SCHOOL OF COMPUTING
UNIVERSITY OF UTAH

Graduate Handbook

For the Academic Year 2021-2022

The official handbook for the MS and PhD programs offered at the School of Computing at the University of Utah

Please carefully read this document and the Frequently Asked Questions.

All questions concerning the graduate program should be directed to grad-advisors@cs.utah.edu.

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General Requirements

The requirements in this section apply to all graduate students (MS and PhD), unless noted otherwise.

The Director of Graduate Studies (DGS) is the responsible entity for all graduate degree related issues. He/she will act in consultation with the track directors for the administration of the Computer Science program and the Computing Degree programs.

Compliance with the requirements stated in this handbook is recorded in the GradTrack system: https://gradtrack.cs.utah.edu.

Registration Requirements

Full-time graduate students in the School of Computing are required to register for 9 credit hours, which includes regular courses, seminars, and research credits as appropriate. This is especially the case for students being supported via research or teaching assistantships. Students who are not being supported by the school are required to take nine credit hours to be classified as full-time by the graduate school.

Graduate School policy dictates that a graduate student who receives tuition benefit during any semester in which he or she holds an assistantship, fellowship, or traineeship, is required to register for at least nine credit hours, including thesis research and seminars. Tuition benefit details are described at https://gradschool.utah.edu/tbp/tuition-benefit-program-guidelines/.

Students must be registered for at least three credit hours per semester, exclusive of summer semester, to remain in a graduate degree program. Students who do not maintain continuous registration and who have not been granted a leave of absence by the Graduate School are subject to being discharged from their degree program. Please consult https://gradschool.utah.edu/graduate-catalog/registration/ for full details on continuous registration.

Students choosing the thesis option or doing a PhD dissertation must be registered for at least three credit hours during the semester of their thesis defense. Once a student has passed the thesis defense, the student does not have to register during the next term. The student needs to turn in the final thesis / dissertation to the thesis office within 90 days.

Course Requirements

All degree programs have certain course requirements. To graduate, this coursework must appear on a student's approved program of study, a customized course plan developed by the student in conjunction with their committee. Courses that count toward graduation must be on the program of study. The following default restrictions apply to these courses:

- CS courses must have a course number of 6000 or above, unless otherwise explicitly stated in a track or program description
- Courses from other departments must be 5000 or above

- Be directly related to the student's degree
- MS students must earn a grade of at least a C, PhD students at least B
- The GPA over all courses in the program of study must be at least 3.0 (MS) and 3.5 (PHD) respectively.

In the subsequent pages of this document, each degree program and/or track may specify modifications and/or additions to these restrictions. Students should also consult the Graduate School Handbook concerning any university requirements.

A student may register for CS 6020 if that student writes and publishes a peer-reviewed article based on research performed in the School of Computing at the University of Utah. Registration must be after the article has been accepted for publication. The contribution of the student to the article should be equivalent to that conferred by first authorship. The paper should be published in a respectable outlet. It is the responsibility of the student's advisor and the DGS to determine whether the student has made such a contribution, and whether the outlet is of sufficient quality. This paper must be accepted for publication prior to the end of the second year of study.

Course Waivers and Substitutes

A student may obtain a waiver for any of the required courses by demonstrating prior knowledge (e.g., successful completion of a similar course taken at another recognized University). This waiver is obtained by petitioning the committee, program/track director, and DGS. The waiver procedure should be initiated by first contacting the Graduate Advisor. Waiving a required course does not reduce the graduate credit-hour requirement.

Students may petition track directors to substitute courses for electives if they can demonstrate that a substitute is relevant to their degree.

Example: *June is a master's student in the Image Analysis Track. June has already completed an applied math master's degree at another accredited institution. During that degree, she has taken an image processing class that she used towards earning her applied Math degree. Because June has already used this course for a degree, she cannot transfer it and use it towards her MS in Computing. However, June can petition the track director to waive the requirement to take CS 6640 – Introduction to Digital Image Processing for the Image Analysis track. If that waiver is granted, she will be able to take another course to fulfil her credit hour requirement instead.*

See also Credit For Previous Courses (PhD Students) and Transfer Credit (MS Students).

Non-Matriculated Coursework

A student may only count up to nine credit hours of non-matriculated graduate work at the University of Utah toward any graduate degree unless the student's registration for more than nine credit hours is specifically approved in advance by the School of Computing Director and the Dean of the Graduate School.

Graduate Coursework as an Undergraduate

Graduate courses taken as an undergraduate at the University of Utah cannot be counted towards a degree program unless a petition for graduate credit was filed with the University's Registrar at the time the course was taken. Graduate courses taken as an undergraduate may be used to waive requirements.

Leave Of Absence

If a student does not plan to take classes during a Fall or Spring semester, a leave of absence must be requested. Contact your Graduate Advisor for the proper procedures to follow, including form(s) to use. Barring unforeseen circumstances, the leave application must be in place by August 1st (for Fall semester leave) and December 1st (for Spring semester leave).

Student Responsibilities, Monitoring Of Progress

All students are expected to be reading their UNID-based email (UNID @ utah.edu, where UNID begins with a 'u') regularly to keep track of all official email correspondence directed at them. All communication with faculty or staff should always be contacted using @utah.edu e-mail addresses, such as name@cs.utah.edu, name@sci.utah.edu, or uid@utah.edu. Email from outside addresses may be deleted without an answer.

Each semester, students must update their progress at the website https://gradtrack.cs.utah.edu. The Program of Study form must be submitted through GradTrack no later than two weeks after the first day of classes in your final semester.

In the event that a student is found not to be in good standing (a decision made by the DGS based on reports from the advisory committee) one or more actions may be taken. For example, the School may assign the DGS to counsel the student, deny opportunities to serve as departmentally funded TA, discontinue tuition benefit, or remove the student from the program.

PhD Program

There are two PhD degree programs within the School of Computing (SoC) at the University of Utah:

- PhD in Computer Science
- PhD in Computing

Transfers between degree programs will be considered between semesters and will occur only once per academic year.

A PhD in Computing is earned within a particular track. Students are, in part, admitted based upon the track that they have selected during the admissions process. If students wish to switch tracks, they should seek approval from DGS and from the track director of the track to which they wish to enter. They should also maintain good Due Progress milestones as specified.

Residency

At least one year (i.e., two consecutive semesters) of the doctoral program must be spent in full-time academic work at the University of Utah. When a student proceeds directly from an MS degree to a PhD degree with no break in the program of study (except for authorized leaves of absence), the residency requirement may be fulfilled at any time during the course of study.

Credit Hour Requirements

At least 50 credit hours of graduate coursework is required for the PhD degree in computer science. This must be composed of at least 27 credit hours of regular graduate coursework, and at least 14 credit hours of dissertation research.

At most 12 course credit hours from graduate courses from other departments (at the 5000 level or above) may be used in the program of study. Individual programs or tracks may further restrict that number.

Independent study and seminar credit hours cannot be counted towards the regular graduate coursework, but can be counted against the overall requirement of 50 credit hours. Each seminar can be used for credit at most twice. Seminar or research credit from other departments can not be used towards a program of study.

Credit For Prior Courses

PhD students may count up to 15 graduate credit hours of coursework taken at other recognized institutions, including from other graduate degrees, toward the coursework requirements associated with the program of study. PhD students with a masters-level degree in computer science or closely related discipline should work with their initial committee to create a program of study that can include graduate courses taken as part of their previous degree program.

Unlike for the MS programs, credit for previous courses for PhD students is administered by the DGS so these courses do not need to be officially transferred to the University.

The suitability of each previous course is reviewed by and has to be approved by the student's supervisory committee, the program/track director and the DGS, who may consult with faculty in the relevant area. Course appropriateness is determined by consideration of course content and the student's declared research area.

Approved courses are certified by inclusion of the appropriate SoC form in the student's file.
Like all programs of study, it must then be approved by the DGS and the graduate school.

Students with a prior Master's degree (including BS/MS students) from the School of Computing at the University of Utah may count all of their graduate coursework towards the program of study for their PhD degree.

Exceptions to these limits will only be made in narrow circumstances, such as a late-stage transfer from another recognized PhD program. For such an exception, the student's dissertation committee evaluates the prior coursework, and the committee (not the student themselves) petitions the program/track director and the DGS.

Example 1: *Jill has completed a BS/MS degree at another university, and is now enrolled in the PhD program in Computing at the University of Utah. She has taken six graduate courses, with a grade of B+ or better. She reviews the six graduate courses with her committee and selects five of them for inclusion in her program of study. She then petitions her track director, who agrees that these courses are of equal quality and scope to the courses offered at Utah. She includes these five courses (15 credit hours) in her program of study, and now has to complete only 15 additional course credit hours at the University of Utah.*

Example 2: *Jane has completed three years in a PhD program at another university. Her advisor was just recruited to the University of Utah, hence Jane transfers to Utah to continue working with her advisor. Jane had already completed 30 course credit hours at her original institution. Jane forms a committee at the University of Utah, and reviews her prior coursework with that committee. The committee agrees that her coursework is equivalent to coursework she would have taken at Utah, and petitions the program/track director and the DGS to include all of her prior courses in her program of study. Hence, she has to take no additional courses at the University of Utah to complete her PhD.*

PhD Specific Registration Requirements

Students doing dissertations must be registered for at least three credit hours during the semester of the student's dissertation defense. Once a student has passed the dissertation defense, the student does not have to register during the next term, but the final dissertation should be turned in within 90 days.

Candidacy for the PhD

A student who has been accepted by the Graduate School is formally admitted to candidacy for the PhD by the University at the recommendation of the student's supervisory committee. Admission to candidacy occurs after the student:

- forms a supervisory committee,
- files an approved Program of Study form,
- completes the course requirements,
- passes the written portion of the qualifying examination, and
- passes the oral portion of the qualifying examination (i.e., proposal defense).

An application for candidacy must be submitted to the Graduate School no later than two months prior to the semester of graduation. For the degree to be conferred, the approved Program of Study form must be completed and the dissertation completed and publicly defended.

A PhD Supervisory Committee conducts the student's written qualifying examination, oral qualifying examination, and dissertation defense. This committee consists of five faculty members, with the following policies:

1. The chair of the Supervisory Committee must be a regular faculty member (tenured/tenure track) from the SoC.
2. The majority of the Supervisory Committee must be regular faculty members (tenured/tenure track) within the SoC.
3. At least one member must be from outside the SoC.

Research or adjunct faculty may chair or may be members of supervisory committees if accorded that privilege by the SoC faculty and the Graduate School. However, an exception to only one of policy 1 and 2 listed above but not both simultaneously will be allowed. For Computing degrees, further restrictions on committee makeup may apply. All official decisions of the committee are decided by a majority vote. Adjunct faculty within the committee must adhere to the School of Computing Adjunct Guidelines.

Research Engagement Requirement For Fellowship Students

All fellowship students are required to take a total of 4 credit hours as follows during their first year enrolled in the PhD program.

- CS 7930 - Intro to Computing PhD – 1 credit (required in the earliest semester offered during your PhD studies, typically the first Fall semester)
- Independent Study and/or Research Seminar– total of 3 credits

Engagement in independent study credits and/or research seminars during the first year is a primary means of identifying a research advisor. An independent study or research seminar cannot be repeated (i.e., one cannot take an independent study course with the same faculty member in Fall and Spring or

register for the same research seminar twice) towards satisfying the 3 research engagement credits during the first year.

The research engagement requirement can be waived by the DGS or the Director of SoC if a student can demonstrate some other “significant research activity”, such as working as an RA in a research group.

Teaching Menteeship (TM)

All PhD students are required to complete 4 credit hours of a *Teaching Menteeship (TM) course* (CS 6951) with a “Pass” grade. The teaching menteeship involves working with one or more faculty members (teaching mentors) on tasks including but not limited to the following:

- Holding student contact hours
- Developing teaching resources (e.g., web pages)
- Lecturing
- Developing and grading assignments

The teaching menteeship must be spread across two semesters (2 credit hours each semester). The required tasks will be laid out by the teaching mentors before the start of the mentorship each semester. A student has to email graduate advisors before their TM semester starts to be able to sign up for the designated CS 6951 TM course.

A final letter grade will be assigned for each semester by the teaching mentors based on how well the mentee performs the required tasks. The teaching menteeship credit hours cannot be used to replace course requirements.

The menteeship assignment will be made for a School of Computing course in conjunction with your advisor and the TA/TM Coordinator. The menteeship should be fulfilled by the end of the 4th semester to meet the stipulated good progress criteria, and must be completed before the written qualifying examination (described below). Note that a teaching menteeship is an academic requirement and independent from an employment/HR definition. Teaching mentees are typically employed as RAs or GRs. Work as a TA cannot be counted towards the Teaching Menteeship academic requirement.

Milestone Master’s

The School of Computing generally does not confer intermediate Master’s degrees (“milestone master's”) on PhD students. The minimum course requirements of the PhD program also do not satisfy the minimum course requirements of the MS program. However, students may appeal for an exception to the DGS. If an exception is granted, the student will have to meet all requirements set forth by the MS program.

Transferring from PhD to MS Degree

The School of Computing generally does not allow transfers from PhD to MS degrees. However, students may appeal for an exception to the DGS to get an MS degree instead of a PhD degree in

compelling extenuating circumstances (e.g., health issues preventing a student from finishing a PhD). If an exception is granted, the student will have to meet all requirements set forth by the MS program.

PhD Qualifying Examination

All PhD students must pass a qualifying examination, as specified by the graduate school. The qualifying exam consists of two parts, a written examination covering the candidate's chosen area of specialization and an oral examination involving a defense of the candidate's written thesis proposal.

The written portion of the qualifying examination will cover the candidate's general area of specialization in sufficient depth to demonstrate his/her preparation for conducting PhD level research. Each member of the student's supervisory committee will contribute one or more questions to this exam. The supervisory committee will provide a written evaluation of this portion of the exam, including an indication of whether or not the student will be allowed to proceed to the oral portion of the qualifying examination. Specific details of the written qualifying exam procedures appear below.

The oral portion of the qualifying exam involves a defense of the candidate's dissertation proposal. At the supervisory committee's option, it may also include follow up questions relating to the written portion of the exam. All members of the candidate's committee should certify that the proposal is ready to be defended prior to conducting the oral portion of the qualifying exam.

There are two forms required to be filled out; these forms are available on-line or from the graduate advisors. The first is a report on the written portion of the qualifying exam. The second is a report for the complete qualifying exam, both written and oral. These forms plus the written examination questions and student answers, will be retained in the student's School of Computing file. Consistent with the requirements of the graduate school, the qualifying examination must be completed at least one semester prior to defense of the thesis.

PhD Written Qualifying Exams

Each member of the student's supervisory committee who holds a faculty rank (note that this includes adjunct faculty) in the University of Utah School of Computing must submit at least one question. Other committee members may each submit a question at their option. Note that in all cases, the examination will be written, not oral.

Question Format

The format of each question can be chosen by the committee member posing the question. Possibilities include (but are not limited to):

1. "Take home" question, to be researched by the student using library, web, and other publicly available resources;
2. A "closed book sit down" examination, to be written during a fixed period without use of background materials;
3. An "open book sit down" examination, similar to (2), but permitting use of reference materials.

Exam Administration and Grading

The entire exam should be completed in no more than seven days from initial question assignment to the submission of answers. Grading should be completed within seven days after the student delivers his/her answers. Each committee member contributing a question will grade that question and provide a specific, written evaluation of the quality and correctness of the answer. Allowable grades on individual questions are:

HP - High-Pass
P - Pass
F - Fail

A grade of P signifies the minimal acceptable performance expected from a PhD student. An F grade indicates that an answer is not up to the standards we expect from our PhD students.

The members contributing questions will each cast a Pass/Fail vote on the examination as a whole. An overall passing grade should be given to candidates who, through their answers, demonstrate that they are well prepared to conduct PhD level research in their specialty area of computer science. The overall exam High-Pass / Pass / Fail grade will be determined by a majority vote of those contributing questions. In the event of equal numbers of Pass and Fail votes, the deciding vote will be cast by the Director of Graduate Studies.

Repeating the Exam

A student who fails his/her first attempt may retake the exam once. No conditional pass grades will be given. However, the supervisory committee can at their discretion include fewer questions on repeated exams.

PhD Dissertation

Most PhD dissertation policies are governed by the University of Utah's Graduate School. This section only gives a summary and adds some department specific regulations. Detailed policies and procedures concerning the dissertation are contained in "A Handbook for Theses and Dissertations" published by the Graduate School.

A dissertation in the School of Computing is typically based on multiple peer-reviewed papers, where the candidate was the lead author. In terms of the format of the dissertation, the graduate school allows two options:

1. A thesis with consistent formatting that can contain substantial text from the publications, but gives freedom to move/edit content and make the whole dissertation consistent.
2. A thesis where individual publications serve as chapters, using the publications style (see Appendix B of the graduate school's handbook). A general abstract covering all publications is required, and a general introduction and conclusion are strongly recommended.

A PhD candidate should consult with their academic advisor and their committee about which of the two styles is appropriate for their dissertation.

The supervisory committee must give preliminary approval of the dissertation prior to the defense. The defense can be scheduled after this approval. To schedule the defense, contact your graduate advisor.

The student must provide the dissertation to the chair of the supervisory committee at least three weeks before the defense, and to the other committee members at least two weeks prior to the defense.

After successfully defending the dissertation, the student must obtain approval that the thesis is satisfactory by obtaining signatures from their committee members for the department's Final Reading Approval form, and submit the form to the School of Computing. This is a required form for the School of Computing to report to the Graduate School that the student has completed all the departmental and Graduate School requirements. The student must complete all committee requested edits to their dissertation prior to submitting the dissertation to the Thesis Office. Students will use the Online Thesis Submissions website to collect electronic signatures from their committee members and the chair of the department and to submit their dissertation. While a student can defend a thesis until the day before the following semester starts, in order to graduate in a certain semester, please see the thesis calendar for submission deadline on the Graduate School's website https://content.gradschool.utah.edu/thesis/.

Students should also read the document regarding copyright notices provided by the School and declare their intentions regarding granting the School the right to photocopy the dissertation before notifying the Graduate Advisor of completion of the defense.

The student has one month after the defense to make any revisions prior to submitting the dissertation to the Graduate School Thesis Editor. There will be at most two additional months to complete any changes required by the Thesis Editor before final acceptance. If either of these deadlines are not met, the candidate must redo the oral defense. The final dissertation must be filed one week before the end of the semester of graduation.

Students are expected to offer each committee member a bound copy of the dissertation once it is completed, and one to the School of Computing library.

Additional PhD Student Responsibilities, Monitoring of Progress

Initial committee: This consists of two University of Utah faculty members and an advisor, who must meet the School of Computing requirements for advising. The initial committee is different from the full committee, who will ultimately administer the qualifier and evaluate the dissertation. The full committee must be chosen to conform to program requirements. The initial committee is automatically dissolved when the student forms a full committee, however, the full committee may consist of the same faculty members as the initial committee.

Good versus acceptable progress: Students completing milestones within the time frame denoted as “good” are generally considered to be in good standing in the program. Students completing milestones within the time frame denoted as “acceptable” are considered to be making acceptable progress in the program and are encouraged to continue on and attempt to meet successive milestones within the time frames denoted as “good.”

Students may or may not be considered in good standing, depending upon evaluation of the director of graduate studies (DGS) with input from their advisor and advisory committee. Students not completing milestones within the time frame denoted as “acceptable” are not considered in good standing. Students not in good standing can face consequences including loss of funding or expulsion from the PhD program.

All PhD students are required to submit (online, on the GradTrack system, https://gradtrack.cs.utah.edu/) a due progress form in the Fall semester every year by October 15th. Those students who fail to submit their due progress forms by this deadline can face consequences including loss of funding or expulsion from the program.

The faculty as a whole conducts a Graduate Student Progress Review meeting every Fall semester (typically in November) to review and monitor graduate student progress. Advice generated during this meeting and other monitoring activities will be suitably conveyed to the student (typically via email from their advisor(s) and/or Graduate Advisors).

All PhD students who are found lagging in any of their progress categories are additionally required to update their information on the GradTrack system by April 15th. By this date, they must also inform their advisor(s) how they have responded to comments (if any) passed on to them. Failure to do so can result in consequences similar to those noted above.

The School of Computing will make all reasonable attempts to support students and help them make progress in their studies, and convey their advice. They will also point the students to our Campus Help Resources as necessary. The School of Computing reserves the rights to follow prescribed Dismissal Policies if a student does not meet the stipulated progress guidelines.

Progress Guidelines For the PhD Program

Milestone	Good Progress	Acceptable Progress	Comments
Choose advisor and initial committee	1 Semester	2 Semesters	
Ethics Training	1 Semester	2 Semesters	
Program of study approved by advisor and initial committee	4 Semesters	5 Semesters	Only email approval is needed
Complete Teaching Menteeship	5 Semesters	6 Semesters	
Complete required courses	5 Semesters	6 Semesters	
Written qualifier	5 Semesters	6 Semesters	U requirement: one semester before defense

Full committee formed	6 Semesters	7 Semesters	U requirement: After written qualifier and one semester before defense.
Program of study approved by committee	6 Semesters	7 Semesters	Approved through the GradTrack
Oral Qualifier (proposal)	7 Semesters	8 Semesters	
Dissertation defense	10 Semesters	12 Semesters	
Final document			U requirement: Document finalized within three months of the defense

All students are strongly advised to plan their own customized schedule for completing the required courses and milestones in frequent consultation with their advisor, as they may run the risk of lagging in publications if they do not start on research early.

Master's Program

There are two Master's degree programs within the School of Computing at the University of Utah:

- MS in Computer Science (see MS in Computer Science section)
- MS in Computing (see MS in Computing sections)

Degree programs may contain a thesis, a project, or a course-only option as specified. Transfers between degree programs will be considered between semesters and will occur only once per academic year.

An MS in Computing is earned within a particular track. Students are, in part, admitted based upon the track that they have selected during the admissions process. If students wish to switch tracks, they should contact the Grad Advisor prior to seeking approval from DGS and from the track director of the track to which they wish to enter.

Residency

At least 24 credit hours must be in resident study at the University of Utah. This does not refer to, or fulfill, state residency requirements. A full-time student working on an MS program is expected to complete the degree requirements within two calendar years. The Graduate School limits MS programs to four years.

Supervisory Committee

The MS Supervisory Committee consists of three members. The following two policies are in place:

- The chair of the Supervisory Committee must have advising privileges in the SoC (tenured/tenure track faculty and career line faculty with advising privileges).
- The majority of the Supervisory Committee must have advising privileges in the SoC (tenured/tenure track faculty and career line faculty with advising privileges).

The supervisory committee of course-only students consists of their track / program director (chair), director of graduate studies, and associate director of graduate studies. Other students typically select their committee with guidance from their academic advisor.

Comprehensive Exam

For the project and thesis options of the MS, the MS comprehensive exam will be administered by the student's supervisory committee and can be coupled with (i.e., satisfied by) a project or thesis proposal defense, and/or meeting a specified level of performance on a set of classes.

For students not opting for a project or thesis, the comprehensive exam will typically be passed by meeting the grade requirements in the courses required for completing their degree/track, but this can be

modified at the discretion of the student's committee. Following the graduate school requirement, students must be registered for at least 1 credit when completing the comprehensive exam.

Transfer Credit

Students who have done graduate study at other recognized institutions may transfer up to six credit hours to the University of Utah. The courses must be bona fide graduate-level classwork (e.g., independent study is excluded), with a grade of at least a C. Students must be able to show that the course work was not used toward any other degree. The suitability of each course is reviewed by and has to be approved by the student's supervisory committee, the program/track director and the DGS, who may consult with faculty in the relevant area. Course appropriateness is determined by consideration of course content and the student's declared research area (if applicable). Approved courses are certified by a transfer credit form. Approval of a course taken elsewhere for transfer credit does not necessarily imply fulfillment of any specific course requirement.

Example: *Jen has completed an undergraduate degree in computer science at a recognized institution. In addition to her regular course load as an undergraduate student, she has completed three three-credit graduate courses with a grade of B+ or better that she did not use toward her undergraduate degree. Jen now is a MS student in the Computer Science program at Utah. Jen can transfer two (not three) of those courses to the University of Utah and count them towards her master's degree. One of the courses she transfers is a graduate-level operating systems class. As she has already taken an operating systems class, she petitions the director of the Computer Science Program to waive the CS 6460 – Operating Systems requirement.*

See also Course Waivers.

MS Degree Options

A student may pursue an MS degree with (1) a thesis option, or (2) a project option, or (3) a course-only option. Orthogonally, an MS/MBA Option can be added to the CS MS degree. The MS program requires 30 total credit hours of graduate coursework (including thesis, seminar, or independent study credit hours as permissible for the options). At least 18 credit hours must be graduate level (6000 and above) CS courses. Programs and tracks may restrict the options offered, and may set higher requirements on the minimum number of CS graduate level credit hours. Seminar or research credit from other departments can not be used towards a program of study.

All MS students are by default considered as course-only. They need to review the School of Computing FAQ document on the process of changing to the thesis or project option.

Thesis Option

A minimum of six and a maximum of nine thesis research credits (CS 6970) are required for the thesis option. Seminar or independent study credits that are consistent with the thesis project, as determined by

the committee chair and approved by the program/track director, can be counted towards thesis credit hours.

Students choosing the thesis option must author a thesis about their research, and defend that thesis in front of the committee. Detailed policies and procedures concerning the dissertation are contained in "A Handbook for Theses and Dissertations"

The supervisory committee must give preliminary approval of the thesis prior to the defense. The defense can be scheduled after this approval. To schedule the defense, contact your graduate advisor at least two weeks prior to the defense date agreed upon by the supervisory committee. A verification notice will be sent to all committee members asking if the student is ready to defend. Once positive responses are received, and no later than one week prior to defense, the defense will be announced to all students and faculty in the School of Computing.

The student must provide the thesis document to the chair of the supervisory committee at least three weeks before the defense, and to the other committee members at least two weeks prior to the defense.

After successfully defending the thesis, the student must obtain approval that the thesis is satisfactory by obtaining signatures from their committee members for the department's Final Reading Approval form, and submit the form to the School of Computing. This is a required form for the School of Computing to report to the Graduate School that the student has completed all the departmental and Graduate School requirements. The student must complete all committee requested edits to their dissertation prior to submitting the dissertation to the Thesis Office. Students will use the Online Thesis Submissions website to collect electronic signatures from their committee members and the chair of the department and to submit their dissertation. While a student can defend a thesis until the day before the following semester starts, in order to graduate in a certain semester, please see the thesis calendar for submission deadline on the Graduate School's website https://content.gradschool.utah.edu/thesis/.

The student has one month after the defense to make any revisions prior to submitting the thesis to the Graduate School Thesis Editor. There will be at most two additional months to complete any changes required by the Thesis Editor before final acceptance. If either of these deadlines are not met, the candidate must redo the oral defense. The final thesis must be filed one week before the end of the semester of graduation.

Project Option

Students choosing the project option must take at least three and at most six independent study credit hours (CS 6950). At most two independent study credit hours can be substituted with seminar credit hours if they are consistent with the project, as determined by the committee chair and approved by the program/track director. The project is done through an independent study with a professor in the School of Computing. The parameters for the scope of the project are set forth at the onset of the independent study, and the defense of the project will be done before the student's entire committee plus the professor in charge of the independent study (normally with the chairperson of the committee being the professor with whom the independent study is done). The student is responsible for arranging a time and place for the defense together with the committee.

Course-only Option

The 30 credit minimum required is met mostly with course credits in this option. At most three seminar or independent study (CS 6950) credit hours may be used to fulfill the required 30 credit hours.

MS/MBA Option

Students must meet the minimum CS requirements of their program or track. The remaining courses needed for this option are specified by the Business School as part of the joint MS/MBA Program. For details on the program and contact information, please visit https://eccles.utah.edu/programs/mba/full-time-mba/concentrations/.

Progress Guidelines For The MS Program

Milestone	Good Progress	Acceptable Progress	Comments
Choose advisor	1 Semester	2 Semesters	
Ethics Training	1 Semester	2 Semesters	Only if funded as a Research Assistant
Full committee formed	2 Semesters	3 Semesters	
Program of study	2 Semesters	3 Semesters	
Complete required courses	3 Semesters	4 Semesters	Program requirement within three semesters
Defend proposal	3 Semesters	4 Semesters	
Thesis defense	4 Semesters	5 Semesters	U. requirement document finalized within three months of the defense
Final document			

Computer Science Degree (PhD & MS)

Director: *Erik Brunvand* ***-*** *elb@cs.utah.edu*

Students must show proficiency in the three fundamental categories: theory, systems and hardware. Students can request approval from the program director to substitute the required courses with other electives, or more advanced courses offered by the School of Computing in the same or related subject areas. Substitute courses must be regular classes with exams and/or assignments, not seminar, readings, or independent study classes. Each advanced course can be employed as a substitute for only one required course.

PhD in Computer Science

All students must take the three required courses or substitutes. The number of coursework credit hours taken outside the School of Computing is limited to at most six credit hours.

MS in Computer Science

A student may pursue an MS with a (1) thesis option, or (2) a project option, or (3) a course-only option. All students must take the three required courses or substitutes. The number of coursework credit hours taken outside the School of Computing is limited to at most six credit hours.

Required Courses

The following courses are required for all degree seeking students:
CS 6150 – Graduate Algorithms
CS 6460 – Operating Systems
CS 6810 – Computer Architecture

Allowable substitutions include the following:
For **CS 6150 – Graduate Algorithms**

- CS 6100 (Theory of Computation)
- CS 6110 (Software Verification)
- CS 6160 (Computational Geometry)

For **CS 6460 – Operating Systems**

- CS 6450 (Distributed Systems)
- CS 6465 (Advanced Operating System Implementation)
- CS 6480 (Advanced Computer Networks)
- CS 6490 (Network Security)
- CS 6530 (Advanced Database Systems)
- CS 6780 (Embedded System Design)

For **CS 6810 – Computer Architecture**

- CS 6710 (Digital VLSI Design)
- CS 6740 (Computer-Aided Design of Digital Circuits)
- CS 6745 (Testing and Verification of Digital Circuits)
- CS 6750 (Synthesis and Verification of Asynchronous VLSI Systems)

- CS 6770 (Advanced Digital VLSI Systems Design)
- CS 6830 (VLSI Architecture)
- CS 7810 (Advanced Computer Architecture).

Computing Degree (PhD & MS)

Computing degrees are completed as part tracks that reflect a research area in the School of Computing.

Computing degrees list required and elective courses. Other, suitable graduate courses not listed in the electives can be substituted for an elective if it fits with a student's program of study and permission is granted by the track director.

A new track on Cybersecurity is being planned. Students will be given the option to switch to the Cybersecurity track when it is formalized.

Computer Engineering Track

Track Director: *Mu Zhang - muzhang@cs.utah.edu*

Track Faculty: *Rajeev Balasubramonian, Erik Brunvand, Neil Cotter (ECE), Peter Jensen, Priyank Kalla (ECE), Sneha Kumar Kasera, John Regehr, Ponnuswamy (Saday) Sadayappan, Brent Stephens, Ken Stevens (ECE)*

Computer Engineering is a discipline that combines elements of both Electrical Engineering and Computer Science. Computer engineers design and study computer systems at many levels from the circuits that make up computers, to the architecture of processors and subsystems, to the programming interfaces of those processors.

The majority of PhD and MS project or thesis committee members must consist of CE faculty from either SoC or ECE.

PhD in Computing – Computer Engineering

All students must take the required courses. At least two additional elective courses must be taken by PhD students. Courses selected should be in an area of specialization selected by the student.

MS in Computing – Computer Engineering

A student may pursue an MS with a (1) thesis option, or (2) a project option, or (3) a course-only option. All students must take the required courses. At least two additional elective courses must be taken by students doing the thesis option, three elective courses must be taken by students doing the project option, and four elective courses must be taken by students doing the coursework option.

Required Courses

CS / ECE 6810 – Computer Architecture
CS / ECE 6710 – Digital VLSI Design

Electives

CS 6110 – Software Verification and Analysis

CS 6150 – Graduate Algorithms
CS 6235 – Parallel Programming for GPUs/Many Cores/Multi-Cores
CS 6460 – Operating Systems
CS 6475 – Advanced Compilers
CS 6480 – Advanced Computer Networks
CS 6490 – Network Security

ECE 5325 – Wireless Communications Systems
ECE 5520 – Digital Communications Systems

ECE 6530 – Digital Signal Processing
CS / ECE 6720 – Analog Integrated Circuit Design
CS / ECE 6740 – Computer-Aided design of Digital Circuits
CS / ECE 6745 – Testing and Verification of Digital Circuits
CS / ECE 6750 – Synthesis and Verification of Async VLSI Systems
ECE 6755 – Relative Timed Asynchronous Circuit Design
CS / ECE 6770 – Advanced Digital VLSI Systems Design
ECE 6775 – Advanced VLSI Memory Design
CS / ECE 6780 – Embedded Systems Design
CS / ECE 7810 – Advanced Architecture
CS / ECE 7820 – Parallel Architecture

Data Management and Analysis Track

Track Director: *Aditya Bhaskara – bhaskara@cs.utah.edu*
Track Faculty: *Qingyao Ai, Lajos Horvath (Math), Chris Johnson, Sneha Kumar Kasera, Mike Kirby, Marina Kogan, Alexander Lex, Miriah Meyer, Baxton Osting (Math), Valerio Pascucci, Bei Wang Phillips, Jeff Phillips, Vivek Srikumar, Blair Sullivan, Hari Sundar, Shandian Zhe*

The rate at which scientists and businesses are producing data is increasing at an unstoppable rate. Being able to efficiently process and make sense of such data has become a key scientific challenge in computer science. Not only must one be able to store such information compactly, but one additionally must develop algorithms to process it efficiently and intelligent systems that can reason about this data to find interesting patterns or make decisions. These topics form the core of the Data Management and Analysis track.

PhD in Computing – Data Management and Analysis

All students must take the required courses or their substitutes with an average grade of at least B. A student must take three elective courses (nine credit hours) from the list below, or use the alternatives to the required courses. Up to three courses (nine credit hours) may be taken from other departments at the University of Utah. In addition to the listed electives, other 6000 level and above classes taught by track faculty are also typically allowed as electives.

MS in Computing – Data Management and Analysis

A student may pursue an MS with a (1) thesis option, or (2) a project option, or (3) a course-only option. All students must take the required courses or their substitutes with an average grade of at least B. A student must take three elective courses (nine credit hours) from the list below, or use the alternatives to the required courses. Up to three courses (nine credit hours) may be taken from other departments at the University of Utah. In addition to the listed electives, other 6000 level and above classes taught by track faculty are also typically allowed as electives.

Required Courses

CS 6140 – Data Mining or CS 6350 Machine Learning
CS 6150 – Graduate Algorithms
CS 6530 – Advanced Database Systems
CS 6630 – Visualization for Data Science (CS 6635 Visualization for Scientific Data may be taken as a substitute)

Electives

Three courses from the following list are required: (or CS 6140/CS 6350 if not counted above)

Algorithmics
CS 6160 – Computational Geometry
CS 6170 – Computational Topology
CS 6180 – Clustering

CS 6966 – Theory of Machine Learning

Analytics
CS 6190 – Probabilistic Modeling
CS 6210 – Advanced Scientific Computing
CS 6300 – Artificial Intelligence
CS 6340 – Natural Language Processing
CS 6355 – Structured Prediction

Management
CS 6230 – High-Performance Computing and Parallelization
CS 6235 – Parallel Programming for GPUs/Many Course/Multi-Cores
CS 6480 – Advanced Computer Networks
CS 6490 – Network Security
CS 6963 – Distributed Systems

Data Science Option

MS students can choose to take a “Data Science Option”. Students may complete the required 30 credits with SoC graduate-level courses or Math graduate-level courses, or from other departments with the approval of the Track Director. This option has the following required classes:

CS 5530 – Database Systems
CS 6140 – Data Mining
CS 6190 – Probabilistic Modeling
CS 6350 – Machine Learning
CS 6630 – Visualization for Data Science (CS 6635 – Visualization for Scientific Data may be taken as a substitute)
MATH 5080 – Statistical Inference I
MATH 6010 – Linear Models

The following electives are suggested:

CS 6150 – Graduate Algorithms
CS 6300 – Artificial Intelligence
CS 6340 – Natural Language Processing
CS 6530 – Database Systems
CS 6961 – Structured Prediction
MATH 5770 – Introduction to Optimization
MATH 6030 – Multivariate Models
MATH 6070 – Mathematical Statistics

Graphics and Visualization Track

Track Director: *Cem Yuksel – cem@cemyuksel.com*
Track Faculty: *Martin Berzins, Elaine Cohen, Chris Johnson, Mike Kirby, Ladislav Kavan, Alexander Lex, Miriah Meyer, Valerio Pascucci, Bei Wang Phillips*

The graphics and visualization track includes research efforts in most areas of computer graphics, including geometric modeling, CAD/CAM, isogeometric analysis, scientific visualization, biomedical visualization, information visualization, visual analytics, computer vision, terrain modeling and rendering, haptics (force-feedback), realistic rendering, physically-based simulation, real-time rendering, GPU programming, computer animation, digital geometry processing, immersive environments, visual perception and spatial cognition.

All students must complete at least 1 credit hour of either CS 7942 Visualization Seminar or CS 7933 Graphics Seminar.

PhD in Computing – Graphics and Visualization

PhD students must demonstrate core knowledge in computer graphics and visualization by passing 3 of the 5 required courses with grades of at least a B in each course and an overall GPA in the required courses greater than 3.5. All students must take 3 of the electives. PhD students may use up to nine credit hours from graduate courses outside of the School of Computing on their program of study.

MS in Computing – Graphics and Visualization

A student may pursue an MS with a (1) thesis option, or (2) a project option, or (3) a course-only option. Course-only and project option MS students must take 4 of the 5 required courses. Thesis students must take 3 of the 5 required courses. All students must take 3 of the electives. A minimum of a B- or greater is required for any of the required courses. A student may take two elective courses at the graduate level from other departments.

Required Courses

CS 6610 – Interactive Computer Graphics
CS 6630 – Visualization for Data Science
CS 6635 – Visualization for Scientific Data
CS 6640 – Introduction to Digital Image Processing
CS 6670 – Computer-Aided Geometric Design

Required Seminar

CS 7933 – Graphics Seminar (or) CS – 7942 Visualization Seminar (one credit hour maximum)

Electives

CS 6160 – Computational Geometry
CS 6170 – Computational Topology

CS 6320 – 3D Computer Vision
CS 6360 – Virtual Reality
CS 6540 – Human/ Computer Interaction
CS 6600 – Mathematics of Computer Graphics
CS 6620 – Ray Tracing for Graphics
CS 6650 – Perception for Graphics
CS 6660 – Physics-based Animation
CS 6665 – Character Animation
CS 6680 – Computer-Aided Geometric Design II

Human-Centered Computing Track

Track Director: *Jason Wiese – wiese@cs.utah.edu*
Track Faculty: *Erik Brunvand, Rogelio E. Cardona-Rivera, Tamara Denning, Marina Kogan, Alexander Lex, Miriah Meyer, Sameer Patil, Eliane Wiese, R. Michael Young*

In human-centered computing (HCC) the design and development of technology is motivated by the needs of people. HCC focuses on understanding how people use technology, creating new and accessible technology that enables novel interactions, and evaluating how technology impacts and supports people in the world. The core methods and techniques in HCC are grounded in computer science, but also draw on social science and design. Current HCC focus areas in the School of Computing include personal informatics, mobile interaction, visualization, computer science education, social computing, games, and privacy.

PhD in Computing – Human Centered Computing.

Students must take all required courses and 5 electives in total. Up to 3 electives can be taken from outside of CS. Courses not on the pre-approved list require approval of the Track Director.

MS in Computing – Human Centered Computing.

A student may pursue an MS with a (1) thesis option, or (2) a project option, or (3) a course-only option. Students must take all required courses, and use electives and project or thesis credit hours following the limits laid out for those options to reach 30 credits. Up to 3 electives can be taken from outside of CS. Courses not on the pre-approved list require approval of the track director.

Required Courses

CS 6540 – HCI
CS 6955 – Advanced HCI
CS 6630 – Visualization for Data Science
ED PS 6010 – Introduction to Statistics and Research Design

Electives

Pre-approved CS Electives

Human-Centered Computing*
CS 69xx – Social Computing
CS 69xx – Social Aspects of Cybersecurity
CS 69xx – Computer Science Education Research
CS 69xx – Personal Informatics
* Contact Track Director (via the Grad Advisors) for the specific course numbers each year.

Data Science
CS 6140 – Data Mining
CS 6160 – Computational Geometry

CS 6190 – Probabilistic Modeling
CS 6340 – Natural Language Processing
CS 6350 – Machine Learning
CS 6530 – Database Systems

Visualization
CS 6635 – Visualization for Scientific Data
CS 6965 – Advanced Data Visualization

Robotics
CS 6300 – Artificial Intelligence
CS 6310 – Robotics
CS 6320 – Computer Vision

Computer Graphics and Interaction
CS 6360 – Virtual Reality
CS 6610 – Interactive Computer Graphics
CS 6640 – Introduction to Digital Image Processing
CS 6955 – Science of Game Design
CS 6964 – Computational Models of Interactive Narrative

Embedded Systems
CS 6780 – Embedded System Design

Pre-approved Non-cs Electives

Courses taught outside of the College of Engineering may require differential tuition.

Design
DES 5320 – Typographic Communication
DES 5370 – Digital Fabrication
DES 5710 – Product Design and Development

Educational Psychology
ED PSY 6030 – Introduction to Research Design

Psychology
PSY 6120 – Advanced Human Cognition
PSY 6140 – Cognitive Neuroscience Approaches to Research
PSY 6420 – Methods in Social Psychology
PSY 6700 – Neuropsychology

Nursing
NURS 7107* – Principles of Qualitative Inquiry I
NURS 7203 – Principles of Qualitative Inquiry II
NURS 7209 – Research Interviews and Focus Groups

*This course must be taken as a sequence with NURS 7203.

Sociology
SOC 6110 – Methods of Social Research

Entertainment Arts and Engineering
EAE 6900 – Games User Research
EAE 6900 – A.I. For Games

Mechanical Engineering
ME EN 7240 – Haptics for Virtual Reality, Teleoperation, and Physical Human-Robot Interaction

Image Analysis Track

Track Director: *Ross Whitaker – whitaker@cs.utah.edu*
Track Faculty: *Shireen Elhabian, Tom Henderson, Sarang Joshi, Srikumar Ramalingam, Tolga Tasdizen*

The School of Computing has image analysis research efforts in a wide variety of areas with a strong focus on biological and medical research but also significant efforts in other rapidly expanding areas such as geosciences. Most of these projects are multi-disciplinary and/or nationwide activities that provide unique opportunities for students to get a broader insight into research and engineering concepts and into the challenges and rewards of collaborative research.

PhD in Computing – Image Analysis

Students must take four of the five required courses, as specified in the pertinent section, and complete the rest of the course credits with the listed electives. Up to 12 credit hours may be graduate courses outside of the School of Computing.

MS in Computing – Image Analysis

A student may pursue an MS with (1) a thesis option, or (2) a project option, or (3) a course-only option. Students must take four of the five required courses, as specified in the pertinent section. 24 credits must be taken from the required, elective, or research credit courses combined. Students may take two graduate-level courses from other departments, subject to approval on their program of study from their committee, track director, and DGS.

Required Courses

CS 6640 – Introduction to Digital Image Processing
CS 7640 – Advanced Image Processing or BIOEN 6500 – Mathematics of Imaging

Students are also required to complete two out of the following three courses. The third can be taken as an elective.
CS 6190 – Probabilistic Learning
CS 6320 – Computer Vision
CS 6350 – Machine Learning

Electives

Recommended elective courses within the School of Computing and other departments are listed below:

Imaging, Visualization & Graphics
CS 6630 – Scientific Visualization
CS 6650 – Perception for Graphics
CS 6670 – Computer-Aided Geometric Design I
BIOEN 6330 – Principles of Magnetic Resonance Imaging

BIOEN 6500 – Mathematics of Imaging

Computation and Theory
CS 6160 – Computational Geometry
CS 6170 – Computational Topology
CS 6210 – Advanced Scientific Computing I
CS 6220 – Advanced Scientific Computing II
CS 6550 – Foundations of Algorithms in Computer Graphics and Visualization
CS 6150 – Graduate Algorithms

Statistics & Learning
CS 6190 – Probabilistic Learning
CS 6300 – Artificial Intelligence
ECE 6540 – Estimation Theory
CS 6140 – Data Mining
CS 6353 - Deep Learning

Robotics Track

Track Director: *John Hollerbach – jmh@cs.utah.edu*
Track Faculty: *Jake Abbott (ME), Tom Henderson, Tucker Hermans, Alan Kuntz, Tommaso Lenzi (ME), Steve Mascaro (ME), Mark Minor (ME), Srikumar Ramalingan, Vivek Srikumar*

The Robotics Track is a program of study that may be taken either in the School of Computing or the Department of Mechanical Engineering. The field of robotics has expanded tremendously since its early focus on industrial robots, and now includes very diverse topics such as autonomous vehicles, medical robots, smart sensor networks, micro robots, robot vacuum cleaners, sentry robots, and pet robots.

PhD in Computing – Robotics

Of the graduate course-work, there are four required core courses and two required seminars. An additional three courses must be taken from at least two areas of the restricted electives.

Two additional elective courses at the 6000-level or above (not including independent study, seminars, or thesis) from any department are required.

MS in Computing – Robotics

A student may pursue an MS with a thesis option, a project option, or a course-only option. Of the graduate course-work, there are four required core courses and two required seminars. Students must take two additional courses from two different areas of the restricted electives. One additional elective course, directly related to the student's degree, at the 6000-level or higher (not including independent study, seminars, or thesis research credit hours) from any department is required.

Required Courses

The starred (*) courses are required. One of the double starred courses (**) in Cognition and in Perception must be taken. CS 7939 – Robotics Seminar must be taken in 1 fall and in 1 spring semester.

Electives

Pre-approved robotics electives: Choose 3 (2 for MS thesis) electives from at least 2 of the 6 following areas if not taken as a Required Course.

Mechanics
CS 6310 - Introduction to Robotics *
CS 7310 – Robot Mobility and Manipulation
CS 7320 – System Identification for Robotics

Control
CS 6330 - Introduction to Robot Control *
ME EN 6200 – Classical Control

ME EN 6210 – State Space Control
ME EN 7200 – Nonlinear Controls
ME EN 7210 – Optimal Controls
ECE 6570 – Adaptive Control

Cognition
CS 6300 – Artificial Intelligence **
CS 6370 – Motion Planning **
CS 6350 – Machine Learning
CS 6958 - Robot Learning

Perception
CS 6640 – Introduction to Digital Image Processing **
CS 6320 – 3D Computer Vision **
CS 7640 – Advanced Image Processing
CS 6955 – Deep Learning for Image Analysis

Human-Robot Interaction
CS 6360 – Virtual Reality
CS 6540 – Human-Computer Interaction
ME EN 7240 - Haptics for Virtual Reality, Teleoperation, and Physical Human-Robot Interaction

Robot Design
ME EN 6240 – Advanced Mechatronics
ME EN 7960 – Wearable Robotics
ECE 6670 – Control of Electric Motors

Scientific Computing Track

Track Director: *Hari Sundar – hari@cs.utah.edu*
Track Faculty: *Martin Berzins, Mary Hall,, Tom Henderson, Chris Johnson, Mike Kirby, Pavel Panchekha, Valerio Pascucci, Ponnuswamy (Saday) Sadayappan, Ross Whitaker*

The Scientific Computing track trains students to perform cutting edge research in all of the aspects of the scientific computing pipeline: mathematical and geometric modeling; advanced methods in simulation such as high-performance computing and parallelization; numerical algorithm development; scientific visualization; and evaluation with respect to basic science and engineering.

PhD in Computing – Scientific Computing

PhD students must complete the required courses and four elective courses that involve the themes of scientific computing or are directly applicable to the student's dissertation research. All students must have an average grade of at least B. The following is the list of those classes which will apply. Students can possibly take other 6000-level and above courses within the School of Computing as electives; advising and permission of the track director (or mentor and committee) is necessary in such cases. Up to six credit hours may be graduate courses outside of CS.

MS in Computing – Scientific Computing

A student may pursue an MS in Scientific Computing with a thesis option or a project-based option. The course-only option is not allowed. All students must have an average grade of at least B.

Students must take the four required courses, and also:
CS 6150 – Graduate Algorithms
MATH 6870 – Math Modeling

Furthermore, students must take two elective courses. Students can possibly take other 6000-level and above courses within the School of Computing as electives; permission of the track director (the student's committee) is necessary in such cases. Students are also required to take two courses of independent study (for projects) or two to three MS thesis credit hours (for thesis).

Required Courses

CS 6210 – Advanced Scientific Computing I
CS 6220 – Advanced Scientific Computing II
CS 6230 – High-Performance Computing and Parallelization OR CS – 6235 Parallel Programming for GPUs/Many Cores/Multi-Cores
CS 6630 – Visualization for Data Science OR CS 6635 – Visualization for Scientific Data

Electives

CS 6100 – Foundations of Computer Science
CS 6530 – Database Systems

CS 6610 – Interactive Computer Graphics
CS 6650 – Image Synthesis
CS 6810 – Computer Architecture
CS 7210 – Advanced Topics in Scientific Computing
CS 7450 – Simulation Methods