multi-level logic
3. Memory and programmable devices
4. Integer number systems
5. Binary arithmetic
6. Introduction to sequential logic: latches, flip-flops, clocking methodologies
7. Finite state machines: Moore and Mealy machines, state assignment, implementation strategies
8. Datapath register transfer level design, memory interface. Register-based architecture
9. Introduction to CPU Design
10. CAD and HDL tutorials and project discussion

CS 301
Languages and Automata
Description: Credit 3. Regular sets and finite automata. Context-free languages and push-down automata. Parsing. Computability theory including Turing machines and decidability.
Prerequisites: Grade of C or better in CS 201; and credit or concurrent registration in CS 202.
Recent Textbooks: Lewis & Papadimitrou, "Elements of the Theory of Computation", Prentice Hall, 2nd Edition.
Topics:

1. Review of relations, induction, strings, trees.
2. Finite automata and regular sets and expressions
3. Nondeterminism, other variations
4. Pumping lemma, decision algorithms
5. Context-free grammars, regular grammars
6. Push-down automata
7. Pumping lemma for CFLs, closure properties
8. Parsing
9. Turing machines and variations
10. Recursively enumerable an non-r.e. languages
11. Undecidability, the halting problem
12. Other undecidable problems, reductions
13. Rice's theorem
14. Brief intro to complexity

CS 335
Computer Ethics
Description: Credit 2. Ethical, societal and environmental issues for computer professionals. Professional ethics, software ownership, unreliability, responsibility, privacy, computer crime, veracity, expert systems, workplace and health issues.
Prerequisites: CS 202.
Recent Textbooks: Sara Baase, "Gift of Fire", Prentice Hall.
Topics:

1. Computers, networks and contemporary society.
2. Ethics for computing professionals.
3. Intellectual property rights & software ownership
4. System unreliability & responsibility for failure
5. Privacy, surveillance, database use and abuse.
6. Hacking and viruses
7. Computer-assisted theft and fraud
8. Veracity of information and images
9. Artificial intelligence and expert systems
10. Computers and the workplace
11. Health issues for users
12. Environmental impact of computing

CS 340
Software Design
Description: Credit 4. Programming language semantics, scope, overloading, data abstraction, constructors. Procedural and object-oriented design, programming tools and environments. Interactive application structure and interface, windows, events, widgets.
Prerequisites: CS 202.
Recent Textbooks: Mark Weiss, "C++ for Java Programmer", Prentice Hall. P. van der Linden, "Just Java 2", Prentice Hall, 6th Edition.
Topics:

1. Programming language semantics
   a. Control structures
   b. Name structure, scope & overloading
   c. Data types and objects
2. Program design
   a. Procedural & object-oriented design
   b. Modules and separate compilation
   c. Data abstraction & encapsulation
   d. Coding style
   e. Programming tools and environments
3. Modern programming language - advanced issues
   a. Functions and overloading
   b. Classes, member functions & access control
   c. Constructors, operators and conversions
   d. Function and class templates
   e. Use of libraries / tool kits
4. Interactive application structure and design
   a. GUI structure
   b. Windows and events
   c. The graphics context and drawing primitives
   d. GUI application structure
   e. Widgets, resources and callbacks

CS 366
Computer Architecture II: Hardware-Software Interface
Description: Credit 4. A continuation of CS 266. Control-unit and I/O design; assembly language and machine programming; hardware control and I/O; memory hierarchy and caching.
Prerequisites: CS 266.
Recent Textbooks: Patterson & Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kauffman, 3rd Edition.

Topics:

1. Stored program architecture
   a. CPU, memory, other devices
   b. Program layout, fetch-execute
2. Languages and systems software
   a. High-level, asm and machine
   b. Linkers, loaders, OS
3. Assembly language programming
   a. Data types
   b. Addressing
   c. Instructions
   d. Subroutines
4. Floating-point
5. Memory Hierarchy
6. I/O
   a. Memory-mapped vs. specialized
   b. Programming I/O and DMA
   c. Interrupt-driven, privileged instrs
7. Control-unit design
   a. Hardwired
   b. Microprogrammed
8. Interfacing
   a. High-level languages
   b. OS, linking, loading
   c. Hardware (I/O)
9. Advanced CPU Design
   a. RICS vs CICS
   b. Superscalar, VLIW/EPIC

CS 376
Practicum in Computer Science Presentations
Description: Credit 1. Techniques for effective presentation of computer science topics: terminology, organization, visual aides and delivery of technical talks; presentations and presentation evaluation required.
Prerequisites: ENGL 161 and CS 102.
Recent Textbooks: Sprague and Stuart, "The Speaker's Handbook", Thomson Learning, 7th Edition.
Topics:

1. Preliminaries
   a. Presentation preparation
   b. Multi-Media presentations
   c. Effective use of language
   d. Technical information
   e. Delivery of the presentation
   f. Question/Answer sections
2. Practice/Demo presentations

CS 385
Operating Systems Concepts and Design
,Description: Credit 4. Operating systems issues, operations, process execution, scheduling, memory management, virtual memory design, concurrent process coordination, properties, deadlock, mutual exclusion, synchronization primitives, distributed systems issues and network design.
Prerequisites: CS 201; and CS 366 or ECE 267.
Recent Textbooks: Silberschatz, Galvin and Gagne, "Operating System Concepts", Wiley, 7th Edition.
Topics:

1. OS overview and history
2. I/O processing and multiprogramming
3. OS services, design structure, and file operations
4. Concurrent processes management mutual exclusion, synchronization, OS and language primitives, deadlock
5. Job and process scheduling.
6. Memory management storage allocation/deadlocation, paging, segmentation, virtual memory.
7. Distributed systems
8. Networking concepts

CS 398
Undergraduate Research
Description: Credit 3. Design and/or research experience for undergraduate Computer Science majors under close supervision of a CS faculty member.
Prerequisites: Consent Of the Instructor.
Recent Textbooks: See Instructor.
Topics:

1. Research of existing ideas on topic
2. Summary of existing ideas
3. Research on related problem
4. Summary of research
5. Presentation of research summary

CS 401
Computer Algorithms I
Cross List: MCS 401
Description: Credit 3UG/4G. Design and analysis of computer algorithms. Divide-and-conquer, dynamic programming, greedy method, backtracking. Algorithms for sorting, searching, graph computations, pattern matching, NP-complete problems.
Prerequisites: Grade of C or better in MCS 360; Grade of C or better in CS 202.
Recent Textbooks: Goodrich & Tamassi, "Algorithm Design: Foundation, Analysis & Internet Examples", Wiley.

Topics:

1. Internal sorting (insertion, quicksort, heapsort, mergesort, lower bounds on sorting algorithms)
2. External sorting (replacement selection, polyphase mergesort)
3. Searching (binary search trees, B-trees, hashing)
4. Graph algorithms (minimal spanning trees, shortest distance, algorithms based on depth-first and breadth-first search)
5. Pattern matching in strings (finite automata, Boyer-Moore algorithm)
6. Dynamic programming (order of matrix multiplication, shortest paths in graphs, optimal binary search trees)
7. Backtracking and branch-and-bound algorithms (graph coloring, knapsack problem, traveling salesperson problem)
8. Local search (traveling salesperson problem)

CS 411
Artificial Intelligence I
Description: Credit 3UG/4G. Problem representation; rule-based problem-solving methods; heuristic search techniques. Application to expert systems, theorem proving, language understanding. Individual projects.
Prerequisites: CS 202.
Recent Textbooks: Russell & Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 2nd Edition.
Topics:

1. Overview of intelligence, human and artificial
2. Problem representation
3. State-space representation; search techniques and heuristics
4. Introduction to predicate calculus
5. Rule-base problem-solving methods
6. Applications
   a. Expert systems
   b. Game-playing
   c. Natural language understanding
   d. Theorem proving
   e. Computer vision
7. Computer project or literature study

CS 415
Computer Vision I
Description: Credit 3UG/4G. Computer vision system design. Segmentation and representation of regions and boundaries; image filtering; object recognition; advanced topics (examples: texture, stereo, color); applications. Programming assignments.
Prerequisites: CS 202 or MCS 360; or consent of the instructor.
Recent Textbooks: Shapiro & Stockman, "Computer Vision", Prentice Hall.
Topics:

1. Introduction to computer vision (CV)
   a. Relationship to other fields
   b. Examples of vision applications
   c. Image formation
2. Processing binary images
   a. Histograms and thresholding
   b. Geometric properties
   c. Connected components labeling
   d. Boundary following
3. Region representations
   a. Array representations
   b. Multi-resolution representations
   c. Relational representations
   d. Geometric representations
4. Region segmentation
   a. Automatic thresholding
   b. Region merging
   c. Region splitting
   d. Split and merge
   e. Region growing
   f. Statistical region segmentation
5. Image filtering
   a. Point processing
   b. Spatial filtering
   c. Template matching
6. Edge detection
   a. Derivative operators
   b. Zero crossings
   c. Parametric models
7. Contour processing
   a. Edge linking
   b. Edge following
   c. Hough transform
8. Contour representations
9. Object recognition
   a. Introduction
   b. Iconic methods
   c. Feature matching (pattern classification)
   d. Bayesian pattern classification
   e. Relational matching
   f. 3D object recognition
10. Advanced topics (e.g., texture, stereo, color)
11. Discussion of real systems

CS 421
Natural Language Processing
Description: Credit 3UG/4G. Design of natural language processing systems; part-of speech tagging,

statistical and symbolic parsers; semantic interpretation; discourse and dialogue processing; natural language generation; applications.
Prerequisites: CS 301 or MCS 441.
Recent Textbooks: Jurafsky and Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall/Upper Saddle River, 2000.
Topics:

1. Introduction
2. Syntax processing
    a. Part of speech tagging
    b. Statistical parsing methods
    c. Symbolic parsing methods
3. Semantic processing
    a. Semantic interpretation
    b. Lexical semantics
4. Discourse processing
5. Dialogue processing
6. Natural language generation
7. Multilingual applications

CS 422
User Interface Design and Programming
Description: Credit 3UG/4G. User interface design, implementation, and evaluation: user-centered design methodologies, windowing systems, I/O devices and techniques, event-loop programming, user studies. Programming projects.
Prerequisites: CS 340.
Recent Textbooks: Required: Shneiderman & Plaisant, "Designing the User Interfaces: Strategies for Effective Human-Computer Interaction", Addison Wesley, 4th Edition. Recommended: Mullet & Sano, "Designing Visual Interfaces: Communication Oriented Techniques", Prentice Hall.
Topics:

1. Introduction/Motivation
2. Case studies of user interfaces
3. User-centered design methodologies
4. I/O technologies
5. Interaction techniques
6. Event-loop programming
7. Windowing systems
    a. Components
    a. X-windows programming
    b. Widget sets
8. User interface management systems
9. User studies

CS 426
Video Game Design and Development
Description: Credit 3UG/4G. Theory and practice of video game design and programming. Students will form interdisciplinary teams, to design, build and demonstrate video games or related interactive simulation environments.
Prerequisites: CS 107 and CS 201 and CS 488; or consent of the instructor.
Recent Textbooks: Sanchez & Dalmau, "Core Techniques and Algorithms in Game Programming", New Riders Press.
Topics:

1. History and taxonony of video games
2. Brainstorming and designing the gameplay
3. Project planning
4. Introduction to game development tools
5. Introduction to 3D computer graphics and stereoscopic computer graphics
6. Software structure of a video game / real-time game loop design
7. Deconstructing a game
8. Sound and psychoacoustics
9. Physical and perceptual limits of game players
10. User interfaces for gaming
11. Artificial intelligence for games
12. Game physics
13. Issues in multiplayer and networked game development
14. Hardware architectures of video game platforms
15. Techniques for special visual effects in gaming (e.g. motion blur, lens flare, real time shadows, reflections)
16. Future topics related to gaming – e.g. virtual reality
17. Final Game Presentations

CS 440
Software Engineering I
Description: Credit 3UG/4G. Software life-cycle model, requirement specification techniques, large-scale software design techniques and tools, implementation issues, testing and debugging techniques, software maintenance.
Prerequisites: CS 340.
Recent Textbooks: Schach, "Object-Oriented and Classical Software Engineering", McGraw Hill, 6th Edition.
Topics:

1. Overview
2. Requirements specification techniques
3. Software design technique and tools
4. Implementation issues

5. Software engineering and programming languages
6. Testing and debugging techniques
7. Software maintenance
8. Software project

CS 441
Distributed Object Programming Using Middleware
Description: Credit 3UG/4G. Design and implementation of distributed object programs using middleware software standards; interface definition languages and programming language mappings; static and dynamic object communication mechanisms.
Prerequisites: CS 340 and CS 385.
Recent Textbooks: M.L. Liu, "Distributed Computing: Principles and Applications," Addison Wesley.
Topics:
1. Overview of CORBA
2. Interface definition language
3. IDL to C++ mappings
4. Introduction to Java
5. IDL to Java mappings
6. Object adapters, basic and portable: Stubs, skeletons, POA policies
7. Object life cycles: creation, destruction, reference counting, garbage collection.
8. CORBA mechanisms: General inter Orb protocol (GIOP), internet IOP, interoperable object references (IORs) marshalling, serialization
9. Dynamic CORBA: TypeCodes, types any and DynAny, dynamic invocation, interface (DII), dynamic skeleton interface (DSI), interface repository
10. CORBA services: Naming, trading, properties, event
11. Performance metrics
12. Client and server multithreading
13. Relationships to related technologies: DCOM, Java RMI, enterprise Java Beans, XML

CS 442
Software Engineering II
Description: Credit 3UG/4G. Advanced concepts in software development: requirements engineering, cost estimation, risk analysis, extreme programming, regression test case selection, and design patterns.
Prerequisites: CS 440.
Recent Textbooks: M. Hutcheson, "Software Testing Fundamentals: Methods and Metrics", Wiley, 2003. K. Wiegers, "Software Requirements", 2nd Edition, Microsoft Press, 2003.
Topics:
1. Requirements specification, analysis and traceability
2. Regression testing and test case selection
3. Extreme programming and agile software development
4. Design patterns

CS 450
Introduction to Networking
Description: Credit 3UG/4G. Network protocols, algorithms, and software issues. Topics include the open systems interconnect model, data link, network and transport layers, TCP/IP, ATM, mobile networks.
Prerequisites: CS 202 and CS 385; and STAT 381 or STAT 401 or IE 342.
Recent Textbooks: A. Tanenbaum, "Computer Networks", Prentice Hall, 4th Edition.
Topics:
1. OSI network model
2. Data link layer
3. MAC sublayer
4. Network and transport layer functions
   a. Functionality
   b. Routing and congestion control algorithms
   c. Protocols: TCP, IP, Mobile IP, IPv6 etc.
   d. Internetworking
   e. Frame relay, ATM, ISDN protocols
5. Web; mobile networks

CS 455
Design and Implementation of Network Protocols
Description: Credit 3UG/4G. Network protocols and their software, examines OS network interface through network layers. Topics include routing, congestion control, fault tolerance, security, name servers, multicast, and performance.
Prerequisites: CS 340 and CS 450.
Recent Textbooks: Required: Peterson and Davies, Computer Networks: A System Approach, Morgan Kaufmann. Recommended: (*) W. Richard Stevens, TCP/IP Illustrated, Vol. I, Addison Wesley.
Topics:
1. Naming and routing
   a. Domain name services
   b. Dynamic routing
2. Service abstractions
   a. Byte stream
   b. Packet
   c. Remote procedure call

3. Congestion control and resource allocation
    a. Queuing discipline
    b. Congestion avoidance
    c. Quality of service
4. Security
    a. Cryptic algorithms
    b. Security mechanism
    c. Firewalls
5. Remote procedure call
    a. Call semantics
    b. Typing, marshalling, and unmarshalling
6. Nodes
    a. Switches
    b. Routers

CS 466
Advanced Computer Architecture
Cross list: ECE 466
Description: Credit 3UG/4G. Design and analysis of high performance uniprocessors. Topics include arithmetic: multiplication, division, shifting; processor: pipelining, multiple function units. instruction sets; memory: caches, modules; virtual machines.
Prerequisites: CS 366 or ECE 366
Recent Textbooks: Hennessey & Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kauffman, 3rd Edition.
Topics:
1. Arithmetic
    a. CSA multipliers
    b. Division using reciprocal approximation
    c. Shifting
    d. Floating point
2. Processor
    a. Pipelining
    b. Multiple function units
    c. Instruction set design
    d. Instruction buffers
3. Memory
    a. Multiple memory modules
    b. Caches
    c. Purity, technology
4. I/O
    a. Disk technology
    b. Alternatives to hard drives
    c. Busses
    d. Recent advancements
5. Multiprocessors
    a. Networks
    b. Design Options

CS 469
Computer Systems Design
Cross list: ECE 469
Description: Credit 3UG/4G. Analysis and modeling of digital systems; hardware description languages; CAD tools for simulation, synthesis, and verification of computer systems. Project: a simple processor design.
Prerequisites: CS 366; or ECE 366 and ECE 368
Recent Textbooks: Gajski, "Principles of Digital Design", Prentice Hall. Ashenden, "The Designer's Guide to VHDL", Morgan Kaufman.
Topics:
1. Design methodology using hardware description languages: digital system design process; hardware description languages; structural, data-flow, behavioral specifications.
2. An HDL: basic concepts, basic language elements, data types, operators, control structures.
3. Timing and concurrency
4. Structural specifications: gate-level description; wiring; modeling a digital system.
5. Design organization and management: subprograms; packaging, parameterization.
6. Data-flow specifications: multiplexing and data selection; state machine description.
7. Behavioral specifications: process statement; sequential and concurrent signal assignment; component instantiation.
8. CPU modeling and design: instruction set, instruction format memory organization; timing and clocking; interconnection and components; data and control partitioning; timing of data and control events.
9. Simulation and verification, test bench modeling.
10. Synthesis methodology, resource sharing.

CS 473
Compiler Design
Cross List: MCS 411
Description: Credit 3UG/4G. Language translation: lexical analysis, parsing schemes, symbol table management, syntax and semantic error detection, and code generation. Development of fully-functional compiler.
Prerequisites: Grade of C or better in CS 301 or Grade of C or better in MCS 441; and Grade of C or better in CS 202 or Grade of C or better in MCS 360; and Grade of C or better in CS 266.

Recent Textbooks: Aho, Lam, Sethi and Ullman, "Compilers 1/e plus Selected Online Chapters from Compilers 2/e Update Package", Addison Wesley.
Topics:

1. Tokens and finite state recognizers
2. Context-free grammars, lexical analysis, parsing
3. Top-down methods and transition diagrams
4. Bottom-up (LR(1)) methods
5. Abstract syntax trees
6. Semantic error checking, internal type structures
7. Run-time environments
8. Code generation

CS 474
Object-Oriented Languages and Environments
Description: Credit 3UG/4G. Data abstraction, classes and objects, messages and methods, polymorphism and dynamic binding, inheritance. Object-oriented design. Pure and hybrid object-oriented languages.
Prerequisites: CS 340.
Recent Textbooks: Drake, "Object Oriented Programming with C++ and Smalltalk", Prentice Hall. Gamma, "Design Patterns: Elements of Reusable Object-Oriented Software ", Addison Wesley.
Topics:

1. General Principles
   a. Software organization
   b. Classes, messages and methods
   c. Inheritance
   d. Object-oriented languages
2. Smalltalk
   a. Language and environment basics
   b. Classes, inheritance and metaclasses
   c. The system class hierarchy
   d. Implementation
3. Alternative OO language (i.e. C++ or Java, etc.)
   a. Review of functions and classes
   b. Inheritance and dynamic binding
   c. Templates, exceptions and namespaces

CS 476
Programming Language Design
Cross List: MCS 415
Description: Credit 3UG/4G. Definition, design, and implementation of programming languages. Syntactic and semantic description; variable bindings, control and data structures, parsing, code generation, optimization; exception handling; data abstraction.
Prerequisites: MCS 360 or CS 340.
Recent Textbooks: R.W. Sebesta, "Concepts of Programming Languages", Addison Wesley.
Topics:

1. Overview of programming language questions
2. Syntax of programming languages
3. Semantics of programming languages
4. Implementation questions
5. Variables: referencing and de-referencing
6. Control structures, Boehm-Jacopini Theorem
7. Data types
8. Input, output, file organization
9. Procedures, parameters, scope, implementation
10. Applicative languages
11. Exception handling
12. Parallel processing
13. Separate compilation and information hiding

CS 480
Database Systems
Description: Credit 3UG/4G. Database design, logical design, physical design. Relational databases. Recovery, concurrency control. Normalization.
Prerequisites: CS 202.
Recent Textbooks: Ramakrishnan & Gehrke, "Database Management Systems", McGraw Hill, Latest Edition.
Topics:

1. E-R and E-C-R model
2. View integration
3. Relational database
   a. Calculus
   b. Algebra
   c. Normalization
   d. Query optimization
4. Physical database design
5. Rollback and recovery
6. Concurrency control
7. Security & Integrity

CS 485
Networked Operating Systems Programming
Description: Credit 3UG/4G. Concepts, design, and programming of multi-process and distributed systems; inter-process communications; fault tolerance; distributed programming semantics. Programming assignments and project required.
Prerequisites: CS 385.

Recent Textbooks: K. Robbins & S. Robbins, "UNIX Systems Programming: Communication, Concurrency, and Threads", Sockets and XTI, 2nd Edition.

Topics:

1. Process:
   a. Process representation
   b. Signals
   c. Process Fork/Exec
   d. POSIX standards
2. Interprocessor communication:
   a. Threads
   b. Pipes
   c. FIFOs
   d. Semaphores
   e. Shared memory
   f. Asynchronous I/O
   g. File I/O
   h. Daemons
3. Network and network protocols
   a. Network layers
   b. Internets
   c. Communication protocols
4. Distributed processing
   a. Naming
   b. Reliability
   c. Multicasting
   d. Client-server vs. Peer-to-Peer
   e. Stateful vs. Stateless servers
5. Network programming:
   a. Sockets
   b. Remote procedure call
6. Fault tolerance and processes:
   a. Process pairs
   b. Reliable message delivery
   c. Logging
   d. ACID

CS 487

Building Secure Computer Systems

Description: Credit 3UG/4G. Building and programming secure systems; protecting systems from threats and reduction of vulnerabilities; Includes application, host and network security.

Prerequisites: Grade of C or better in CS 385; and senior standing or above; or consent of the instructor.

Recent Textbooks: Garfinkel and Spafford, "Practical Unix and Internet Security", O'Reiley Press, 2003.

Topics:

1. Introduction to security
   a. Host system security
   b. Network security
   c. Cryptography
2. Developing secure applications
   a. Buffer overflows
   b. Secure coding practices
   c. Tools and techniques to uncover bugs
   d. Type safety and language based safety
3. Protection of host systems
   a. Strengthening existing systems
   b. Understanding system services and their role in security
   c. Firewalls
   d. Virus protection
   e. Malicious code protection
   f. Personal information privacy
4. Protection of networked systems
   a. Security in a networked environment
   b. Authentication in a networked environment
   c. Denial of service/distributed denial-of service attacks

CS 488

Computer Graphics I

Cross List: AD 488

Description: Credit 3UG/4G. Principles of interactive computer graphics. Raster and vector display, techniques and hardware considerations. Introduction to two-dimensional and three dimensional rendering.

Prerequisites: Credit or concurrent registration in CS 340.

Recent Textbooks: Required: Foley, van Dam, Feiner & Hughes, "Computer Graphics: Principles and Practice in C", Addison Wesley. Recommended: OpenGL Architecture Review Board , Shreiner, Woo, Neider, & Davis, "OpenGL® Programming Guide: The Official Guide to Learning OpenGL®, Addison Wesley, Latest Edition. OpenGL Architecture Review Board & Shreiner, "OpenGL® Reference Manual, Addison Wesley, Latest Edition.

Topics:

1. Historical development of computer graphics
2. Black and white graphics programming
3. Color raster graphics
4. Resolution and memory requirements
5. Look-up tables
6. Vector graphics and matrices
7. Surfaces, rotation and scaling
8. Fractals
9. Rendering
10. Lighting models

CS 491
Seminar
Description: Credit 3UG/4G. Subject matter varies from term to term and section to section, depending on the specialties of the instructor.
Prerequisites: Consent of the instructor.
Recent Textbooks: To be determined by the instructor.
Topics: To be determined by the instructor.

CS 493
Special Problems
Description: Credit 3UG/4G. Subject matter varies from term to term and section to section, depending on the specialties of the instructor.
Prerequisites: Consent of the instructor.
Recent Textbooks: To be determined by the instructor.
Topics: To be determined by the instructor.

CS 501
Computer Algorithms II
Cross List: MCS 501
Description: Credit 4. Advanced topics in algorithms. Lower bounds. Union-find problems. Fast Fourier transform. Complexity of arithmetic, polynomial, and matrix calculations. Approximation algorithms. Parallel algorithms.
Prerequisites: CS/MCS 401; and graduate standing.
Recent Textbooks: V.V. Vazirani, "Approximation Algorithms", Springer Verlag, 1st Edition.
Topics:
1. The selection problem
2. Lower bounds via information-theoretic methods
3. Lower bounds via adversary arguments
4. The union-find problem and its applications
5. The fast Fourier transform
6. Complexity of arithmetic operations
7. Complexity of polynomial and matrix operations
8. Introduction to approximation methods
9. Parallel algorithms

CS 502
Design and Analysis of Efficient Algorithms in Computational Molecular Biology
Description: Credit 4. Design and analysis of efficient algorithms for computational problems in molecular biology such as genome sequencing and construction of evolutionary trees.
Prerequisites: Grade of B or better in CS/MCS 401; and graduate or professional standing; or consent of the instructor.
Recent Textbooks: Setubal & Meidanis, "Introduction to Computational and Molecular Biology", Tompson Learning.
Topics:
1. Basics of molecular biology – DNA and proteins, genetic code, transfer RNA and protein sequences, biological chemistry
2. DNA mapping and sequencing problems
    a. Physical mapping: STS-content mapping, radiation-hybrid mapping, mapping by fingerprinting, an overview of clone overlap
    b. Large scale sequencing and sequence assembly
        i. Directed sequencing
        ii. Top-down, bottom-up sequencing: illustration using YACs
        iii. Shotgun DNA sequencing: shortest superstring problem
        iv. Sequencing by hybridization
3. Sequence alignments and string matching
    a. Suffix trees and exact string matching
    b. Sequence alignments
        i. Number of alignments
        ii. Global and local distance and similarity alignments of two sequences
        iii. Computing alignments in linear space
        iv. Multiple sequence alignments
            - Dynamic programming based approach
            - Special cases: sum of pairs and consensus objective functions
            - Alignment to a phylogentic tree
        v. Parametric sequence alignments
4. Sequences and evolutionary trees
    a. Ultrametric distances and ultrametric trees
    b. Additive-distance trees
    c. Parsimony: character-based evolutionary reconstruction
    d. Maximum parsimony, Steiner trees and perfect phylogeny
    e. Phylogentic alignments
    f. Connection between multiple alignments and tree construction

5. Probability and statistics for sequence alignments
    a. Global alignments
    b. Local alignments
    c. Extreme value distributions
    d. Poisson approximation and long matches
    e. Sequence alignment with scores

CS 503
Applied Graph Theory
Description: Credit 4. Paths, circuits, trees, cutsets, planarity, duarity, matrices and vector space of graphs, directed graphs, coloring, covering, matching and applications to switching networks and computer science.
Prerequisites: Graduate standing; and consent of the instructor.
Recent Textbooks: N. Deo, "Graph Theory with Application to Engineering and Computer Science". Prentice-Hall, 1974. Materials provided by Instructor.
Topics:
1. Introduction
2. Paths and circuits
3. Trees, distance, centers, f-circuits and traveling-salesman problem
4. Cut-sets, f-cutsets, connectivity,separability, and isomorphisms
5. Planar graphs, dual graphs, and planarity test
6. Vector spaces of a graph
7. Matrix representation of graphs
8. Coloring, minimal covering, partitioning, and maximum matching
9. Directed graphs, directed trees, matrices of digraphs, acyclic graphs and decyclization
10. Graph theoretic algorithms
11. Analysis and synthesis of switching (contact) networks
12. Topological formulas
13. Activity networks and real-time applications

CS 505
Computability and Complexity Theory
Description: Credit 4. Turing machines, undecidability, Rice's theorem, recursively enumerable sets, complexity theory, hierarchy theorems, alternation, parallel complexity classes, complete problems.
Prerequisites: CS 301.
Recent Textbooks: Required: M. Sipser, "Introduction to the Theory of Theory of Computation", PWS. C. Papadimitriou, "Computational Complexity", Addison Wesley. Recommended: Garey & Johnson, "Computers and Intractability: A Guide to the Theory of NP-Completeness", W.H. Freeman.
Topics:
1. Turing machine def. and examples
2. Equivalent models of computations, 2CM, RAM
3. Recursive and RE sets
4. Undecidability, diagonalization, reducibility
5. Reducibility and completeness
6. Time and space complexity
7. Complexity of DTM, NTM and ATM's
8. Complexity relationships, Savitch's theorem
9. NSPACE hierarchy, padding arguments
10. ASPACE vs. DTIME
11. CSAT, vertex cover, NP-complete problems
12. Cook's theorem
13. Quantified boolean formula problem
14. DSPACE complete problems, geography

CS 511
Artificial Intelligence II
Description: Credit 4. Predicate logic and resolution strategies, reasoning under uncertainty, incomplete information reasoning, state and change, planning, temporal reasoning knowledge representation, learning, advanced search techniques and current topics.
Prerequisites: CS 411.
Recent Textbooks: Russell and Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 2nd Edition.
Topics:
1. Predicate logic & resolution strategies
2. Reasoning under uncertainty
3. Incomplete information reasoning
4. State and change
5. Planning and action
6. Temporal reasoning
7. Knowledge representation
8. Machine learning
9. Advanced AI search techniques
10. Current topics

CS 514
Expert Systems
Description: Credit 4. Anatomy of expert systems, types of expert systems, architecture of an expert system, expert system tools, building an expert system; expert systems in the marketplace.
Prerequisites: CS 411.
Recent Textbooks: Giarratano & Riley, "Expert Systems", PWS, Latest Edition.

Topics:

1. Anatomy of an expert system
   a. Knowledge base
   b. Inference engine
   c. Working memory
2. Uses of expert systems
3. Architecture of an expert system
4. Building an expert system
5. Expert system tools
6. Expert system in marketplaces

CS 515
Advanced Computer Vision
Description: Credit 4. Analysis of 3-D scene images. Shape from shading, texture, line drawings, and surface orientation. Surface representation methods and reconstruction of 3-D scenes. Design of knowledge-based vision systems and 3-D applications.
Prerequisites: CS 415.
Recent Textbooks: Trucco & Verri, "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
Topics:

1. Visual perception
   Study of human visual system, illusions, brightness, resolution, color vision, color blindness and visual models
2. 3-D Shape analysis
   3-D moments, edge labeling, shape from line drawings, 3-D triangulation and polyhedral shapes
3. Surface representation
   Primal sketches, interpolation and approximation, discontinuities
4. Shape from shading
   Surface illumination, gradient space, reflectance map
5. Shape from texture:
   Texture measurements, isolation of texture elements (texels), texture parameters
6. Photometric stero
   3-D from single viewpoint but multiple light source
7. Relaxation methods in vision
   For scene labeling, stereo correspondence, and in general for reduction of ambiguity in vision problems
8. Extended Gaussian images
   Object-centered representation, Gaussian curvature, and Gaussian images
9. Knowledge-based vision systems
   Expert systems, model-based systems, procedural and structural knowledge-based systems
10. Applications
    3-D applications in robot navigation and bin-picking, scene reconstruction and 3-D positioning

CS 521
Statistical Natural Language Processing
Description: Credit 4. Statistical techniques for Natural Language Processing, including maximum likelihood estimation, hidden Markov models and probabilistic grammars; and their applications, including parsing, semantic inference, dialogue processing and summarization.
Prerequisites: CS 421 or consent of the instructor.
Recent Textbooks: Author, Title, 1988, Publisher.
Topics:

1. Foundations
   a. Mathematical foundations
   b. N-gram models
   c. Markov models
   d. Supervised classification
   e. Unsupervised classification
2. Applications
   a. POS tagging, word sense disambiguation
   b. Statistical parsing
   c. Semantic inferencing
   d. Dialogue processing
   e. Generation, summarization

CS 522
Human-Computer Interaction
Description: Credit 4. The computer-user interface: media, languages, interaction techniques, user modeling. Human factors in software development. Theory, experimental methods, evaluation, tools. Project required.
Prerequisites: CS 422.
Recent Textbooks: Buxton and Baecker, eds., Readings in Human-Computer Interaction, 1988, Morgan-Kaufmann.
Contemporary Articles from:

- International journal of Man-Machine Studies
- Human factors
- Journal of human-computer interaction
- IEEE software
- Proc. ACM Conference on Human Factors in Computer Systems (CHI)
- Proc. Workshop on Empirical Studies of Programmers

Topics:

1. The User Interface
    a. Landmark user interface
    b. Experimentation and evaluation
    c. Workspace paradigms
    d. User modeling
    e. Pointing, graphics, and direct manipulation
    f. Hypermedia
    g. Errors and assistance
    h. Design methods and tools
    i. Computer-supported cooperative work
2. Human factors in software development
    a. Experimental methods
    b. Landmark experiments
    c. Programming and specification languages
    d. Debugging and documentation

CS 523
Multi-Media Systems
Description: Credit 4. Principles of multi-media interface design for computer applications. Multi-disciplinary approaches to integrating text, still images, animation and sound into human-computer interfaces.
Prerequisites: CS 422; or consent of the instructor.
Recent Textbooks: Recent journals and conference papers provided by the instructor.
Topics:

1. Design methodology
2. User perception and cognition
3. Text features
4. Page layout
5. Photographic composition
6. Audio production techniques
7. Video games
8. Video production techniques
9. Music and music production
10. Drama
11. Computer mediated spaces
12. Design of spaces
13. Ethics

CS 525
Advanced Graphics Processor Programming
Description: Credit 4. Graphics Processing Unit (GPU) Programming languages, vertex shaders, fragment shaders, general purpose computing on GPUs.
Prerequisites: CS 488; or graduate standing; and consent of the instructor.
Recent Textbooks:
Topics:

1. Introduction to GPU Programming
2. GPU Language Study
3. Standard Effects from Shaders
4. More Sophisticated Effects From Shaders
5. GPGPU Concepts
6. Shader Case Studies
7. Project Presentations
8. Paper Presentations

CS 526
Computer Graphics II
Cross list: AD 588
Description: Credit 3. State of the art in computer graphics, visualization, and interactive techniques.
Prerequisites: CS 488; or consent of the instructor.
Recent Textbooks: Required: Schroeder, Martin & Lorensen, "The Visualization ToolKit: An Object Oriented Approach to 3D Graphics", Kitware Inc., 3rd Edition. Recommended: Ware, "Information Visualization: Perception for Design", Morgan Kauffman.
Topics:

1. Lighting models
2 Fast polyson algorithms
3. Volume rendering
4. User interface/graphical
5. Natural phenomena simulation
6. Curves and surfaces
7. Physically based modeling
8. Filtering
9. Hardware systems
10. Laboratory

CS 527
Computer Animation
Description: Credit 4. Theoretical and practical aspects of computer animation: keyframing, kinematics, simulation, and motion capture.
Prerequisites: CS 488; or consent of the instructor.
Recent Textbooks: K.M. Stanney, "Handbook of Virtual Environments Design, Implementation and Applications", Lawrence Erlbaum Associates, 2002.
Topics:

1. Historical developments in computer animation
2. Single-bit-per-pixel (RasterOp) animation techniques
3. Full-color raster animation techniques
4. Parametric animation
5. Rendering
6. Digital compositing
7. Real-time video computer animation systems

CS 528
Virtual Reality
Description: Credit 4. Principles of virtual reality and virtual environments: hardware, software, input and control devices, design issues, and quantitative assessment of user performance.
Prerequisites: CS 488; or consent of the instructor.
Recent Textbooks: Sherman & Craig, "Understanding Virtual Reality: Interface, Applications and Design", Morgan Kaufmann, 1st Edition.
Topics:

1. History
2. VR Display hardware
   a. Head mounted displays
   b. Boom displays
   c. Projection displays
   d. Graphics engines
3. VR Control hardware
   a. Data gloves
   b. Tracking devices
   c. Other sensors
4. VR Control software
   a. Stereographics
   b. Off-axis perspective
   c. Distributed processing
   d. Input devices
5. VR Display software
   a. Importing models
   b. Building models
      i. Space construction and editing
      ii. Object construction and editing
   c. Viewpoint control
   d. Successive approximation
   e. Boundary integrity and collision detection
   f. Control of time
   g. Coordination of multiple participants
6. Sound/Sonification hardware/software
7. Quantitative assessment and measurement
8. Applications for high performance computing and communications research
9. Case studies

CS 540
Advanced Topics in Software Engineering
Description: Credit 4. Formal methods; requirements and specification languages; program flow analysis; validation and verification; software metrics; program representations; software tools; software testing; software process.
Prerequisites: CS 440; or consent of the instructor.
Recent Textbooks: Tsai & Weigert, "Knowledge-Based Software Development for Real-Time Distributed Systems", World Scientific.
Topics:

1. Software process models
2. Requirements formalisms
3. Specification formalisms
4. Software design methods
5. Verification formalisms
6. Validation and testing techniques
7. Software metrics

CS 541
Software Engineering Environments
Description: Credit 4. Software configuration management; software quality assurance; software engineering economics; software factory; software reuse; computer aided software engineering; software prototyping.
Prerequisites: CS 540; or consent of the instructor.
Recent Textbooks: Heineman & Councill, "Component Based Software Engineering", Pearson Education, 2001.
Contemporary Articles from:
*IEEE Transactions on Software Engineering
*ACM Transactions on Programming Languages and Systems
*Proceedings of ACM/Sigplan Conference
*Proceedings of OOPSLA Conference
*Proceedings of Conference on LISP and Functional Programming
Topics:

1. Overview of software engineering environments
2. Software project management
3. Software engineering economics
4. Software configuration management
5. Software verification and validation control
6. Software quality control and assurance
7. Software reuse and software factory
8. Software prototyping
9. Modem CASE environments

CS 542
Distributed Software Engineering
Description: Credit 4. Fundamental concepts of distributed software. Task allocation algorithms, language concepts for concurrency and communication, analysis methods and tools, and formal models.
Prerequisites: CS 440.
Recent Textbooks: Notes provided by the instructor.
Topics:

1. Introduction to distributed computing and distributed software
2. Requirements specification issues

3. Design issues: partitioning, allocation, representation
4. Implementation constructs and languages
5. Testing: static and dynamic
6. Fault tolerance and current trends

CS 545
Formal Methods In Concurrent and Distributed Systems
Description: Credit 4. Formal methods in concurrent and distributed systems, particularly temporal logic and automata for specifying and reasoning real-time properties. Automated and manual techniques for checking correctness.
Prerequisites: Consent of the instructor.
Recent Textbooks: Notes provided by the instructor.
Topics:

1. Introduction
   a. Semantics of concurrent systems
   b. Shared memory, message passing models
   c. Proving correctness of programs
2. Temporal logics and automata
   a. Different temporal logics-linear, branching temporal logics
   b. Using automata as specifications
3. Model-checking and decision procedures
   a. Automated methods for checking correctness such as model-checking
   b. Decision procedures for temporal logics
4. Real-Time Specifications
   a. Temporal logics for real-time specifications
   b. Automata for real-time specifications
   c. Real-time model-checking
5. Manual proof methods
6. Other specification techniques - fixed point calculus, CCS, etc.

CS 553
Distributed Computing Systems
Description: Credit 4. Distributed computing systems terminology and design issues. Data communications protocols; distributed operating systems, resource management, and synchronization; security; database systems.
Prerequisites: CS 366 and CS 385.
Recent Textbooks: Notes provided by the instructor. Reference: Attiya & Welch, "Distributed Computing", McGraw Hill, Latest Edition.
Topics:

1. Motivation, objectives and characterization of distributed computing systems
2. Reference model for distributed system architecture and protocols
3. Identifiers (naming) in distributed systems
4. Resource management and distributed control/synchronization
5. Protection and security
6. Hardware/software relationships
7. Architecture and issues for distributed operating systems
8. Distributed database systems
9. Trends in distributed systems

CS 554
Advanced Topics in Concurrent Computing Systems
Description: Credit 4. Petri nets, methods and their applications to concurrent, distributed, parallel, and data-flow systems; and logic programming and rule-based systems.
Prerequisites: Graduate standing; and consent of the instructor.
Recent Textbooks: Notes provided by the instructor.
Topics:

1. Transition enabling and firing rule, and classification of nets
2. Introductory modeling examples: FSMs parallel processing, dataflow computing communication protocols, synchronization, formal languages, and multiprocessor systems
3. Behavioral properties: reachability, boundedness, liveness, reversibility coverability, persistence, synchronic distance, and fairness
4. Analysis methods: incidence matrix and state equation reduction rules, and coverability-reachability trees
5. Criteria for liveness, safeness, and reachability, subclasses of Petri nets
6. Analysis and synthesis of marked graphs
7. Token distance, maximum concurrency, and synthesis of synchronic distances matrices
8. Structural properties
9. Time Petri nets and minimum cycle time
10. Stochastic Petri nets and performance evaluation
11. High-level Petri nets for logic programming and rule-based AI systems

CS 559
Neural Networks
Cross List: ECE 559
Description: Credit 4. Artificial neural networks, perceptron, backpropagation, Kohonen nets, statistical methods, Hopfield nets, associative memories, large memory networks and cognition.
Prerequisites: Consent of the instructor.
Recent Textbooks: D. Graupe, "Principles of Artificial Neural Networks", World Scientific, 1997.
Topics:

1. Fundamentals of artificial neural networks for parallel computing
2. Perceptrons
3. Backpropagation
4. Kohonen nets and counterpropagation
5. Statistical methods
6. Hopfield networks
7. Associative memories
8. Adaptive resonance theory
9. Optical neural nets
10. Cognition
11. Neocognition

CS 560
Fuzzy Logic
Description: Credit 4. Crisp and fuzzy sets; membership functions; fuzzy operations; fuzzy relations and their solution; approximate reasoning; fuzzy modeling and programming; applications; project.
Prerequisites: Graduate standing; and consent of the instructor.
Recent Textbooks: T. Terano, K. Asai and M. Sugeno, "Fuzzy Systems Theory and its Applications", Academic Press, 1992.
Topics:

1. Crisp sets
2. Fuzzy sets, operations with fuzzy sets, membership functions, fuzzification.
3. Fuzzy relations and solution of relational equations
4. Approximate reasoning
5. Fuzzy rules
6. Fuzzy models and programming
7. Applications to areas such as control, expert systems, pattern recognition

CS 565
Physical Design Automation
Cross list: ECE 565
Description: Credit 4. Computer-aided physical design of integrated circuits; circuit partitioning and placement; floorplanning; global and detailed routing; timing optimization; general optimization tools: local search, constraint relaxation.
Prerequisites: CS 401 and (CS 466 or ECE 465).
Recent Textbooks: Sarrafzadeh & Wong, "An Introduction to VLSI Physical Design", McGraw Hill, Latest Edition. Sarrafzadeh & Lee, "Algorithmic Aspects of VLSI Layout", World Scientific, Latest Edition. Sarrafzadeh, Wang, & Yang, "Modern Placement Techniques", Kluwer Academy, 2002. Sapatnekar, "Timing", Kluwer Academy, 2004.
Topics:

1. Circuit partitioning
2. Cell placement
3. General optimization techniques:
   a. Simulated annealing
   b. Local search
   c. Mathematical programming
4. Floor planning / building block placement
5. Compaction
6. Signal routing
7. Clock routing
8. Timing optimization
9. Technology specific CAD: FPGAs
10. Design rule checking
11. Advanced topics

CS 566
Parallel Processing
Cross-list: ECE 566
Description: Credit 4. Parallel processing from the computer science perspective. Includes architecture (bus based, lockstep, SIMD), programming languages (functional, traditional and extensions), compilers, interconnection networks and algorithms.
Prerequisites: CS 466 or ECE 466; and CS 401.
Recent Textbooks: Grama, Karypis, Kumar & Gupta, "An Introduction to Parallel Computing: Design and Analysis of Algorithms", Addison Wesley, 2nd Edition.
Topics:

1. Computer architecture
   a. Models
   b. Locality and caching
   c. Sync
   d. Communication
2. Interconnection networks
   a. Hypercube, omega, CCC, shuffle and their relation
   b. Algorithms
3. Programming languages and compilers
   a. Operation scheduling
   b. Program analysis
4. Algorithms

CS 567
Principles of Computational Transportation Science
Cross list: UPP 567 & CME 567
Description: Credit 4. Builds on the fundamentals of transportation science and emphasizes its high-level computational aspects. Topics covered include database design and theory, spatial and temporal information systems issues and travel modeling.
Prerequisites: Grade of B or better or concurrent registration in UPP 560. Open only to PhD degree students; or consent of the instructor.
Recent Textbooks:
Topics:

1. Course Introduction and Overview
2. Modeling information systems: the relational model
3. Query languages; concurrency control; recovery; transactions and atomicity; indexing
4. Spatial-temporal issues: spatial and temporal modeling; query operators; spatial and temporal indexing
5. Query processing in distributed, mobile and peer-to-peer environments; moving objects databases
6. Fundamentals of computational transportation and real-time transportation environments; modeling transportation networks and traffic flow patterns
7. Aggregate network models; link performance measures; traffic simulation models; flow and real-time travel time forecasting
8. Dynamic OD flow estimation; dynamic traffic assignment
9. Modeling traveler behavior: aggregate and disaggregate behavior; modeling traveler response to travel information and location-based services
10. Implications for the ITA environment
11. Student presentations & student-led discussions
12. Course review and future directions for research

CS 569
High-Performance Processors and Systems
Cross-list: CS 569
Description: Credit 4. Instruction-level parallelism, multiple-instruction issue, branch prediction, instruction and data prefetching, novel cache and DRAM organization, high-performance interconnect, compilation issues, case studies.
Prerequisites: CS 466 or ECE 466; and graduate standing.
Recent Textbooks: Shen, "Modern Processor Design: Fundamentals of Superscalar Processors", McGraw Hill, 2005.
Topics:

1. Instruction-level parallelism
2. Multiple instruction issue
3. Branch prediction
4. Cache hierarchy
5. Compilation issues
6. Prefetching
7. New DRAM organizations
8. High-performance interconnect
9. Case studies
    a. State-of-the-art systems
    b. Performance analysis

CS 577
Object Stores
Description: Credit 4. Use, design, and implementation of object stores. An object store enables object-oriented programming to be extended by storing objects on disk and communicating objects between processes.
Prerequisites: CS 385 and CS 480; and graduate standing and knowledge of C++, or consent of the instructor.
Recent Textbooks: Notes provided by the instructor.
Topics:

1. The object store interface
    a. Transactions and ACID properties
    b. Pointer mapping (swizzling, hardware vs. software)
    c. Protection
    d. Storage allocation
2. Implementation of traditional stores logical layer
    a. Locking
    b. Fault tolerance
    c. Operating system implementation techniques (threads, processes, IPC, asynchronous I/O)
3. Implementation of object store logical layer
    a. Pointer mapping (swizzling, hardware vs. software)
    b. Virtual functions
    c. Protection
    d. Clustering
4. Implementation of physical storage layer
    a. Logging, write ordering, checkpointing, and recovery
    b. Disk organization and scheduling (including mirroring and RAID)
5. Survey of object oriented stores

CS 580
Query Processing in Database Systems
Cross List: IDS 511
Description: Credit 4. Query processing in deductive databases and in distributed/parallel databases systems.
Prerequisites: CS 480.
Recent Textbooks: Noted provided by instructor. Recommended: Yu & Meng, "Principles of Query Processing for Advanced Database Applications", Morgan & Kaufmann, 1998.
Topics:

1. Deductive databases
    a. Horn clauses
    b. Semi-naive method
    c. Naive method
    d. Counting method
    e. Magic set
    f. Reverse counting
    g. Propagation of constants
2. Distributed databases
    a. Fragment and replicate algorithm
    b. Partition relation for parallel processing
    c. Placement dependencies
    d. Semi-join algorithms
    e. Chain query optimization
    f. Tree query optimization
    g. Estimation of sizes of intermediate relations
    h. Local reduction
3. Optimization of nested queries
4. Multibase systems
5. Object-oriented Systems
6. Semantic query optimization

CS 581
Database Management Systems
Description: Credit 4. Concurrency control; reliability, recovery, data integrity, database machines and current topics.
Prerequisites: CS 480.
Recent Textbooks: Güting & Schneider, "Moving Objects Databases", Morgan Kauffman.
Topics:

1. Concurrency control in centralized and distributed database systems: locking, timestamp, and optimistic techniques
2. Recovery and reliability in database systems 2-phase, 3-phase commit protocols, system reconfigurations, integrity assertions
3. Database security: identification, authentication, authorization, statistical databases, data encryption
4. Database machines
5. Current topics

CS 582
Information Retrieval
Description: Credit 4. Document retrieval, office automation. Optimal retrieval, relevance feedback, clustered search, construction of clusters, model of term weighting, thesaurus construction, multimedia data, handling of audio and video.
Prerequisites: CS 480.
Recent Textbooks: Notes provided by the instructor. Reference: Yu & Meng, "Principles of Query Processing for Advanced Database Applications", Morgan Kaufmann, 1998.
Topics:

1. Optimal retrieval
2. Relevance feedback
3. Clustered search
4. Construction of clusters
5. Models for term weighting
6. Thesaurus construction
7. Data storage and retrieval
8. Hypertext

CS 583
Data Mining and Text Mining
Description: Credit 4. Provides students with a sound knowledge in data and text mining tasks and techniques, as well as ensure students ability to use this technology.
Prerequisites: CS 401 and graduate standing.
Recent Textbooks: Recommended: Han and Kamber, "Data mining: Concepts and Techniques", Morgan Kaufmann. Mitchell, "Machine Learning", McGraw Hill. Baeza-Yates & Ribeiro-Neto, "Modern Information Retrieval", Addison Wesley. Tan, Steinbach & Kumar, "Introduction to Data Mining", Addison Wesley, 1st Edition.
Topics:

1. Data pre-processing: data cleaning, transformation, feature selection and discretization
2. Association rule mining
3. Classification and scoring
4. Clustering (unsupervised learning)
5. Introduction to some other data mining tasks
6. Post-processing
7. Introduction to text mining
8. Information retrieval, text processing & representation
9. Text classification
10. Text clustering
11. Semi-supervised learning
12. Introduction to web mining

CS 586
Data and Web Semantics
Description: Credit 4. Data modeling and semantics; knowledge representation, querying, and reasoning for the semantic web; metadata; data integration and interoperation; web services; applications.
Prerequisites: CS 480 or equivalent.
Recent Textbooks Recommended books and papers:

1. Hjelm , "Creating the Semantic Web with RDF", Wiley, 2001.
2. Sowa, Brooks/Cole, "Knowledge Representation", 2000.
3. Fensel, "Ontologies: A Silver Bullet for Knowledge Management and Electronic Commerce", 2001.
4. Ahmed, Ayers, Birbeck et al., "XML Meta Data", Wrox Press, 2001.
5. Glass, "Web Services", Prentice-Hall, 2002.
6. Papers from the Proceedings of the International Conference on Semantic Web, Semantic Web Working Symposium, WWW conference, and other related conferences and workshops.

Topics:

1. Introduction to data models
   a. E-R model
   b. Semantic data models
   c. Frame-based models
   d. Knowledge representation
2. Languages, reasoning, querying for the semantic web
   a. XML and XML schema
   b. RDF and RDF schema
   c. DAML+OIL and OWL
   d. Xquery
   e. RQL and RDQL
   f. Logic for the semantic web
3. Ontologies and ontology engineering
   a. Definition
   b. Languages for ontologies
   c. Systems to create and maintain ontologies
   d. Large ontologies
   e. Alignment and merging
4. Semantic data integration and interoperation
   a. Global as view and local as view
   b. Ontology-based integration
   c. Modeling heterogeneous data
   d. Querying
   e. Data translation
   f. Machine learning approaches
5. Applications
   a. Search
   b. Personalization
   c. Context-awareness
   d. Sensor data management
   e. Geospatial applications
6. Web services
   a. Web services stack
   b. SOAP
   c. WSDL
   d. UDDI
   e. WSFL, XLANG
   f. Semantic issues

CS 587
Computer Systems Security
Description: Credit 4. Security policies; security properties; protection mechanisms for single systems, networked systems, and distributed computing; trust; attacks on computer systems.
Prerequisites: CS 485 or CS 450; and graduate standing; or consent of the instructor.
Recent Textbooks: Notes & papers provided by instructor. Reference: Pfleeger and Pfleeger, "Security in Computing", Prentice-Hall, 3rd Edition.
Topics:

1. Intro to security
   a. Defining security and protection
   b. Attacks
   c. Single systems security
   d. Distributed security
2. Security Models
   a. Partial orders and lattices
   b. Bell-LaPadula
   c. Biba
   d. Lipner
   e. Clark/Wilson
   f. Information flow
   g. Chinese walls
   h. Covert channels/non interference
3. Protection of single systems
   a. Kernel vs. application protection
   b. Harrison-Russo-Ullman Undecidability result
   c. Jones-Lipton-Snyder Take-Grant linear result
   d. Unix protection model
   e. Posix 1e protections
   f. Role-based access controls
   g. Type enforcement
   h. Lattice protection models
   i. Issues with kernel-based protection mechanisms
4. Protection of distributed systems
   a. Cryptography background
   b. Network protections including appl. level & kernel level encr. & auth.
   c. Federated trust
   d. Remote authentication
   e. Distributed denial of service attacks

CS 588
Security and Privacy in Networked and Distributed Systems
Description: Credit 4. Introduction to cryptographic principles; network authentication; confidentiality; integrity; distributed denial of service; certificates and distributed architectures for security; multiorganization trust; privacy, anonymity in distributed systems.
Prerequisites: CS 401; and CS 450 or CS 485; or consent of the instructor.
Recent Textbooks:
Topics:

1. Applied Cryptography
    a. Encryption, Decryption, and Authentication requirements and assumptions: Public Key, Private Key, Cryptographic hashing.
2. Networking Security Protocols
    a. Authentication
    b. Shared Key
3. Distributed Denial of Service
    a. Attack taxonomy
    b. Defenses
4. Distributed systems
    a. Theory of Distributed authentication
    b. Certificate based systems
    c. Kerberos
    d. Trust negotiation systems
5. Privacy
    a. Anonymity (onion ring)
    b. Steganography

CS 594
Special Topics
Description: Credit 4. Subject matter varies from term to term and section to section, depending on the specialties of the instructor.
Prerequisites: Consent of the instructor.
Recent Textbooks: To be determined by the instructor.
Topics: To be determined by the instructor.

CS 597
MS Project Research
Description: Credit 0-9 hours. Satisfactory/unsatisfactory grade only. May be repeated for credit, but only minimum & maximum of 4 hours will apply towards MS degree. A research design or reading project approved by the committee appointed by the director of graduate studies. For CS majors only.
Prerequisites: Consent of the instructor.
Topics: See Instructor

CS 598
MS Thesis Research
Description: Credit 0-16. Satisfactory/unsatisfactory grade only. May be repeated for credit, but only minimum & maximum of 8 hours will apply towards MS degree. MS thesis work under the supervision of a faculty advisor. . For CS majors only.
Prerequisites: Consent of the instructor.
Topics: See Instructor

CS 599
PhD Thesis Research
Description: Credit 0-16 hours. Satisfactory or unsatisfactory grade only. May be repeated for credit. PhD thesis work under supervision of a graduate advisor. For CS majors only.
Prerequisites: Consent of the instructor.
Topics: See Instructor

8/09

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