INTRODUCTION

This handbook is intended to be a focal point of information for computer science graduate students and their advisors. Its users are expected to be familiar with the contents of the Class Schedule, Handbook for Graduate Assistants and Graduate School catalog, including both the general material and that specifically pertaining to the Computer Science Program. Graduate School required forms are referred to throughout this document as well as our departmental forms. Valuable information about the graduate faculty, their research interests, and current research facilities is available on the departmental website.

This document is addressed to students already admitted to the Graduate Program in Computer Science. While information in it may interest those applying for admission, it is not intended to present any information directly pertinent to the admissions process. Every effort has been made to present this material in a straightforward and accurate manner. Any minor errors or ambiguities will not affect the actual rules and processes of the Graduate School and the Program.

DIRECTOR OF GRADUATE STUDIES (DGS)

The Director of Graduate Studies, referred to as the DGS, oversees all aspects of graduate studies. Professor George Karypis will be the DGS for this academic year. Sara Howard is the coordinator for graduate student services and most questions can be directed to her.

The Department of Computer Science and Engineering's office is located in 4-196 Keller Hall. All departmental forms mentioned in this handbook can be obtained online. All forms that are to be signed by the DGS should be given to Sara Howard via the receptionist in this office. The DGS will send the forms to the Graduate Student Services and Progress Office (GSSP) on the student's behalf.

As the DGS handles the activities of a large number of graduate students, the DGS can see students on matters concerning the graduate program by appointment only. Make appointments through Sara Howard at 625-1592. The DGS's general office hours are used only for instructional purposes pertaining directly to the DGS's classes. For urgent requests, please contact the DGS via e-mail at dgs@cs.umn.edu.

ADVISING

The DGS is the official advisor of all students unless an advisor was assigned at the time of admission. After students take some courses in their area of interest, attend seminars, and individual discussion, students will become acquainted with some of the faculty. Then students will be able to choose an advisor for their plan B project, plan A thesis, or doctoral dissertation. Only faculty with graduate education responsibilities are eligible to serve as advisors for graduate students. The advisor-advisee relationship is a mutual one and an advisor must also agree to advise any student. If the faculty member of the student's choice agrees, then the student will inform the DGS of this with the departmental form ("Declaration of Advisor") signed by the new advisor. A student can change advisors again if desired or needed, and this must be indicated to the DGS using the same form. However in this case both the new and the previous advisor must sign to acknowledge the change. All PhD students should have a research advisor chosen by the end of their first year. Since the majority of MS students do the Plan C, which is coursework without a research project or thesis, they are not required to have a research advisor. Any questions they have can be directed to the DGS or Graduate Coordinator. For those who do decide to do Plan A or Plan B, they should have a research advisor chosen by the beginning of their second year.
REGISTRATION

Graduate student registration occurs at the beginning of the registration period for each semester. The day that a student registers will change each semester. Students can check their registration queue by going to onestop.umn.edu and clicking on “When to register” which is located on the right hand side. If the class is closed students may sign up on the waiting list as long as the waitlist remains open.

If a class is closed and the waitlist is closed and a student still wishes to take the class, then the student must show up for the first day of class. The instructor will then be able to tell how many people are actually intending to take the class and how many additional students will be allowed into the class. Many times we are limited to the classroom size and so students should always have an alternative in case they are not able to register for a particular class. If a student is able to get into a closed class, a permission number will be needed. Upon approval of the instructor, the front desk receptionist will issue a permission number to the student. Students are strongly discouraged from registering for more courses than they intend to take as this takes a seat from another student who may wish to take the class.

Students are required to register no later than the end of the second week of the semester. Deadlines to Cancel/Add, change of grading options and refunds are all available at onestop.umn.edu. No registration changes are permitted after the last day of instruction.

The details of registering for classes can be found on the website for One Stop under Registration. Graduate students must register each fall and spring semester to maintain their active status. Students who need to register only to maintain active status may register for Grad 999, which is a no-fee, no-credit option. International students must check with the International Student and Scholars Services office to see if there are any restrictions or additional paperwork needed to register for this course or any reduced course load. Registration for Grad 0999 will be limited to 4 occasions. If additional semesters are needed, special exception must be requested from the DGS. Those students who have not registered in each semester but wish to return must apply for readmission. Prior admission is not a guarantee for readmission. Those readmitted may be required to take additional classes and/or examinations to complete their degree. They may also be required to retake courses and/or examinations (such as the WPE or prelim oral).

DEGREE REQUIREMENTS

MASTER OF SCIENCE DEGREE (M.S.)

An M.S. degree requires at least 31 total credits. There are three options to the M.S. degree; Plan A thesis, Plan B project and Plan C course work. Students electing plan A must have at least 22 course credits and 10 thesis credits. Students choosing the plan B method must register for their plan B project using the Plan B course number (#8760). Thesis credits are not accepted for a plan B M.S. degree. The Plan C requirements are described in more detail below but it is essentially a coursework master’s that includes project work at a significant level done within the confines of one or two courses. Students must have an advisor if they wish to do Plan A or Plan B but no advisor is required for the Plan C.

Of the required class credits for any plan, at least 16 of them must be Computer Science Program courses including 3 breadth courses and one credit of the CS Colloquium. All credits must be 5000 level or above, and at least 3 of the total credits must be a regular 8000 level CS course. For Plan B students, the course CSci 8760 Plan B project is in addition to the required 3 credits of an 8000 level course. Plan C students must take two regular 8000 level courses. It is required that these 8000-level credits be Department of Computer Science course credits. Students may take grad level courses in a related field, defined as non-CS courses that contribute to a student’s research or career goals but need not be from the same department. Requirements for a minor are established by each program so if a student desires to declare a minor, those requirements must be met along with the consent of the DGS of the appropriate graduate program. However, it is no longer required that students take related field courses or minor courses although it is still an option if a student desires.

The Minor Field is defined as a minimum of 6 semester credits of coursework outside CS in a single department of the College of Science and Engineering (e.g., EE, Math, Stat, IOR, etc.), Management, Cognitive Science and/or other related fields for a designated minor. The minor is awarded by that department and their requirements for a minor must be met in order to qualify for a minor in that field.
One credit of the Computer Science Colloquium is mandatory and must appear on a student's graduate degree plan form.

M.S. students are expected to maintain a GPA of at least 3.25 for all courses listed on their graduate degree plan. No course for which the student has received a grade below a C- can count towards the degree. There is no foreign language requirement for M.S. degrees.

All requirements for the master's degree must be completed and the degree awarded within 5 calendar years after initial enrollment in the graduate program. Students who are unable to complete the degree within the time limits described due to extraordinary circumstances may submit a time extension request to the DGS and the college for an extension of up to 12 months.

**M.S. Degree Committees**

An M.S. degree committee consists of three faculty members who have formal graduate education responsibilities. Two will be from the Computer Science Program (which includes a student’s advisor who serves as the chair) and one from an outside program. The outside person usually represents the related or minor field if declared. The advisor and student should discuss appropriate members and these individuals should be contacted for preliminary approval. All members must have graduate education responsibilities in order to serve on an MS committee. Once members have agreed to serve, the student must submit their names on the Examining Committee site. This form is routed for DGS and collegiate approval and then sent to graduate school to enter the information. Committee members cannot be appointed until after the graduate degree plan has been approved and entered into the student’s record.

For Plan B programs, the committee serves as the committee for the oral examination. For Plan A programs, the committee serves as a reading committee for the thesis. The committee must approve the thesis as ready for defense and administers the final oral examination. The Graduate Coordinator must be notified of the final oral defense date.

Plan C students are not required to defend in front of a degree committee so none is appointed. Instead, the DGS must sign the Final Examination form and return it to the GSSP office to indicate official completion of the degree.

If it becomes necessary to make changes to any committee, the DGS must be notified by email, outlining the change, the reason for it, and any suggestions for revised membership along with the written consent of the new committee member. The advisor should concur with the change. The student must then update this information on the same Examining Committee site before the final exam takes place. If the Final Exam Report form has already been received by the student and/or advisor, the unavailable committee member’s name can be crossed off and the new committee member’s name can be written in.

**Plan A Procedures**

The Plan A committee will review the thesis and determine when it is ready for the final oral examination. The advisor and the other committee members must be notified that the thesis will be delivered on a particular date, at least two weeks in advance of that date. All members of the examining committee must then have at least two weeks to read the thesis after it has been delivered. The committee certifies that the thesis is ready for defense by signing a Thesis Reviewer's Report. This form is included in the graduation packet and can be requested online any time after the graduate degree plan has been approved by the program, the college and entered into the student’s records by the GSSP office. The Thesis Reviewer's Report form should be given to the committee members for signature. The same committee will also serve as the final oral committee. The Final Examination Report form must be obtained from the GSSP office before the final oral examination, which is scheduled with the committee members. The committee indicates the student’s performance on this report form. The student is then responsible for bringing the form directly over to the GSSP office, 160 Williamson Hall. The student must also supply the GSSP office with two unbound copies of the thesis, including any changes required by the committee. The Graduate School web site has information about formatting of the thesis. The degree will be awarded on the last day of the month indicated on the student’s Application for Degree providing that all requirements have been met.
Plan B Procedures

The graduate degree plan must be submitted at least one semester before the Plan B project defense. The student and advisor should discuss appropriate members for the committee; verify that they have graduate education responsibilities and that they are willing to serve. The student should then go online to appoint them to the committee after the graduate degree plan has been approved. This is the committee that will serve as the final oral exam committee. The exam will include a presentation of the student’s project and discussion with questions and answers. The duration of the exam will be approximately one hour. The “Final Examination Report” form should be obtained and brought to the exam. This form is included in the Graduation Packet which can be requested any time after the graduate degree plan has been approved by the advisor, DGS and college and entered into a student’s record by the GSSP office. The committee members will indicate their satisfaction or dissatisfaction with the defense by signing the form. The signed form should then be returned to the GSSP office, 160 Williamson Hall.

Plan C Procedures

The requirements for the M.S. (Plan C) are explained in more detail here:

- Each student must complete 31 credits of graduate-credit coursework, including:
  - 1 credit of CSci Colloquium (CSci 8970 S/N)
  - At least 16 graduate credits from 5xxx or 8xxx courses with a CSci designator (including courses to fulfill the breadth requirement as well as 6 credits of CSci 8000 level courses).
  - Other graduate-level credits to reach a total of at least 31 credits which may include related field courses from programs other than CS or courses for a graduate minor.

- All CSci courses included in the graduate degree plan must be taken A-F if the A-F grading basis is offered.
- Students must maintain a minimum GPA of 3.25 on courses appearing in the graduate degree plan and no courses with a grade below a C- can be included.
- In addition to the above requirements, students must complete, through their coursework, a total of 100 hours of significant project work, at least one written report, and at least one oral presentation; such work may be completed individually or in group activities:
  - Students are responsible for documenting their completion of these requirements on a Plan C progress tracking form. The documentation includes instructor certification of the requirements met by the student.
  - Projects are independent research, design, development, theory, or practice activities, completed alone or in groups, and graded for credit by a faculty member authorized to teach courses for graduate credit within a course taken by the student for degree credit. A course project may fulfill either one-half of the requirements (a half-project of 50-99 hours of average expected effort) or the full requirement (a full-project of 100 or more hours of average expected effort). Ordinary assignments where all students in the class complete the same work do not count towards project credit. We define “average expected effort” as the instructor's estimate of the number of hours of effort required per student for a typical graduate student to complete a project earning a grade of B. It is the instructor's responsibility to indicate in the course syllabus whether the course fulfills project requirements, and if so whether the project is a half-project or a full-project. In most cases, half-project courses will be 3-credit courses where the project accounts for at least half the course grade; full-project courses will usually be independent or directed study projects taken for 3 credits (CSci 8994 is the preferred course number).
  - Written reports must be at least 2000 words (or several components within the same course totaling at least 2000 words), must report either on a project (as defined above) or on some separate research effort, and may be completed individually or in groups.
  - Oral presentations must be at least 5 minutes long (at least 10 minutes for group presentations), and must present research (the student's or that of others) or project work by the student.
  - For a student to receive credit for a project, report, or oral presentation, the faculty member grading the project must certify the completion of that component (including whether a completed project is a half-project or full-project) and must verify that the student received a grade of B or higher on the component. The student also must receive a grade of B- or higher in the course in which the component was contained.
Many of our graduate level courses will qualify as Plan C courses and the student should check with the instructor if it is not indicated in the syllabus but seems to contain the requisite research component.

The graduate degree plan form should be submitted by the end of the third semester (or before the beginning of the last semester). The DGS will serve as the default advisor. No committee is required for this plan and therefore no exam will be necessary. However the form "Final Report Form" must be submitted to the Computer Science office to be signed by the DGS. This form is included in the Graduation Packet which can be requested any time after the graduate degree plan has been approved by the DGS, the college and verified by the GSSP office.

For more information on completion procedures, please see the following web sites: Master's Plan A; Master's Plan B; Master's Plan C. We also have two documents on our web site with additional completion and graduation instructions.

**MASTER OF COMPUTER SCIENCE DEGREE (MCS)**

Candidates for this degree must complete a minimum of 31 semester credits in graduate courses with a minimum of 16 credits in the major. All major credits must be 5000 level or above, and at least 6 of the total credits must be 8000-level courses. These 8000-level credits must be Department of Computer Science course credits. One credit of the Computer Science Colloquium is mandatory and should be taken before filing a graduate degree plan and should be included on that form. Related field or minor courses are not required but are optional.

The Minor Field is defined as a minimum of 6 semester credits of coursework outside CS in a single department of the College of Science and Engineering (e.g., EE, Math, Stat, IEOR, etc.), Management, Cognitive Science and/or other related fields for a designated minor. The minor is awarded by that department and their requirements for a minor must be met in order to qualify for a minor in that field. A minor is not required but is optional.

The Related Field is defined as credits of coherent coursework outside CS in a field within the College of Science and Engineering, Management, Cognitive Science and other related fields. These courses should contribute to a student’s greater understanding of computer science or career goals.

All degree candidates must maintain a GPA above 3.0 after completion of 8 credits. No course for which a grade of a C- or below can count towards the degree.

Each student needs to satisfy the departmental breadth requirement. However, none of the MS research requirements including the Plan C course project requirements, the Plan B project nor Plan A thesis of the Master of Science degree is required. There is no requirement for a final oral examination although the Final Report form must be submitted to the Grad Coordinator to be signed by the DGS.

All requirements for the MCS degree must be completed and the degree awarded within 5 calendar years after initial enrollment in the graduate program. Students who are unable to complete the degree within the time limits described due to extraordinary circumstances may submit a petition to the DGS and the college for an extension of up to 12 months.

**PH.D. DEGREE**

Although Graduate School has no requirement for total credits on a doctoral degree plan, the Computer Science program requires at least 31 course credits, of which 16 must be Computer Science program courses including 5 breadth courses and one credit of Colloquium which is mandatory. Credits used to obtain a master's degree can be used to obtain a doctoral degree. We also require at least 6 credits in a supporting program or in a minor field. A minor must also be approved by the DGS of the program from which the minor is taken. The Graduate School also requires a minimum of 24 thesis credits (to be taken after passing the preliminary oral exam) in addition to course credits. There is no foreign language requirement for doctoral students in the Computer Science program.

The Minor Field is defined as a minimum of 12 semester credits of coursework outside CS in a single department of the College of Science and Engineering (e.g., EE, Math, Stat, IEOR, etc.), Management, Cognitive Science and/or other related fields for a designated minor. The minor is awarded by that department and their requirements for a minor must be met in order to qualify for a minor in that field. The minor must be declared before passing the Preliminary Oral Examination.

The Supporting Program is defined as a minimum of 6 semester credits of coherent coursework outside CS in a field within the College of Science and Engineering (e.g., EE, Math, Stat, IEOR, etc), Management, Cognitive Science and other related fields. These courses should contribute to the student’s research or career goals.

The doctoral graduate degree plan must be submitted at the same time that the student submits the Written Preliminary Examination Report, WPE. The WPE, graduate degree plan form submission and oral preliminary exam should take place no later than the student’s 4th semester. Students will be expected to complete the courses listed on the
doctoral degree program with a GPA of at least 3.45. No course for which a grade below a C- has been received can count towards the doctoral degree.

All requirements for the PhD degree must be completed by five years from the end of the semester following the semester in which the student passes the preliminary oral examination. A petition may be submitted to the College of Science and Engineering to extend this time limit. The Computer Science Program and the College are both quite strict about extending this limit. Petitions for a second extension are almost never granted.

Background Knowledge Requirement

The concepts covered here are considered to constitute a minimal core body of knowledge with which all PhD graduates of our department should be familiar. These concepts are required prerequisites for many of our graduate classes; students must know these concepts to succeed in these classes.

Background concepts
- **Machine Architecture and Organization.** Covers basic hardware/software components of a computer system, including data representation, machine-level programs, instruction set architecture, processor organization, memory hierarchy, virtual memory, compiling, and linking.
- **Theoretical Foundations.** Must cover one of the following two bodies of knowledge:
  - **Algorithms and Data Structures.** Analysis, data structures, and algorithms, e.g.: basic algorithm analysis (recurrences, asymptotic notation), basic data structures (lists, stacks, queues, heaps, hash tables, (balanced) binary search trees), basic algorithms (sorting, searching, graph traversal, shortest paths, minimum spanning trees).
  - **Formal Languages and Automata Theory.** Logical/mathematical foundations of computer science. Specific topics include formal languages, their correspondence to machine models, lexical analysis, string matching, parsing, decidability, undecidability, limits of computability, and computational complexity.
- **Operating Systems.** Topics include processes/threads, process coordination, interprocess communication, asynchronous events, memory management/file systems.
- **Programming & Software Development.** Topics include: design and analysis of programs, software development tools and methods, debugging, I/O, state machines, exception handling, testing, coding standards, software lifecycle models, requirements analysis.

Satisfying the Background Knowledge Requirement

The Background Knowledge Requirement may be satisfied in five different ways:

1. By passing the GRE Computer Science subject exam with a score in the 90th percentile or higher.

2. By passing an appropriate undergraduate course with a grade of B or higher. The appropriate courses at The University of Minnesota are noted below. However, a student may take such courses anywhere, and simply needs to point out on their transcript any qualifying courses. The Director of Graduate Studies is responsible for approving the use of courses to satisfy the background requirement. The relevant UMN courses are:
   - **Machine Architecture and Organization** = CSCI 2021
   - **Theoretical Foundations:**
     - **Algorithms and Data Structures** = CSCI 4041
     - **Formal Languages and Automata Theory** = CSCI 4011
   - **Operating Systems** = CSCI 4061
   - **Programming & Software Development** = CSCI 3081

3. By passing the final exam for the appropriate UMN class with a grade of B or higher

4. By passing a graduate course with a grade of B or higher for which an appropriate undergraduate course is a clearly defined prerequisite. For example, at the University of Minnesota, CSCI 5421 "Advanced Algorithms and Data Structures" has CSCI 4041 "Algorithms and Data Structures" as a prerequisite. Thus, getting a B in 5421 is evidence that a student has adequate background in Algorithms and Data Structures. Students must check with the Director of Graduate Studies to verify that a specific graduate course demonstrates knowledge of a particular background area.

5. By petitioning the Director of Graduate Studies to accept some other experience as evidence of adequate background. For example, a student could have extensive industrial software development experience without having taken a course on software development.

**Students must satisfy the background requirement within their first year in the PhD program.** If they are not able to do so, they may – with the support of their advisor – petition the Director of Graduate Studies for an extension.
**Prerequisite Table** – Graduate courses for which background undergraduate courses are substantial prerequisites.

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**Written and Oral Preliminary Examination for the Doctorate**

Graduate School policy requires that all doctoral candidates pass both a Written and Oral Preliminary Exam. All PhD students will be requested to take the courses CSci 8001 (Fall) and CSci 8002 (Spring), Introduction to Research in Computer Science I and II. These courses will assist students in developing their research interests and capabilities and prepare them to begin their first major research project or survey paper. This research project paper or survey paper along with an oral exam will be the basis for evaluating a student’s ability to do research. The goal of the Written and Oral Preliminary exams is to serve as an early test of a student’s research abilities. It is not a thesis proposal; a separate later examination will be required for this purpose.

**The Written Report**

Different areas and different advisors use different methods and have different expectations of what a student must do to demonstrate research ability. Therefore, we cannot specify precisely what a student's report and oral presentation must include. However, we can offer a few “best practice” examples that would be acceptable in most if not all research areas.

- **Completed research project.** A report on a research project completed while a graduate student at the University of Minnesota. This could be a published paper with the student as the major author although further instructions and information will be available when the student is ready to begin.
- **Literature review.** A careful and insightful review of research in the student's specialty. This review should demonstrate a student's understanding of key research topics and methods in the area and show that he or she can identify interesting open research problems and appropriate means to address those problems.

The report should be at least the length of a published conference paper, 6000-8000 words, or 8-10 pages in the ACM SIG Proceedings format.

**The Oral Preliminary Exam**

Before scheduling the Oral Prelim, students must submit a written report to the Coordinator who will forward it to the student’s examining committee. Once the committee approves that report, the student may schedule the Oral Prelim. Therefore, students should submit their written report at least two months before their preferred Oral Prelim date. The Oral Prelim should be taken as soon as the student is ready. Students must take the exam no later than their second year in the PhD program (however, with the support of their advisor, students may petition the Director of Graduate Studies for an extension). Students must pass the exam by the end of their third year.

**Exam Scope and Format**

The student will present the material in the written report. The committee will question the student about that material and directly related material, such as the methods that were used and possible alternative methods, ideas for future work, potential problems and obstacles. The committee is encouraged to probe the student's understanding of related material and concepts.

**Possible outcomes of the exam**

The committee may pass the student or fail the student. If the student fails, the committee may or may not choose to give the student another chance to pass the exam. A student can have at most two chances to pass the Oral Prelim. As stated above, students must pass the exam within three years of entry to the PhD program.

**Committee Composition**

Graduate education policy requires that the committee include three members from the Computer Science graduate faculty and one external member. The student, in consultation with her/his advisor, will nominate three members, two internal (including the student’s advisor) and one external. The DGS will approve these choices and will appoint one
member of the committee from the department's Preliminary Oral Examination committee, selecting a person who is not in the student's research area. Once the committee membership has been decided upon and all have agreed to serve and the GDP has been approved, the student must then appoint the committee by submitting their names to this online form. Reminder: the same committee will examine both the written report and the oral exam.

Relationship to a student's M.S. research (Plan A Thesis / Plan B Report)

The same piece of research can be used to satisfy both the MS (Plan A or B) and Oral Prelim requirements. If this is done, there are four possible outcomes of the exam:

- The student can pass both exams.
- The student can fail both exams.
- The student can pass the MS, fail the Oral Prelim, and be given the option to retake the Oral Prelim.
- The student can pass the MS, fail the Oral Prelim, and not be given the option to retake the Oral Prelim.

Preliminary Oral Examination

To formally be admitted to Ph.D. candidacy, a student must pass the preliminary oral examination. Once the written report has been approved by the committee, the graduate coordinator will notify the GSSP office. Upon approval of the graduate degree plan which was previously submitted, the student will need to schedule the Preliminary Oral Exam with the GSSP office. The GSSP office will send a "Report of Preliminary Oral Examination for Doctoral Candidates" form to the chair of the examining committee. The examining committee must vote either unanimously or 3 to 1 to pass the student. Another possibility may be 'passed with reservations', in which case the committee will inform the student in writing within one week of what is required to remove the reservations. Students who fail the examination may be terminated or may be allowed, upon unanimous recommendation of the committee, to retake the examination, provided the original examining committee conducts the reexamination. No more than one reexamination is allowed.

Thesis Proposal Examination

The Preliminary Oral Exam formerly was seen as a thesis proposal exam. However, under the new format, a separate exam will be required for this purpose. The thesis proposal examination should be taken within 1-2 years after passing the Preliminary Oral Examination. This examination should be organized around a presentation of a student's thesis proposal, but exam committee members are entitled to test the full range of a student's expertise to evaluate preparation for thesis research and the suitability of the thesis research plan. The committee members for the thesis proposal exam can be the same as the prelim oral exam although the departmental representative can be replaced. The student, in consultation with her/his advisor, should review the committee and verify committee membership by contacting the graduate coordinator. Committee members may vote to pass, pass with reservations, or fail. At least three passing votes are required to pass the exam. Students who fail the examination may be terminated, or may be allowed, upon unanimous recommendation of the committee, to retake the examination. No more than one reexamination is allowed and must consist of the same committee members. The thesis proposal examination is internally administered; students should schedule the exam with their committee and contact the front desk to reserve a space. Once you have scheduled the exam, email the graduate coordinator exam details. She will send you a Thesis Proposal Examination Report Form. You must return the form with all signatures to the graduate coordinator within 24 hours of the examination.

Thesis

Upon completion of the thesis, the student may request the Graduation Packet. Included in the packet is the "Thesis Reviewer's Report Form" along with the Application for Degree. The student must be sure that the committee membership has been updated indicating which of the members will be the three reviewers and which member will serve as chair since the advisor cannot be the chair for the final defense. The advisor, co-advisor (if there is one) or one other CS member as well as the outside member must be designated reviewers.

Copies of the thesis should be given to all members of the committee. All members of the committee read the thesis, although only those designated as thesis reviewers sign the form indicating that the thesis is ready for defense. The student must notify the advisor and the other members of the committee at least two weeks in advance that the thesis will be delivered on a particular date. All members of the examining committee must then have at least two weeks to read the thesis after it has been delivered. The thesis reviewers sign the Reviewer's Report form to certify that it is ready for defense. The Reviewer's Report form must be submitted back to the Graduate School at least one week before the date of the final oral examination. The reviewers must decide unanimously that the thesis is ready for defense.

Final Oral

The student is responsible for scheduling the thesis defense with the committee members and notifying the GSSP office at least one week in advance. The GSSP office will send a "Final Oral Examination Report Doctoral Degree" form to the chair of the committee; this will not be the advisor. It is wise for the student to verify that this form was indeed received
by the Chair of the committee. The Department of Computer Science requires all Ph.D. students to hold their final thesis defense within ninety days of obtaining the signatures of all assigned committee members on the "Reviewers Report on the Ph.D. Thesis" form which states that the thesis is ready for defense. Those who fail to take their thesis defense due to scheduling conflicts may take the exam only if they again obtain the signatures of all the committee members within ninety days. In other words, for each signed form, the candidate may have up to ninety days to take the final thesis defense.

The Graduate School has adopted a policy of open public thesis defense for doctoral candidates. This means that the final oral examination is open to the public. To ensure complete openness the Computer Science Program has adopted somewhat more stringent requirements. Once the readers have approved the thesis, one copy must be made available for public perusal, preferably on-line. The availability of this copy, along with the time and place of the thesis defense must be announced in writing and via electronic mail to graduate faculty and students, at least one week in advance. This announcement must contain a one-page descriptive abstract of the thesis to be defended, the name of the advisor and the URL of the thesis.

The Graduate Coordinator should be notified of the date and time of the final defense. The Coordinator will answer any last minute questions and assist in making a room reservation if needed.

It is important to note that the student has only one chance to take the final oral.

The committee of the final oral will complete the "Final Oral Examination Report" form which needs to be delivered directly to the GSSP office. To be awarded the degree the student must receive no more than one dissenting vote from the total examining committee. All the necessary changes in the text of the thesis must be made before it is bound. All requirements must be observed, including submitting one electronic copy of the thesis with a hard copy of the signature page with your advisor’s signature to the GSSP office, before the degree can be awarded. The department also requests a bound copy of the thesis. Upon departure, the student must verify his/her address is correct on their account, submit the name of the first employer (after graduation) and return keys for their office and/or the labs.

The GSSP office has provided a document that outlines the PhD Completion Procedures.

**DEGREE PROGRESS**

Please refer to the Degree Completion Procedure documents mentioned under the Master's degree and PhD degree above. We believe that a Master's degree can be completed in two years and a doctorate in five years. While we do not hold students precisely to these time periods, students who exceed them by substantial amounts of time without completing their degrees will be asked to explain their lack of progress. Graduate Education policy has also set time limits. According to the policy on "Master’s Degree: Performance Standards and Progress", all requirements for the master's degree must be completed and the degree awarded within five calendar years after initial enrollment in the graduate program. All requirements for the doctoral degree must be completed and the degree awarded within five calendar years after passing the preliminary oral examination.

Ph.D. Thesis" form which states that the thesis is ready for defense. Those who fail to take their thesis defense due to scheduling conflicts may take the exam only if they again obtain the signatures of all the committee members within ninety days. In other words, for each signed form, the candidate may have up to ninety days to take the final thesis defense.

It is Graduate School policy that programs annually review the progress of all MS and PhD students. Each fall, CS PhD students will be required to complete an Annual Review form. This will then be forwarded to a student’s research advisor who will then make comments on each student's progress. All forms will be reviewed by the DGS and progress will be compared to the Progress Guidelines presented in Appendix A. Anyone who deviates considerably from these expectations will be discussed by the faculty as a whole to determine any possible actions and then contacted by the DGS to explain the faculty's decisions. MS and MCS students will not be required to complete a review form but the DGS will review progress and GPA of each master’s student and contact any student who appears to be having difficulty.

Students and advisors should select coursework so as to best make orderly and timely progress, always keeping the student's interests and the requirements of their areas of specialization in mind. New students should concentrate on disposing of the breadth requirement and should also focus on courses that will prepare them for research in their chosen area.

**BREADTH REQUIREMENT**

The purpose of the Breadth Course Requirement is to expose students to diverse Computer Science research topics and methods. PhD students must take a total of five (5) courses with at least one course in each of the three different breadth areas.

PhD students must have an average GPA of 3.45 or higher for the five courses they use to satisfy the Breadth Course Requirement. Students have three (3) years to satisfy this requirement. If students want to take a more advanced course than the listed options – typically, one for which one of the listed options is a prerequisite – they may petition the Director of Graduate Studies to use this course for satisfying the requirement. Permission to do so is rarely granted but if a student has compelling reasons, it will be considered. Students may petition the Director of Graduate Studies to transfer credit for up to two courses to use for satisfying the Breadth Course Requirement.
Master’s students (MS and MCS) are required to take three (3) courses, one from each of the areas. Students must
maintain an overall GPA of 3.0 for MCS and 3.25 for MS candidates for all courses on their degree program, as well as
those used to satisfy the breadth requirement. Substitutions are rarely permitted and transfer courses will not count
towards the breadth requirement.

All courses must be taken for graduate credit and on the A-F grading basis.

Breadth Areas

There are three breadth areas:
  o Theory and Algorithms
  o Architecture, Systems, and Software
  o Applications

Theory and Algorithms
  • 5302: Analysis of Numerical Algorithms
  • 5304: Computational Aspects of Matrix Theory
  • 5403: Computational Complexity
  • 5421: Advanced Algorithms & Data Structures
  • 5481: Computational Techniques for Genomics
  • 5525: Machine Learning

Architecture, Systems, and Software
  • 5103: Operating Systems
  • 5104: System Modeling and Performance Evaluation
  • 5105: Introduction to Distributed Systems
  • 5106: Programming Languages
  • 5161: Introduction to Compilers
  • 5204: Advanced Computer Architecture
  • 5211: Data Communications and Computer Networks
  • 5221: Foundations of Advanced Networking
  • 5231: Wireless and Sensor Networks
  • 5451: Introduction to Parallel Computing: Architectures, Algorithms, and Programming
  • 5708: Architecture and Implementation of Database Management Systems
  • 5801: Software Engineering I
  • 5802: Software Engineering II

Applications
  • 5115: User Interface Design, Implementation and Evaluation
  • 5125: Collaborative and Social Computing
  • 5271: Introduction to Computer Security
  • 5461: Functional Genomics, Systems Biology, and Bioinformatics
  • 5471: Modern Cryptography
  • 5511: Artificial Intelligence
  • 5512: Artificial Intelligence II
  • 5521: Introduction to Machine Learning
  • 5523: Introduction to Data Mining
  • 5551: Introduction to Intelligent Robotic Systems
  • 5561: Computer Vision
  • 5607: Fundamentals of Computer Graphics I
  • 5608: Fundamentals of Computer Graphics II
  • 5609: Visualization
  • 5611: Motion and Planning in Games
  • 5619: Virtual Reality and 3D User Interaction
  • 5707: Principles of Database Systems

GRADUATE DEGREE PLANS FOR MASTER’S & PHD DEGREES

Graduate education policy requires every graduate student to file a graduate degree plan for each degree for
which he/she is a candidate. On the graduate degree plan the student will list the courses that have been taken and those
that are planned to take to complete the degree. For Master's degree candidates, this plan should be filed during the
student's third semester or before the beginning of the last semester. Doctoral students are expected to file their plans in the semester in which they submit their WPE report. Doctoral students who are interested in obtaining a Master's degree in addition to their PhD must file two separate graduate degree plans, one for each degree. Courses used to obtain the MS can be reused for the PhD except for CSci 8760 or MS thesis credits. The graduate degree plan is filled out in consultation with the advisor, who then must approve it. If a minor is stated on the graduate degree plan, the DGS of the minor graduate program must also approve it. The graduate degree plan then is approved by the DGS in Computer Science and the graduate education dean of the College of Science and Engineering. Possible members of the doctoral examining committee should be discussed by the student and advisor and their agreement to serve on the committee should be obtained. The student will then appoint the committee members by submitting their names to the online form for assigning and updating the prelim oral committee.

The courses listed on the graduate degree plan must only be those that qualify towards degree completion, as explained below. In addition, these courses must generally be relevant to the subject area of the thesis or plan B paper and provide the background and depth normally expected of a student receiving the degree for which the student is a candidate. Only 5000 and 8000 level courses will be accepted on the degree plan. No courses for which a student has received a grade below a C- are allowed to count towards the degree. If CS 5991 or 8991 independent study or CS 5994 or 8994 directed research credits are used, a separate sheet submitted with the degree plan must explain the nature of the research or independent study. Limits will be placed on the number of these credits that can be used on the GDP. Consult with the DGS before registering for more than one of these courses. All courses taken from the Department of Computer Science and Engineering must be taken A-F, unless they are only offered S-N. Courses in other departments may be taken S-N. The total number of credits taken S-N cannot exceed one third of the total graded course credits on the graduate degree plan.

Any credits that qualify to be transferred to a student’s plan will be approved at the time of graduate degree plan submittal. Only the credits transfer, grades do not and do not count towards the student’s GPA. Generally, only credits from accredited schools with comparable graduate degree programs will be approved for transfer. Credits from outside computer science may be approved. Approval must be obtained from the advisor and the DGS. Credits transferred from other institutions must be graduate level (post baccalaureate), have been taken as graduate level work and have been taught by faculty authorized to teach graduate courses. For Master’s degree programs, at least 60 percent of the coursework must be completed while registered as an enrolled graduate student at Minnesota; therefore no more than 40 percent of Master’s degree program credits can be transferred. Part of the transferred credits can be from courses taken while a student had non-degree seeking status at the University of Minnesota. However, registration for those courses must have been done by using the form 99PRD. Request for Graduate Credit for a non-degree seeking student. No more than 12 of these non-degree credits can be transferred to either the MS or PhD programs.

PETITIONS

Once it has been submitted, a student must strictly conform to the graduate degree plan. If there is need to deviate from it, the graduate degree plan can be changed by petition. The petition is a special form available on line. The petition should list the courses to be added and/or removed and must again be approved by the advisor, the DGS, the DGS of the minor field (if a minor has been formally declared) and then submitted to the GSSP office.

There is also a form to be used to apply for a time extension. A student desiring a time extension should complete the form stating a cogent reason why the extension should be granted. Any request for a time extension should be filed before the time limit has expired and is to be signed by the advisor, the DGS of the minor field if a minor is declared and the DGS before being sent to the GSSP office for entry.

COMMENCEMENT ATTENDANCE

MS and MCS graduates are required to be completing their last semester of coursework of their approved graduate degree plan if they wish to attend commencement ceremonies.

Ph.D. graduates are expected to defend their thesis before the end of the summer of the spring in which they wish to attend commencement. Students are then eligible to attend commencement ceremonies.

Commencement is held once a year at the end of spring semester and is hosted by the College of Science and Engineering in cooperation with several other colleges. The announcement of the commencement date and time as well as the procedure to sign up to attend will be sent to the student’s x.500 account.
FINANCIAL ASSISTANCE

Teaching Assistantships

The Computer Science and Engineering Graduate Program provides financial support to many of its doctoral students through teaching assistant appointments. The number of such appointments is difficult to predict because of budgetary considerations and variations in enrollment. Unfortunately, not all students applying for such appointments can be accommodated.

New students are awarded teaching assistantships as part of the admissions process. Continuing students may apply in the Spring to be considered for TA positions for the next academic year. Dates when applications for the next year will be accepted will be announced on the grads mailing list, so interested students should subscribe to that list and watch their mail. Any continuing student who did not apply last Spring is welcome to submit an application for the current academic year anytime during the summer and fall. Such applications will be merged with those submitted the previous spring, and will be considered for any openings that arise during the current academic year. TA application forms are available online.

Summer Session teaching assistants are selected from among students who have served as teaching assistants in the previous academic year. These students will be notified of summer possibilities during the preceding Spring semester.

Appointments are based on a number of criteria. The primary criteria are:

- Language ability and communication skills. TA applicants must be able to speak and write well, explain CS concepts clearly, relate well to students, etc. Students whose native language is not English must pass the University’s English requirements prior to receiving a TA appointment. See the Center for Teaching and Learning for more information.
- Teaching experience and quality of past TA performance. Students with superior past teaching or TA performance will be given preference in TA appointments.
- Departmental need. Each year there are a few courses for which it is difficult to find qualified TAs. Applicants with demonstrated experience in these courses will be given preference.
- Ph.D. vs. Masters: the department gives preference in TA offers to Ph.D. students. M.S. students are considered if there are no suitably qualified Ph.D. students available. (Students currently in the M.S. program who are in transition to the Ph.D. program are not considered Ph.D. students until the change is officially completed. Moreover, the department usually allows such a change only with strong faculty backing, which usually implies that the involved faculty member(s) will support the student with a research assistantship, rather than having the student rely on a teaching assistantship.) Moreover, MCS students are not eligible for CS&E TA appointments.
- Degree Progress: students making substandard progress have lower priority for TA positions.

More information on the appointment process and criteria can be found in the TA handbook

Most appointments are for 50% of full time basis; some may be at 25% (or, on rare occasions, for other percentages such as 12.5%). A 50% appointment provides a 100% tuition benefit; a 25% appointment gives a 50% tuition benefit. For more detailed information please refer to the Graduate Assistants Employment page. Graduate assistant salaries vary from year to year. For the salary currently in use see the section on salary ranges.

Fifty-percent (or half-time) teaching assistants (TAs) are expected to provide an average of 20 hours per week of service, and twenty-five-percent (or quarter-time) TAs 10 hours. The workload is not constant, being lighter some weeks and heavier others, such as the weeks around examinations. A teaching assistant's specific duties are assigned by the instructor. These may include, among other things, conducting laboratory or recitation sessions, assisting students with laboratory and homework assignments, grading assignments and examinations, and assisting the instructor with the preparation of course materials. In addition, depending on a TA's experience with the course materials or the particular instructor, the TA may be required to attend the lectures and/or do all the assignments.

Teaching assistants must be enrolled for a minimum of six credits each semester, except for doctoral candidates (those who have passed the preliminary oral examination for the Ph.D. degree and have completed all Doctoral thesis credits) who must enroll for a minimum of one credit (CSci 8444). There may be additional registration requirements imposed by sources external to the Graduate School and international students should check with the International Student & Scholar Services office.

International students on F-1 and J-1 visas are not allowed to be employed more than 20 hours per week during the academic year except during vacation periods. This is a regulation of the Immigration and Naturalization Service (INS), not the University of Minnesota. The INS has unequivocally stated that Assistantships are considered employment and are subject to the 20-hour per week rule.
The Computer Science and Engineering Program participates in TA training and orientation programs that are sponsored by the Center for Teaching and Learning of the University of Minnesota. Teaching assistants will be notified if such programs are mandatory. Even when they are optional, students are urged to attend them.

Additional information on teaching assistantships is available in the TA handbook. This includes information on the offer process and criteria that will be useful to prospective TAs, as well as rules and teaching tips that current TAs should know.

Teaching Assistantships Departmental Policy

It is the Department's policy:

1. To limit eligibility for graduate TA appointments to 6 semesters total. This is irrespective of the percentage of appointment. However, summer TA appointments are not included in this count.
2. To make as many 50% appointments as possible for the whole academic year as are consistent with budgetary prudence and the known and confidently anticipated needs of the Department.
3. To make the above appointments before the end of Spring semester of the year preceding the year of appointment.
4. To save at least eight appointments for new students and make the balance from continuing students. New student appointments are made during the admission process, based on merit.
5. To allow new students not appointed to file applications for Spring consideration.
6. To make summer appointments from among students who had an appointment in one of the semesters of the preceding academic year.
7. To minimize the number of combined RA-TA appointments and split assignments.
8. To enforce departmental rules regarding eligibility, total percentage of appointment, and degree progress in an objective manner consistent with the needs of the Department.
9. That the total TA/RA support from all sources not exceed 50% in any semester (including summer sessions) for anyone with a CS TA appointment. Exceptions to this policy can be granted only by the Department Head in advance under extraordinary circumstances.
10. Students who have a record of cheating not be given TA appointments.

Research Assistantships

Computer science graduate students are eligible for appointments to the position of research assistant on various research grants and contracts held by faculty members. Such appointments are recommended by the principal investigators and not by the DGS. Accordingly, students who are interested in being research assistants (RAs) should contact faculty members directly and indicate their interest in working with them on their research. Once a student has demonstrated his/her ability to contribute to the research, the possibility of an appointment can be discussed. However, most faculty members select research assistants from among their degree advisees and outstanding students in their research seminars. Research assistantships count as part of the total departmental support, and are similar to TA appointments in regards to remission of tuition. The principal investigator determines the duties of each RA.

Research assistants must be enrolled for a minimum of six credits each semester, except for advanced doctoral candidates (those who have passed the preliminary oral examination for the PhD degree and completed all 24 Doctoral thesis credits) who must enroll for a maximum of one credit (CSci 8444 PhD FTE). There may be additional registration requirements imposed by sources external to the Graduate School and international students should check with the International Student & Scholar Services Office.

Salary for Assistantships in C.S. Department

For the 2014-2015 academic year, the salary of teaching and research assistants for the period covering Fall and Spring semesters has been set at $18221 ($23.36 per hour).

Graduate Education policy requires that all RAs/TAs be registered as full time students in each Fall and Spring semester during which they hold appointments of at least 12.5%. It also requires that all RAs/TAs be registered for an appropriate number of credits before the end of the second week of classes. RAs/TAs who fail to properly register by this deadline will forfeit their assistantship.

Most appointments are for 50% of full time; some may be at 25% (or, on rare occasions, for other percentages such as 12.5%). The 100% tuition benefit for graduate assistants working an average of 50% time will be the dollar value of the Graduate School's tuition band ($7,729 per semester for 2014-2015) or the dollar value of the Graduate School's one-credit tuition cost ($1,250.67 per semester for 2014-2015) depending on the student's payroll class. For a 25% appointment the tuition waiver will be a 50% waiver of the $7,729 tuition cost, again depending on the student's payroll class. For more detailed information please refer to the Graduate Assistant Office web page.
Students must be aware of the policy where all non-refundable fees are the student’s responsibility. If a student cancels a class after the 100% refund deadline, the student is responsible for paying the difference. Also, if a student registers for more than 14 credits in any semester, the student will be responsible to pay the tuition charged for any credits above 14 credits. Advanced Doctoral students who register for CSci 8444 (PhD FTE) will only be allowed to register for that one credit and only that one credit of tuition will be paid by their assistantship. Students who need to register for additional credits after completing all thesis credits need to discuss their situation with the Coordinator.

It is the policy of the Department that the total TA/RA support from all sources not exceeds 50% in any semester for anyone with any departmental TA appointment. Violating this policy is grounds for terminating TA appointments. Only the Department Head can grant exceptions to this policy, in advance, under extraordinary circumstances.

Fellowships

College of Engineering and Science Fellowships are available only to new students and are awarded as part of the admissions process. Therefore, these will not be discussed further here. In addition, the Graduate School offers a variety of fellowships of a general nature. Watch the Graduate School and departmental web sites for announcements of these fellowships as well as the grads email alias.

The Program is allowed to nominate a limited number of candidates for dissertation fellowships. There is no guarantee that the Program's nominees will be awarded such fellowships. Nominees must have passed the preliminary oral examination and have satisfied a variety of other conditions. Announcements of these fellowships will be sent to the grads email alias so students must be sure to subscribe to this list. Since the application form is quite difficult and requires the cooperation of the advisor and the DGS, potential candidates should consult both with their advisors and the DGS early in the process. Those waiting until the last moment are unlikely to be nominated.

Employment

Because of their special skills, computer science students may be able to obtain appointments from other departments. If a computer science graduate student receives an appointment from another department he/she is subject to the salary rates of that department. The Computer Science Program is not directly involved with such appointments, so students should deal directly with the department or program concerned. However, students with appointments in other departments must inform the DGS of this in a timely manner. Failure to do so can result in a loss of both current and future support from the Computer Science Program.

The CSE Career Center for Science and Engineering also has an Employment Opportunities Program for graduate students. Although this program is open to all CS graduate students, the primary purpose is to help those students who are not financially supported by the department to make themselves known to outside companies that have need for their skills. We hope this coordination/matching service will benefit both our students and potential employers. Details are handled directly by the CSE Career Center for Science and Engineering, Room 105 Lind Hall. The office will compile a student’s data and send it out to companies that indicate a need for a student’s particular skills. All negotiations after that would be between the student and the company. The CSE Career Center also offers services for alumni.

GENERAL DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING INFORMATION

CSGSA

All computer science graduate students are automatically members of the Computer Science Graduate Student Association (CSGSA). The CSGSA holds regular meetings throughout the school year. These meetings are a forum for graduate students to voice any concerns or ideas they might have about improving the graduate program and graduate student life. The CSGSA also plans several social events throughout the year. The CSGSA has representation on several departmental committees. For more information, please see their web site.

Mailboxes and Bulletin Boards

Mailboxes and a copy machine are located in room 4-201 Keller Hall. Access to this room is gained through the use of a student’s U card. Mailboxes are available to CS graduate students who wish to have one. These mailboxes are for University use only and no personal mail should be sent to the departmental address. All PhD students will be assigned a mailbox as departmental materials are distributed to these mailboxes. Since most University business is directed to a student’s x.500 account, most students have no need for a mailbox. However, if one is desired, an email should be sent to cse-desk@cs.umn.edu. All mailboxes will be set up by the 2nd week of the semester.
A good deal of information is posted on the bulletin boards outside of the Department office, 4-192 Keller Hall, and in the mailroom 4-201 Keller Hall.

**Keys and Space**

All computer science graduate students have access to the graduate students' computer lab (2-216 Keller Hall) and the William Munro Graduate Student Lounge (2-212 Keller Hall). These facilities are available to graduate students for their research and study. *Access* is available through use of the student’s U card.

**Systems Information**

All computer science graduate students are entitled to accounts on the departmental machines in the graduate computer labs. Computer Science graduate students should apply for a [CS computer and email account](http://www.cs.umn.edu). New students should complete the application form upon arrival.

Information about the departmental computing systems and staff is available on line. All graduate students should subscribe to the grads email alias for departmental announcements.

The Computer Science graduate computer lab is located in room 2-216. For information about what equipment is located in that room, please see [http://www.cs.umn.edu/resources/facilities/labs.php](http://www.cs.umn.edu/resources/facilities/labs.php). All the other laboratories in Keller Hall are under the direction of various faculty members. Accounts on equipment in these laboratories must be arranged through the respective professors in charge of each of them.

**Useful locations, hours, and phone numbers**

- **Department of Computer Science and Engineering Office**
  4-192 Keller Hall
  200 Union St SE
  Minneapolis, MN 55455
  8:00 - 4:30 M-F
  (612) 625-4002
  [www.cs.umn.edu](http://www.cs.umn.edu)

- **Graduate Admissions**
  309 Johnston Hall
  101 Pleasant St SE
  Minneapolis, MN 55455
  8:00 - 4:30 M-F
  (612) 625-3014
  [http://www.grad.umn.edu/admissions/index.html](http://www.grad.umn.edu/admissions/index.html)

- **Graduate Student Services and Progress Office**
  160 Williamson Hall
  231 Pillsbury Dr.
  Minneapolis, MN 55455
  8:00 – 4:00 M-F
  (612) 625-3490
  [www.grad.umn.edu_students/index/html](http://www.grad.umn.edu_students/index/html)

- **Graduate Assistant Office**
  200 Donhowe
  319 15th Ave SE
  Minneapolis MN 55455
  8:00-4:30 M-F
  (612) 624-7070
  [http://www1.umn.edu/ohr/gae/](http://www1.umn.edu/ohr/gae/)

*Hours subject to change*
Figure 1: SUGGESTED TIMELINE FOR PHD STUDENTS. Note that most of the dates are guidelines, i.e., they are suggested, not required. The requirements for taking and passing the Written and Oral Preliminary Exams are exceptions: the exams must be attempted during the second year and passed no later than the end of the third year. ** The time frame from when the Written Report or Paper is submitted to the committee to when the Preliminary Oral Exam is passed should be no more than two months.**
APPENDIX B - Lists of Faculty

The Computer Science and Engineering Faculty and Their Research

Professors
Daniel Boley, Ph.D., Stanford. Numerical linear algebra, data mining, control theory, fault tolerance, robotics.
John Carlis, Ph.D., Minnesota. Database systems.
David Hung-Chuang Du, Ph.D., Washington (Seattle). High-speed networking, multimedia applications, high-performance computing over workstation clusters, database design and CAD for VLSI circuits.
Maria Gini, Doctor of Physics, Milan. Artificial intelligence, robotics, intelligent agents.
Mats Heimdahl, Ph.D., California at Irvine. Software engineering, software testing, model-based development, safety critical systems.
Ravi Janardan, Ph.D., Purdue. Computational geometry, computer-aided design and manufacturing, computer graphics, solid modeling.
George Karypis, Ph.D., Data mining, bio-informatics, parallel processing, CAD, and scientific computing.
Joseph Konstan, Ph.D., California at Berkeley. Human-computer interaction, social computing, recommender systems, public health Computing.
Vipin Kumar, Ph.D., Maryland. High performance computing, data mining.
Gopalan Nadathur, Ph.D., U of Pennsylvania. Programming language design and implementation, computational logic.
William Papanikolopoulos, Ph.D., Carnegie Mellon. Robotics, computer vision, sensors for transportation applications, control, and real-time systems.
Stefanos Roumeliotis, Ph.D., USC. Distributed robotics, autonomous vehicle navigation, sensor networks, fault detection and identification, human-robot interaction.
Yousef Saad, Doctorat, Grenoble (France). Sparse matrix computations, iterative methods, preconditioning methods, parallel computation, matrix eigenvalue problems, nonlinear equations, control theory.
Shashi Shekhar, Ph.D., California at Berkeley. Spatial database, data and knowledge engineering, spatial data mining, GIS.
Jaideep Srivastava, Ph.D., California at Berkeley. Databases, multimedia systems, data mining.
Loren Terveen, Ph.D., Texas at Austin. Human-computer interaction, computer supported cooperative work, computer-mediated communication, recommender systems.
Anand Tripathi, Ph.D., Texas at Austin. Distributed and network computing systems, object-oriented programming, fault-tolerant computing.
Jon Weissman, Ph.D., Virginia. Distributed and networked systems, cloud computing, mobile computing, scheduling and resource management, high performance computing, operating systems.
Pen-Chung Yew, Ph.D., Illinois at Urbana-Champaign. Parallel machine organization, domain-specific parallelizing compilers, system virtualization, dynamic binary manipulation, performance evaluation, parallel simulation.
Zhi-Li Zhang, Ph.D., Massachusetts. Computer networking, multimedia systems.

Associate Professors
Arindam Banerjee, Ph.D., Texas, Austin, Data mining, machine learning, scalable algorithms for learning.
Abhishek Chandra, Ph.D., UMass @ Amherst, Operating Systems, Computer Networking, Multimedia Systems, and Distributed Systems.
Tian He, Ph.D., University of Virginia, Wireless/mobile communication, sensor networks, real time computing, embedded & distributed systems.
Nicholas Hopper, Ph.D., Carnegie Mellon, Internet privacy, anonymity and censorship resistance; applied cryptography; network & distributed systems security.
Victoria Interrante, Ph.D., North Carolina at Chapel Hill. Visualization, computer graphics.
Ibrahim Volkan Isler, Ph.D., University of Pennsylvania, Robotics and sensor networks.
Daniel Keefe, Ph.D., Brown University, Interactive Data Visualization, 3D Computer Graphics, 3D and Multi-touch User Interfaces.
Rui (Ray) Kuang, Ph.D., Columbia University, Computational Biology, protein structure prediction and protein function analysis, machine learning, discriminative learning, string kernels and network diffusion.
Gary Meyer, Ph.D., Cornell. Computer graphics, color synthesis and reproduction.
Mohamed Mokbel, Ph.D., Purdue, Database systems, data streaming, query processing algorithms, spatio-temporal database engines.
Antonia Zhai, Ph.D., Carnegie Mellon, programming languages, compiler optimization, computer architecture and pervasive computation/communication systems.

Assistant Professors
Stephen Guy, Ph.D., North Carolina at Chapel Hill, Physically-based animation and simulation, robotics, interactive computer graphics, multi-agent systems.
Brent Hecht, Ph.D., Northwestern University, Relationship between big data and human factors, geographic information and its application in location-aware technologies.
Erik Van Wyk, Ph.D., University of Iowa. Extensible and declarative specifications of programming and modeling languages and the generation of tools, such as compilers, translators, analyzers, or optimizers, from such specifications.
Antonia Zhai, Ph.D., Carnegie Mellon, programming languages, compiler optimization, computer architecture and pervasive computation/communication systems.
Computer Science Faculty with Graduate Education Responsibilities

**Computer Science Faculty**

* Arindam Banerjee
* Daniel Boley
* John Carlis
* Abhishek Chandra
* David Du
* Maria Gini
* Stephen Guy
* Tian He
* Brent Hecht
* Mats Heimdahl
* Nicholas Hopper
* Victoria Interrante
* Ravi Janardan
* George Karypis
* Volkan Isler
* Daniel Keefe
* Dan Knights
* Joseph Konstan
* Rui (Ray) Kuang
* Vipin Kumar

* Denotes senior members of the Computer Science Graduate Faculty.

**Graduate Faculty from Other Departments**

* Vladimir S. Cherkassky, Professor of Electrical and Computer Engineering
  Lucy E Dunne, Associate Professor of Design, Housing/Apparel
  Paul Johnson, Professor of Management Sciences
  Rahmet Ulya Karpuzcu, Assistant Professor of Electrical and Computer Engineering
* Daniel J. Kersten, Professor of Psychology
  Larry Kinney
* David Lilja, Professor of Electrical and Computer Engineering
  Richard F. Maclin, Professor of Computer Science, Duluth
  Bernie Mettler, Associate Professor of Aerospace Engineering and Mechanics
  Vassilios Morellas, Program Director of Center for Distributed Robotics
  Ted Pedersen, Professor of Computer Science, Duluth
  Sanjai Rayadurgam, Program Director for MSSE, Computer Science and Engineering
  Martin Saar, Associate Professor of Earth Sciences/Geology/Geophysics
* Sachin Sapatnekar, Professor of Electrical and Computer Engineering
  John Sartori, Assistant Professor of Electrical and Computer Engineering
  Yunhe Shen, Assistant Professor of Urologic Surgery
  Michael Steinbach, Research Associate of Computer Science and Engineering
  Hudson Turner, Associate Professor of Computer Science, Duluth
  Michael W. Whalen, Program Director for MSSE, Computer Science and Engineering

* Denotes senior members of the Computer Science Graduate Faculty.

**Note:** Senior Members may advise both MS & PhD students. Members may advise MS students and co-advising PhD students in conjunction with a senior member.