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Institute Mission

Achieving international impact through world-class research and education
In fundamental computer science and information technology.

This overall mission has two components --- a research mission and an education mission.

The Research Mission
TTIC aims to achieve international impact through world-class research in fundamental computer science and information technology. Here we clarify the intended meaning of the terms in this statement.

Impact. The mission statement focuses on academic impact. A number of criteria may serve to evaluate such impact. These include volume of peer-reviewed publications; reputation of venues in which publications appear; visibility of work in the community, as expressed in citations by others; number and reputation of co-authors, in particular in other institutions; recognition by research community, including awards, prizes, invited talks, and invitation or election to serve in senior service positions in professional organizations; reports by external advisory bodies comprised of reputable senior researchers, etc.

Precise objective measures of academic impact are controversial and elusive, and no one of the criteria above is alone a solid measure in itself. However, the combined evaluation of these and similar criteria helps assess the academic impact achieved by TTIC researchers.

Note that the number of patents filed, or the amount of extramural research funding, are not considered measures of academic impact. Although funding is clearly an important tool in achieving impact, it is only a tool and not an end in itself.

Fundamental. The mission statement is intended to focus on scientifically fundamental research. A scientific result is fundamental to the extent that it has open-ended implications. It is important to distinguish being fundamental from being economically important. A calendar program can be economically successful, and hence important, without adding to fundamental knowledge. The concept of NP-completeness adds greatly to the fundamental understanding of computation without having clear economic significance.

Computer Science and Information Technology. Computer science and information technology encompasses many sub-disciplines. In the selection of sub-disciplines for study at TTIC there should be some consideration of relevance to society as a whole. The interpretation of “computer science” and “information technology” should be such that TTIC remains relevant to the societal impact of computation and information.

The Education Mission
The educational mission of TTIC is to achieve international impact through the accomplishments of its graduates as productive scientists and citizens. The notion of “impact” in the educational mission is broader than in the research mission. The graduates of TTIC might achieve impact by starting successful companies, managing successful products, or influencing government directions in research funding. Of course TTIC also strives to produce Ph.D.s who achieve academic impact throughout their careers. The institute strives to produce graduates who contribute to society through their intellectual leadership in computer science and information technology. Success in the educational mission requires appropriate selection of curriculum, effective teaching to enable learning, effective assessment and mentorship of students, and effective marketing of students in the job market. TTIC strives to place its Ph.D. graduates at high quality research institutions. TTIC also strives to make its Ph.D. students visible to the academic community before graduation. This can be done most effectively through publications prior to graduation.
Introduction to the Program

The Ph.D. Program at the Toyota Technological Institute at Chicago leads to a doctorate in computer science, and focuses primarily on:

- Machine Learning
- Algorithms & Complexity
- Computer Vision
- Speech Technologies
- Computational Biology

TTIC is proud of its Ph.D. Program, designed to prepare students for academic or research careers. To complete the Ph.D. Program a student must make an original and significant contribution to the field of computer science and this contribution must be described in a Ph.D. Thesis. In addition to the Ph.D. Thesis, there are course and examination requirements for the completion of the Program. These requirements are described in this Student Academic Planning Guide.

Students should keep in mind that these formal requirements are actually only a part of obtaining a Ph.D. degree. The main component of a Ph.D. program is the intangible process by which the student learns to do research and become a part of the academic community. Progress in the program will be judged by a student's progress in research as well as their progress in satisfying the formal requirements.

Academic Calendar

<table>
<thead>
<tr>
<th>2014 AUTUMN QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
</tr>
<tr>
<td>Quarter Begins</td>
</tr>
<tr>
<td>Thanksgiving</td>
</tr>
<tr>
<td>Quarter Ends</td>
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</tbody>
</table>

<table>
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<tr>
<th>2015 WINTER QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter Begins</td>
</tr>
<tr>
<td>Martin Luther King, Jr. Day</td>
</tr>
<tr>
<td>Break</td>
</tr>
<tr>
<td>Quarter Ends</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2015 SPRING QUARTER</th>
</tr>
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<tbody>
<tr>
<td>Quarter Begins</td>
</tr>
<tr>
<td>Memorial Day</td>
</tr>
<tr>
<td>Quarter Ends</td>
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</tbody>
</table>

<table>
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<tr>
<th>2015 SUMMER QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter begins</td>
</tr>
<tr>
<td>Independence Day</td>
</tr>
<tr>
<td>Quarter Ends</td>
</tr>
</tbody>
</table>
Financial Support

Tuition is $30,000.00 per year.

**All Ph.D. students at TTIC are expected to receive financial support that covers tuition and living expenses.** This support is typically provided by individual faculty members who “sponsor” that student.

Part of the admissions process involves securing an agreement with a faculty member willing to sponsor an applicant. Once a faculty member has agreed to sponsor an applicant, that faculty member has a responsibility to that student should they decide to attend TTIC. Students are supported with a monthly stipend, provided the student maintains fulltime enrollment status at the institute and remains in good academic standing. Students’ acceptance letters include the amount and duration of support, however, continued support for prolonged enrollment can not be guaranteed, although every effort will be made by TTIC to maintain support for worthy students, independent of temporary funding conditions of the particular sponsoring faculty.

Financial assistance such as scholarships and grants received by a student from other sources will reduce the amount of stipend provided by the Institute, in the ratio of 2:1. In other words, for every $2.00 received from outside sources, the Institute scholarship provided that student is reduced by $1.00.

Current tuition, fees and charges are listed on the TTIC Intranet.
# Program Prerequisites

## Program Entrance Requirements

A student entering the Ph.D. program is expected to have completed a bachelor’s degree (or similar degree for international students) in computer science or a related field. Applicants who hold a Ph.D. degree from another institution will not normally be admitted.

## Pre-Requisites

Graduate education at TTIC builds on ideas and material learned during undergraduate education. Specifically, we expect the students are familiar and comfortable with the topics listed in the table below. These subjects are considered a pre-requisite for graduate education and for required classes at TTIC.

<table>
<thead>
<tr>
<th>Subject Name</th>
<th>Detail</th>
<th>Suggested Text</th>
<th>Suggested Univ. of Chicago Course</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Algorithms</strong></td>
<td>Time and memory complexity analysis; sorting and searching; basic data structures: linked lists, trees, balanced trees, heaps; paradigms: greedy methods, recursion, divide and conquer, dynamic programming; basic graph and network algorithms: BFS, DFS, MST, shortest path algorithms, max flow</td>
<td>Introduction to Algorithms, 3rd Edition / Cormen, Leiserson, Rivest and Stein, MIT Press 2009. Chapters 1-16 and 22-26, excluding starred Sections.</td>
<td>CMSC 27200</td>
</tr>
<tr>
<td><strong>Probability</strong></td>
<td>Probability space, events, random variables, independence; probability density function, mass function and cumulative density function; discrete and continuous probability distributions and random variables; mean, median, variance, moments; Bernoulli, binomial, multinomial, geometric, Poisson, Gaussian, multivariate Gaussian and exponential distributions; Convergence in probability and almost sure convergence*: Laws of Large Numbers; Central Limit Theorem</td>
<td>Probability / Jim Pitman, Springer 1993</td>
<td>STAT 25100</td>
</tr>
<tr>
<td><strong>Linear Algebra</strong></td>
<td>Vector spaces, matrices, linear transformations; elimination, inverse, and systems of equations; null spaces and image space; linear span, independence, basis, change of basis; orthogonality, projection, and the Gram-Schmidt procedure; unitary, rotation and permutation matrices; eigenvalues, eigenvectors</td>
<td>Introduction to Linear Algebra, 4th Edition / Gilbert Strang, Wellesley-Cambridge Press 2009 (video lectures using this text are also available online).</td>
<td>MATH 25000</td>
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and determinants; inner products and norms; semi-definite matrices; LU decomposition; matrix similarity and Jordan normal form; diagonalization and exponentiation

Programming

Familiarity with at least one general-purpose high-level procedural or object-oriented language such as C, C++ or Java; Data types; Variable scope; Pass by value/ by reference; Modularity, abstraction and reuse; Iteration and recursion

CMSC 15100+ 15200 or CMSC 10600

*Indicates topics not covered by the recommended text.

Upon entering the graduate program, the student will report on a New Student Prerequisite form (provided at orientation,) how they fulfilled each of the topics in the table above, and discuss their background in these subjects with the Director of Graduate Studies (DGS) and with their advisor. Students who are missing a class or do not feel comfortable with some of the topics mentioned, should study the required material, either independently from a textbook (as recommended by TTIC) or online course, or by taking the corresponding UoC course.

Based on the recommendation of the DGS and the advisor, the faculty may choose to REQUIRE that a student either take a course at the University of Chicago to make up for a missing subject, or study the material independently and pass an appropriate exam. In such cases, the students will be notified of this requirement during their first quarter at TTIC, and the requirements should be completed within a year.

English Language Prerequisites and Further Enhancement for International Students:
Applicants who are international students and have not studied for at least one academic year within the last five years in a school in the United States, the United Kingdom, Ireland, Australia, New Zealand, or an English-medium university in Canada or South Africa, must take the Test of English as a Foreign Language (TOEFL), or the International English Language Testing System (IELTS).

To be successful in the academic program, it is essential that each graduate student is competent in understanding and communicating in English. The assessment of English competency will be made based on two factors: 1) the TOEFL or IELTS score, and 2) applicant interviews.

The minimum TOEFL score to be considered for admission is 92 on the internet-based test (iBT) and 580 on the paper-based test (PBT). Please note that the computer-based test results are no longer valid (see the TOEFL website for more information).

The minimum IELTS score allowed is 7. Minimum required scores in the IELTS are an overall score of 7, with sub scores of 7 each. (Note: students are required to take the Academic Reading/Writing test within IELTS, not the General Training Reading/Writing test).

English competence, evaluated based on the test scores and an interview with a TTIC representative, is factored into the final admissions decision.
An applicant may be admitted with an English proficiency test score lower than that listed above. The score must still fall within the range listed below:

| 6.0-6.9 IELTS | 61-91 TOEFLiBT | 500-579 TOEFL |

In such cases, and as terms of acceptance, the applicant must enroll in and complete an English enhancement course from the University of Chicago International House’s English Language Institute in the Language Skills or Pronunciation and Conversation Skills course list. This must be completed in the first quarter after enrolling at TTIC. All course expenses and material fees will be covered by TTIC, and a note of attendance/completion must be submitted from the English Language Institute and kept on file in the TTIC Registrar’s Office.

Students whose first language is not English may be eligible to enroll in English as a Second Language classes and be partially reimbursed by TTIC. Details of this policy may be found on the TTIC Intranet under ‘Student Policies’.

**Advisors**

**Interim Advisor**
Upon entry to the program the Institute assigns each student, in consultation with the student, an interim advisor. Students’ admission letters include this assignment.

Interim Advisors will assist students with course selection, introduction to initial research, and navigating the Pre-Candidacy stage of the program, up through the Qualifying Exam.

**Research Advisor**
A Research Advisor assists the student through the Candidacy stage of the PhD Program. The advisor will be the head of the student’s thesis committee, and offer guidance regarding research, thesis matters and post-thesis opportunities.

The Research Advisor must be tenured or tenure-track TTIC faculty. A student may also choose to designate a University of Chicago tenured or tenure-track faculty member to be their primary research advisor and a (tenured or tenure-track) TTIC faculty member as a secondary advisor. In such cases, the TTIC secondary advisor shall bear all the responsibilities outlined here for the research advisor, including bearing the primary responsibility for ensuring the student is engaged and progressing in the Ph.D. program.

The advisor relationship will be formalized on the Application for Master’s Degree/Candidacy, with both the student and the advisor(s) signatures. In the case of two research advisors (University and TTIC), both advisors must sign the form. The form will be reviewed and signed off on by the Chief Academic Officer (CAO). The student submits this completed form to the Registrar (by Week 8 of summer quarter, typically in a student’s second year).

**Change of Advisor**
The relationship between a student and their advisor is a central aspect of the Ph.D. program. This relationship requires the ongoing consent of both parties; either party can withdraw from a Ph.D. research advising relationship by notifying the Chief Academic Officer. If a student has difficulty finding an advisor, they should seek the help of the Director of Graduate Studies (DGS) or CAO. The DGS and the CAO shall be notified of all changes in advisors.
When the advisor of a student is also the DGS, then any action or approval that is normally required by the DGS will instead be required of the CAO.

**Residency Requirements**

TTIC’s degrees are residence degrees in the sense that a major portion of work must be done on campus in the Institute community with the faculty and other graduate students.

The Institute requires the student to be in full-time residence until the Candidacy requirements are fulfilled, (mandatory residence and registration for Autumn, Winter, Spring and Summer quarters). A student may request to be not in residence for up to one quarter before Candidacy, (typically summer quarter after their first or second year,) subject to the following:

- Only one not-in-residence quarter is permitted before all Pre-Candidacy requirements are fulfilled. (Note: the student need not be in residence after the requirements are fulfilled but before Candidacy is approved.)

- The student must be in residence during the entire quarter in which Pre-Candidacy requirements are being fulfilled (e.g. core courses taken, the Programming requirement submitted, the Qualifying Exam taken or the research talk given).

- Requests for absence must be made before the registration period for the quarter which the student is requesting absence, and must be approved by the student's advisor. A student should then still register for the quarter they will be absent, but simply select "I will not be in full time residence this quarter" on the registration form.

Once in Candidacy, a student is required to have a minimum of three more quarters in residence before defending a thesis.

To be eligible for any degree, a student must complete the residency requirements as stipulated above.

**Student Status: Defined**

The following categories define the status options for students enrolled at TTIC:

- **Pre-Qualifying Candidate**- Student in the graduate degree program leading to a Ph.D. degree.
- **Ph.D. Candidate**- Student who has been approved for Candidacy after completion of the Qualifying Exam, fulfilled seven core course requirements, the Programming requirement, Research at TTIC Series requirement, the Student Talk requirement and whose advisor has agreed to begin supervising thesis efforts.
- **Provisional**- This status refers to a level of academic standing between satisfactory and academic dismissal. Once Provisional, a student is allowed to continue enrollment at TTIC, but is no longer in good standing. It serves as a
serious warning that the student’s academic performance needs improvement, alerting him or her that they are in jeopardy of being dismissed from the program. The advisor will alert the student if faculty has determined they are Provisional and the student will be advised of some directives to help address faculty concerns that may be impacting their academic performance, and a plan may be given to the student with the aim of improving academic success. In addition, he or she may be required to participate in some academic enhancement activities.

- **Academic Probation** - This status is automatically imposed when a student fails to meet program requirements as specified in the Academic Program Guide, or as formally dictated by the faculty where prior warning was given. To maintain good-standing as a full-time student and receive a stipend, students must officially register by specified deadlines. Eligibility to register includes meeting the deadlines stated in the Academic Program Guide, Student Handbook and additional individual-specific requirements and deadlines previously communicated to the student. Academic Probation results in a 20% reduction in stipend and continues until stipulated requirements have been met.

- **Suspended** - If faculty determines a student is “suspended,” that student’s TTIC and University of Chicago privileges are suspended, along with the student’s living stipend, and any course(s) the student is registered for are cancelled. Suspension may occur if a student has very dissatisfactory performance after a period of being Provisional, or disregards crucial program deadlines and requirements.

- **Student-at-Large** - Registered for special study but not a candidate for a TTIC degree. Students from TTI Japan taking courses at TTIC are considered Students-at-Large.

- **Full Time Enrollment Status** - This status is accorded to all students enrolled who undertake an academic workload consisting of any (advisor-approved) combination of courses, work experience, research or special studies that would be considered a full-time workload.

- **All But Thesis Status (ABT)** - This status is accorded to all students whose only remaining requirements are the completion and defense of their thesis. Once a student has successfully proposed a thesis, ABT status may be requested and must be approved by both the thesis advisor and Director of Graduate Studies. A student will register for this status, as they would a course (during the registration period,) and indicate if they will be in or not-in residence. In-residence students may still receive health insurance and University of Chicago privileges, and are expected to physically be at TTIC. Non-residence students will not receive privileges. Stipend support while on ABT will be determined on a case-by-case basis, dependent upon student progress. It is the student’s responsibility to confirm the details of his or her ABT status privileges.

All students enrolled in the TTIC degree program are expected to be in full-time status at all times. Exceptions to the above must be in writing from the Director of Graduate Studies.
Student Progress/ Academic Evaluation

To ensure students are on track to meet the requirements necessary to progress through the program, regular student progress reviews are conducted by faculty.

Twice a year, at the beginning of the Fall and Spring quarters, the faculty will hold a review and evaluation meeting to discuss each student’s standing and success in the program.

The faculty will discuss and determine for each student whether that student is making sufficient progress in academic goals to continue in the Ph.D. Program. In the event that a student is not meeting their academic obligations, they may be notified of being placed on Provisional status, Suspended or they may be notified that they are not permitted to continue with the program. In any case, a letter of evaluation is written to each student by their advisor, based on the discussion in the meeting, to be signed by the advisor and the Director of Graduate Studies. This will take place from the first year of study until a student completes (or leaves) the program.

The letters will be distributed to each student, along with Confirmation of Receipt form that students must sign and return to Registrar within ten days of letter distribution. Registration for the next quarter may be restricted until the Confirmation of Receipt form has been returned to the Registrar.

Before the autumn and spring Student Evaluation meetings of faculty, students complete a Student Data form indicating progress in the program and in academic performance. These forms are evaluated by faculty in the evaluation meeting.

Grading Policy/ Incompletes/ Withdrawals

Grading Policy
All core required courses as identified in the Ph.D. curriculum require a letter grade. For elective courses, pass/fail grades are allowed, and, if the instructor is not using a grade system, it is not required that the student receive a grade.

In general, the student will receive the type of grade consistent with the instructor’s grading system for the course. However, if a student desires a different type of grade, such as a pass/fail designation in a letter-grading system, they must attain that status or request such by the end of week 5 of the quarter.

More on Pass/Fail
If a student is requesting a pass/fail grade for an elective course, they must obtain that status before the end of week 5 of the quarter. “Pass” indicates that the student has submitted sufficient evidence to receive a passing grade, as determined by the course professor. Pass/Fail grades are not included in determining a student’s grade point average.

Incompletes
In the case of a student not fulfilling course requirements due to failure to complete all coursework prior to the end of the quarter, the student will receive an Incomplete rather than a grade, and this shall be recorded in the student’s academic record. The Incomplete will remain
on the student’s record until such time as he/she completes the coursework. If coursework is not completed by the end of the following quarter, the grade becomes a Withdraw, (see below).

Withdraw from Courses After Add/ Drop Deadline
A student may drop a course in the first three weeks of the quarter and it will not appear on his or her transcript. After week 3, a student must explicitly request a W (withdraw) from the instructor of the course if they do not intend to complete the course. This must be requested prior to the final paper, the final exam or the last day of the quarter, whichever comes first. A permanent grade notation of "W" (withdraw) is automatically recorded on the student’s transcript for that course, but is not calculated in the official GPA. The TTIC Registrar must be notified if a Withdrawal has been elected by the student.

Students and international students on F1/J1 VISA should check with Institute officials before withdrawing from a class which could potentially place them below full-time status, resulting in being ineligible for scholarship support or risk violating their legal status.

The Quarter System

The academic year consists of four quarters. All students take courses in the Autumn, Winter, and Spring Quarters. It may be possible for students to take courses in the Summer Quarter, but the summer course offerings are limited and financial support may not be guaranteed. The Autumn, Winter, and Spring Quarters consist of ten weeks of classes plus one week of final examinations. Each quarter is a complete unit of work.

New students may be accustomed to the rhythm of a semester system, and find that adjusting to the quarter system is a challenge that usually requires changing study habits and improving time management skills. Because the quarter passes quickly, students must be prepared to begin working seriously on their studies in the first week of the quarter.

COURSES AND REGISTRATION

List of Courses

A list of current and upcoming courses, along with course details and instructor listing is maintained on the TTIC website (www.ttic.edu/courses).

Registering for Courses

Requirements
Each quarter, students are required to register for at least one course (with a letter grade,) during the early registration period which begins four weeks prior to the start of the quarter. (The TTIC Independent Reading/ Research courses may qualify for the one course.) Students must receive a letter grade for a minimum of one course each quarter. (Pass, Audit or Withdraw courses do not qualify.) Students are expected to confer with their advisor regarding the number and selection of courses, prior to each quarter.
Students that are not registered for any courses by the end of Add/Drop (Friday of week 3 of the quarter) will be considered to be inactive, and will be placed on Academic Probation. Academic Probation results in a 20% reduction in stipend and continues until stipulated requirements have been met. The student must then petition the DGS to register for a course or courses in the current or upcoming quarter. If the student is allowed to register and resume active status, student privileges and full stipend will be reinstated.

To Register for TTIC, UofC
To register, students complete a TTIC Course Registration | Add/Drop form listing all the courses they are enrolling in for the upcoming quarter (both TTIC and UofC courses). This form can be accessed from the Registrar site. The form is electronically forwarded to, and must subsequently be approved by advisors.

If the student has approval to register for University of Chicago courses(such as CMSC, MATH, STAT courses,) the student must also register at classes.uChicago.edu, the University of Chicago student registration system, using their cNet ID.

Students may sit in on a number of classes at the beginning of each quarter, without officially registering for them. However, they must decide by the end of week 3 of the quarter whether they will register for the course. If they do register for that course, they must fulfill all course requirements, including any assignments, tests, projects or the like they may not have completed in the first three weeks (while they were not registered).

Add/ Drop
Accordingly, the Add/Drop deadline is the Friday of week 3 each quarter, and no adds or drops are allowed after that date. Students use the same TTIC form for Add/ Drop as they do for Registration. Dropped classes are not reflected on transcripts.

After the Add/Drop period, if a student cannot complete the requirements of a course, the options available are:

1) Request from the instructor a Withdraw from the course at any time prior to the last assignment, test or day of the course, (with a W recorded on the transcript) - or -

2) Receive an “Incomplete” for a grade if all required coursework and/or tests are not completed, with the intention to complete the work.

All changes in course enrollment status should be reported to the TTIC Registrar. The implications of withdrawals and incompletes are stated in the section “Grading Policy/Incompletes/Withdrawals”. University of Chicago courses not registered in the TTIC registration system by the end of add/drop period will be cancelled automatically by the TTIC Registrar.
**PRE-CANDIDACY REQUIREMENTS**

TTIC does not offer a dedicated Master’s program. Students who fulfill the requirements as discussed below during the Pre-Candidacy period may receive a Master’s diploma before continuing on to become a Ph.D. Candidate. The chart on page 14 illustrates a general timeline of requirements and goals to be reached throughout stages of the program as a Pre-Qualifying Candidate.

**Pre-Candidacy Course Requirements**

Students are required to take a total of seven courses for partial fulfillment of the requirements, during their Pre-Candidacy period.

During the Pre-Candidacy period, a student must complete the following combination of classes from the following categories, as illustrated in the chart below: all three courses from List A, and a total of at least five courses between lists A, B and B.1, and a total of at least seven courses between lists A, B, B.1 and C. Five courses from list A, B and B.1 must be completed before taking the Qualifying Exam (details below,) and then the additional 2 courses shall be taken and completed before the student may become a Ph.D. Candidate. Passing grades must be made in all courses. Overall grade and course requirements are laid out in the two charts below.

<table>
<thead>
<tr>
<th>List A</th>
<th>List B</th>
<th>List B.1</th>
</tr>
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<tbody>
<tr>
<td>Core Requirements</td>
<td>Depth Electives</td>
<td>Application Electives</td>
</tr>
<tr>
<td>Algorithms TTIC 31010</td>
<td>Computability and Complexity Theory TTIC 31060</td>
<td>Intro to Computer Vision TTIC 31040</td>
</tr>
<tr>
<td>Intro to Statistical Machine Learning TTIC 31020</td>
<td>Convex Optimization TTIC 31070</td>
<td>Intro to Bioinformatics &amp; Computational Biology TTIC 31050</td>
</tr>
<tr>
<td>Mathematical Foundations TTIC 31030</td>
<td>Approximation Algorithms TTIC 31080</td>
<td>Speech Technologies TTIC 31110</td>
</tr>
<tr>
<td></td>
<td>Signals, Systems &amp; Random Processes TTIC 31090</td>
<td>Visual Recognition TTIC 31130</td>
</tr>
<tr>
<td></td>
<td>Computational Geometry TTIC 31100</td>
<td>Structural Computational Biology TTIC 31160</td>
</tr>
<tr>
<td></td>
<td>Statistical and Computational Learning Theory TTIC 31120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learning and Inference in Graphical Models TTIC 31140</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mathematical Toolkit TTIC 31150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduction to Information and Coding Theory TTIC 31200</td>
<td></td>
</tr>
</tbody>
</table>

**List C:** Supporting classes in the student’s research area, approved by the advisor. Classes should generally be regular graduate-level TTIC, UoC Computer Science, UoC Math or UoC Statistics classes consisting of coursework and/or a project and/or an exam. Reading classes, pass/fail classes or special topics classes will not generally be approved.
Timeline and Requirements Chart for Pre-Candidacy Period

**First 5 (non-summer) quarters at TTIC**

- 3 courses from List A
- 2 courses from List B or B.1
- 3 courses must have A- or better scores, 2 courses must have B- or better scores (out of 5 courses taken prior to Exam)

**Programing Requirement**
(Consult with advisor and Programming Czar)

**Research at TTIC Series Requirement**
*Completed the first Autumn, Winter, Spring Quarters of enrollment*

- 2 more courses from List B, B.1 or List C
  *Must have B- or better scores.*

**Student Talk Requirement**
*To be completed in the year preceding Candidacy.*

**Teaching Assistant (TA) Requirement**
*To be completed before Thesis Proposal*

**Submit Application for Qualifying Exam**

- Schedule & prepare for the Qualifying Exam

**Apply for Master’s Diploma/Candidacy**

**Qualifying Exam**

- Spring quarter to June 30 of 2nd year

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**Course Exemptions**

Students may petition for exemption from List A courses based on very similar graduate level courses from other institutions— in which they performed well (generally, received an A-, A or A+).

Exemption petitions should be completed in the student’s first year at TTIC using a [Course Exemption Request form](#) from the Registrar website, and should be submitted to the TTIC instructor scheduled to teach the course. Course exemption is decided on a case-by-case basis. Such exemptions will be noted as “exemption-no credit” in the student’s record. Even if such exemptions are granted, the student is still required to complete the five courses from Lists A, B and B.1 by end of Winter Quarter of their second year, by taking additional course(s) from List B or B.1.
Transfer Student Course Requirements

Students transferring to TTIC from programs leading to a Ph.D. in other institutions may be granted credit for up to three courses toward the above course requirements based on similar courses taken at the other institution in which they performed well (generally, received an A-, A or A+). This is true for programs in which a Master's degree is obtained on the way to a Ph.D., but not for terminal Master's programs. The request for credit should be made during the first quarter at TTIC using the Transfer Student Credit Request Form. Credit(s) awarded will be determined by the Director of Graduate Studies in consultation with faculty who oversee courses related to the area of the course(s) which have been submitted for credit approval. Transfer credit for courses taken elsewhere is decided on a case-by-case basis.

If a student receives credit for one or more courses, the following grade requirements are in effect:

<table>
<thead>
<tr>
<th>Course Credits Transferred (from other institution)</th>
<th>TTIC Courses Prior to Qual. Exam (student must still take)</th>
<th>Adjusted Grade Requirement (for TTIC courses taken)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>One grade below A- is allowed</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>All grades must be a minimum of A-</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>All grades must be a minimum of A-</td>
</tr>
</tbody>
</table>

Responsible Conduct of Research Training

Within thirty days of initial enrollment at TTIC (or prior to enrollment,) a student must successfully complete Responsible Conduct of Research (RCR) training. TTIC's objective through student RCR training is to inform about the basic rules that apply to responsibly conduct research- such as ethical considerations when performing research, or the permitted used of research funding, and so on. RCR training is designed to provide the student research community with knowledge about expectations and protocol, enabling each member to be responsible in an academic research community. Candidacy will involve more independent research, and the training is a first-step in preparation.

AT TTIC, RCR training is completed online through the CITI program. Students must take the online course, and pass a quiz on the material, passing with an 80% or better. Test results will be relayed to the Office of the Registrar, and results are valid for up to ten years. Instructions for completing training may be found on the Registrar website.

Students that are not successfully passed training within 30 days will be placed on Academic Probation. Academic Probation results in a 20% reduction in stipend and continues until stipulated requirements have been met.

Programming Requirement

As part of the TTIC program, students must have or acquire experience in computer programming with a general purpose programming language. Students must demonstrate that they have designed and implemented some substantial software system, either from scratch or as a significant extension to existing software.
The student must be responsible for the design of the software or the extension. The software does not have to be "industrial strength", i.e., it does not have to be polished to the point where it is ready to be released to a user community. A simple demonstration of some algorithm or idea is sufficient. However, the problem should be large enough that significant systems engineering issues are addressed.

This requirement can be satisfied through a summer programming job, programming experience as an undergraduate, or by independently writing software, provided that the above criteria are satisfied.

TTIC has appointed a member of the faculty as "Programming Experience Czar". Students should consult with this faculty member to make sure that whatever project they embark on or have embarked on is substantial enough to provide actual "programming experience". After completion of the project, students will submit a report to the Programming Experience Czar for approval. This requirement should be fulfilled before the application deadline for the Qualifying Exam.

Research at TTIC Seminar Requirement

TTIC Professors are constantly re-examining the boundaries of computer science, expanding their areas of study, and publishing new insight for the consumption of computer scientists around the globe. Much of this research is presented during the Research at TTIC seminars, where professors talk about their most current research. TTIC has the Research at TTIC Seminar Requirement and students are required to register for course ‘TTIC 31000 Research at TTIC’ and attend these seminars their first Autumn, Winter and Spring quarters at TTIC. Students receive a pass/fail grade. This requirement is intended to familiarize students with emerging areas of computer science, and promote the opportunity for engagement with faculty and visitors who may play a role in the students' future research endeavors. Seminars are typically on Fridays.

Student Talk Requirement

Students of the PhD program gather an intense knowledge base during the Pre-Candidacy phase of the program. The Qualifying Examination and the Candidacy phase of the program will require students to demonstrate an ability to communicate technical ideas and disseminate their knowledge and findings to fellow students, professors and researchers. To emphasize the value of communication of ideas and knowledge, each student must fulfill a Student Talk Requirement.

In the year proceeding Candidacy, (typically year two of study,) the student shall give an advertised talk, on research work the student has directly been involved in, to a TTIC audience. This may be at a seminar series, at a reading group, or another set time. The student is responsible for setting the date, time and reservation of the talk, ensuring the talk is advertised to the 'TTIC talks mailing list' at least 2 weeks before the talk date, and ensure an announcement is received by the Registrar as a record of fulfilling the requirement. The student may report completing this requirement when they submit the Application for Master’s Diploma/ Candidacy.
Teaching Assistant (TA) Requirement

TTIC students are required to TA for one quarter, prior to proposing a thesis. Students may complete this requirement in Pre-Candidacy, or in Candidacy. Details of the Requirement are in the next section, Candidacy Requirements. This requirement does not need to be completed before taking the Qualifying exam, or applying for a Master’s diploma/Candidacy.

Qualifying Exam

Each Ph.D. student must pass a qualifying exam administered by an Examination Committee. Five core courses and the Programming Requirement must be completed before the initial exam application is submitted, generally by the end of week 2 of the Spring Quarter of the student’s second year. Extensions for special circumstances can only be approved by the DGS.

Once a student applies for the exam, the DGS will appoint an Examination Committee for each student taking the exam. The student should schedule an exam at a time convenient for themselves as well as the examiners, prior to the end of week 8 of Spring Quarter, and reserve a conference room. It is recommended to have taken the exam by week 2 of Summer Quarter.

Qualifying Exam Description

The goal of the exam is to evaluate the student's ability to absorb, communicate and apply new technical ideas. The exam also tests understanding of key concepts in List A courses (Mathematical Foundations, Algorithms and Introduction to Statistical Machine Learning).

The student is given reading material which requires understanding some concepts outside of their immediate research area. The student is required to submit a written summary of the material, give a presentation to the exam committee and answer questions based on the given material. They are evaluated on their ability to clearly understand and explain the given material. The writing component tests the student's ability to extract, organize and explain technical ideas in a logical manner. The questions during the exam test their ability to extrapolate and apply the concepts from the given material (and the List A courses) to possibly different problems.

Exam Format

- One week before date of the exam, the student is required to submit a short written summary of the reading material to the committee. The length of write-up should be at most 4 pages. The summary may also include a description of any results or concepts not covered in assigned material that the student thinks might be helpful in understanding the material. The write-up is required to be original – students should refrain from copying any material directly from the paper or other sources. If something needs to be quoted (e.g. a theorem statement) a reference should be included.

- For the exam, the first part will consist of a presentation based on the reading material (and any other concepts/results necessary for context.) Students may use a white-board or digital slides for presentation. The length of the presentation should be limited to 45 minutes. The committee may interrupt with questions during the presentation.
• After the presentation, the committee may ask questions based on the reading material. These may include questions directly based on the content, or on applying some of the concepts to a different problem. The questions may also test the knowledge of concepts covered in the List A courses (Mathematical Foundations, Algorithms and Introduction to Statistical Machine Learning).

Exam Outcome

The examiners must reach consensus on the outcome of the exam. Possible outcomes are:

• **Full pass.** This results in a recommendation to continue in the Ph.D. Program.

• **Continuation.** A continuation means that the student did not yet pass the exam and must still complete it before continuing in the Ph.D. program. A continuation of the examination must be scheduled with the same committee and possibly with additional reading material. Failure to pass a second continuation exam will result in dismissal from the program.

• **Failure.** The student may not continue in the PhD Program. The student may petition the Director of Graduate Studies to retake the exam.

The examiners will provide formal feedback orally to the student regarding their performance in the exam, as well as via an online Qualifying Exam Evaluation form, which will become part of the student’s record at TTIC.

The front page of the Qualifying Exam Form lists specific deadline dates and submission instructions for the student, leading up to the exam date.

All exams must be passed by week 8 of summer quarter, when Master’s Diploma/Candidacy Applications are due.

Application for Master’s Diploma/Candidacy

After passing the Qualifying Exam and completing all requirements of Pre-Candidacy, a student may apply to receive a Master’s Diploma/Candidacy by the end of week 8 of summer quarter (of their second year of study), submitting the Application for Master’s Diploma/Candidacy to the TTIC Registrar. Master’s diplomas are awarded each fall at the beginning of the academic year (usually late September). Students whose applications are accepted and will be awarded diplomas will be notified during the summer of the exact date of the diploma ceremony.

A student who leaves the program after completing the Pre-Candidacy course requirements (all three list-A courses, at least 5 total from A, B and B.1, and at least seven total from A, B, B.1 and C) may also apply to receive a Master’s diploma. Courses must have passing letter grades. A “P” pass grade will not qualify.

Any requests for an extension to meeting the Master’s Diploma/Candidacy Application deadline must be submitted in writing to the Director of Graduate Studies by week 8 of summer quarter, the same as the Master’s Diploma/Candidacy Application deadline.
PH.D. CANDIDATE REQUIREMENTS

There are four main required components of the Ph.D. program, as follows.
- Course requirements, including the Application Requirement
- Programming, Research at TTIC Seminar, TA Requirement and Student Talk Requirement
- Qualifying Exam
- Doctoral thesis and defense

Full details for the Pre-Candidacy portion of the Ph.D. program are explained in the “Pre-Candidacy Requirements” section of this Guide. Course requirements as a Ph.D. Candidate and thesis details are found in the text below. A full timeline reference chart of the Ph.D. Program as a whole may be found on p. 24.

Candidacy

Approval for Candidacy indicates that a student is moving into a more advanced stage of the Ph.D. Program, permitting him/ her to devote most of their time to research and writing a thesis.

Admission to the Ph.D. program does not automatically include approval of Candidacy. The TTIC faculty will evaluate the progress of the student and determine that the student has completed all course and other requirements, passed the Qualifying Exam, and is otherwise qualified to do work at a level required to complete a doctoral thesis.

To become a Ph.D. Candidate and therefore allowed to continue in the program, a student must have completed seven core courses as detailed in the requirements chart on p.15, the Programming requirement, Research at TTIC Seminar requirement, Student Talk requirement, passed the Qualifying Exam, completed Responsible Conduct in Research training, have a research advisor willing to supervise the student's Ph.D. thesis work, and have Candidacy approved at a student evaluation meeting (typically during Autumn quarter of a student’s third year). (These items are all noted on the Application for Master’s Diploma/ Candidacy form.) If all these requirements are met, and Candidacy is approved by faculty, the Director of Graduate Studies will officially notify the student that they have become a Ph.D. Candidate.

If Candidacy has not been approved by Autumn quarter of a student’s third year, and no special arrangements have been approved by faculty, the student will be asked to leave the program. Requests for extensions must be submitted in writing prior to week 8 of summer quarter.

Research Advisor

As part of the Master’s Diploma/ Candidacy Application, the student must select a research advisor and request the advisor confirm the arrangement with a signature.

The relationship between a student and their advisor is a central aspect of the Ph.D. program. This relationship requires the ongoing consent of both parties - either party can withdraw from a Ph.D. research advising relationship by notifying the Chief Academic Officer (CAO) and the DGS.
When the advisor of a student is also the DGS, then any action or approval that is normally required by the DGS will instead be required of the CAO.

There are many helpful books and guides available such as Mastering Your Ph.D.: Mentors, Leadership, and Community by Patricia Gosling, Bart Noordam (in the TTIC Library) that give good tips about how to utilize an advisor, get the most out of the relationship, and what to do to be instrumental to an advisor in return.

An advisor will steer a student through the process of determining when research is reaching milestones that indicate it may be thesis proposal and defense time, and even provide insight into plotting a course for a career, once their student has achieved their Ph.D. degree.

**Ph.D. Candidate Course Requirements**

Students are required to take a total of nine courses for partial fulfillment of the requirements for the Ph.D. degree. Seven are to be completed before Candidacy and a final two courses once a student is notified that they have attained Ph.D. Candidate status.

To fulfill the Application Requirement of coursework, at least one of the four courses taken from List B must be from List B.1. This course can also count toward the five courses required prior to Ph.D. Candidate status. A grade of B- or higher is required in this course. This requirement should be completed before submitting a thesis proposal. *Similar courses taken at another institution will not qualify to fulfill or be exempt from this requirement.*

Refer to the full list of courses on page 14.

All nine required courses should be completed before a thesis proposal is submitted. The minimum grade requirement for all courses is B-. A student may petition the Director of Graduate Studies to approve lower grades for courses in list C under special circumstances.

Students who receive grades below A- in courses from list A, B or B.1 may petition course instructors to receive an A equivalent based on extra study, an oral exam, a project, or other arrangements as determined by the instructor. Such an A- equivalent will not replace the original grade in the student's transcript, but will be noted in the student's record and count toward fulfilling the 5-course requirement. Students should petition the instructor who most recently taught the course. Alternatively, the student may choose to repeat the class.

**Teaching Assistant (TA) Requirement**

TTIC students are required to TA at least one quarter prior to proposing a thesis. A student may approach a professor, or be approached by a professor to TA.

**TA Notice to TTIC**

Before the beginning of the quarter in which the student will TA, the student must report the TA position in a TA Notice form, indicating that they intent to complete the TA requirement. The notice form informs the Registrar that the requirement will be in effect that quarter. The Director of Graduate Studies will then review the TA position for that particular course, and if approved, the student may proceed.
Courses approved for TA'ing
Students may TA for any TTIC course, and some University of Chicago courses. Director of Graduate Studies will have final approval for any courses proposed by the student.

TA Duties Compensation
When the Director of Graduate Studies approved a TA position, TTIC will provide a one-time TA payment to the student of $500/quarter in addition to the stipend provided by the institute.

If a student is TA'ing a University of Chicago course, the university may provide compensation. If the compensation provided by the university is less than that provided by TTIC to a student TA'ing a TTIC course, TTIC will compensate the difference. Documentation of university compensation will be required.

Completion of the Requirement
Upon completion of the quarter, and TA duties, the course instructor is sent a TA Completion Form and the instructor will indicate if the student satisfactorily completed the TA requirement.

A TA has a professional and ethical role in helping provide high quality education. In addition to helping students learn, TAs have an opportunity to be instrumental in igniting students’ interest in a field that they love.

Whether a student intends on becoming a professor or not, the skills acquired through TA'ing are helpful outside of the classroom as well. For example, excellent public speaking and presentation skills are critical for presenting at professional conferences or in any public forum. A TA can also learn valuable time and task management skills, how to mentor and supervise others, and how to use technology for presentation purposes. In addition, one of the best ways to truly understand something is to try to teach it to someone else; being successful at it can boost self-confidence as well.

If you are planning on an academic career, being a successful TA is paramount to your future. Even at a research institution, teaching will be a significant part of your duties as a professor. If you do it well and enjoy it, it can likewise make professional life easier and more enjoyable.
### Timeline and Requirements Chart for Ph.D. Program

#### Enrollment

<table>
<thead>
<tr>
<th>First 5 (non-summer) quarters at TTIC</th>
<th>Spring Quarter of 2nd year</th>
<th>Ph.D. Candidate Phase</th>
<th>Thesis Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 courses from List A</td>
<td>Submit Application for Qualifying Exam</td>
<td>2 more courses from List B or List C (or from List B and C) Must have B- or better scores. Total of 9 courses passed.</td>
<td>Schedule to be determined by student and Research Advisor</td>
</tr>
<tr>
<td>2 courses from List B or B.1</td>
<td>Qualifying Exam</td>
<td>Apply for Master's Diploma/Candidacy</td>
<td></td>
</tr>
<tr>
<td>3 courses must have A- or better scores, 2 courses must have B- or better scores (out of 5 courses taken prior to Exam)</td>
<td>Schedule &amp; prepare for the Qualifying Exam</td>
<td>Fulfill Application Requirement</td>
<td></td>
</tr>
</tbody>
</table>

#### Programming Requirement

(Consult with advisor and Programming Czar)

- Schedule & prepare for the Qualifying Exam

#### Research at TTIC Series Requirement

Completed the first Autumn, Winter, Spring Quarters after enrollment

- 2 more courses from List B, B.1 or List C Must have B- or better scores.

#### Student Talk Requirement

To be completed in the year proceeding Candidacy.

#### Teaching Assistant (TA) Requirement

To be completed before Thesis Proposal

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By Thesis Proposal time, a student should have acceptably completed the following nine courses:

<table>
<thead>
<tr>
<th>List A courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>List B courses (incl. Applc Req.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List B, B.1 or C courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
</tbody>
</table>
Deadline for Completion of Degree Requirements

Full-time students must successfully defend their theses within six years of initial enrollment in the program. All students must produce an accepted thesis proposal by the end of their fourth year at the Institute. Any requests for an extension may be granted at the discretion of the Director of Graduate Studies, and only when there is demonstrated progress toward the completion of the thesis, or when there is evidence that the thesis will be completed in a reasonable amount of time.

Doctoral Thesis and Defense

The institute requires each student to write a Doctoral Thesis that includes significant original research in computer science. The full Thesis Guide is available on the Registrar website.

Thesis Committee

The student’s Thesis Committee must consist of at least three faculty members, with at least two TTIC tenured and/or tenure-track faculty. The third and any further members may be any TTIC faculty (tenured, tenure-track, research or visiting), or University of Chicago faculty. With the specific approval of the Chief Academic Officer, the third and further members may also be faculty or equivalent at another institution. The chair of the Thesis Committee is the student’s advisor.

The student must choose their Thesis Committee members and complete the Thesis Committee Membership Request form available on the Intranet. The Registrar keeps this record in the student’s file.

Thesis Proposal Defense

The student presents their thesis proposal defense orally to the Committee and the Committee either approves or makes recommendations. The student is expected to provide the Committee with a written thesis proposal as well. The student’s proposal is evaluated both orally and on a Thesis Proposal Approval form which is provided by the student, completed by the thesis committee, and the committee submits to the Registrar to be placed in the student’s file.

Thesis Defense

The student must successfully defend his or her thesis in a public forum before the Thesis Committee and any other interested TTIC community members. The Thesis Committee will decide the format for the defense. An evaluation will be provided to the student both orally and on a Thesis Defense Evaluation form, by the Thesis Committee subsequent to the defense. The thesis defense must occur at least two weeks after the student has given proper notice. Proper notice consists of the following actions:

- The student must give a draft of the thesis, approved by the advisor, to each member of the Thesis Committee and to the Chief Academic Officer. The draft must be nearly complete with only minor changes expected in the final version.
- The student must put an additional copy on display in a common area designated by the Registrar.
- The thesis abstract must be posted in a common area designated by the Registrar.
• The student must advertise the time and date of the defense in the appropriate TTIC mailing lists.

The TTIC Registrar may assist students with securing a room for the defense to be held.

**Thesis Publication Requirements**

Doctoral theses are original contributions to scholarship. As such, they should be and are made available to the scholarly community at the Institute and elsewhere. As a condition for receipt of the doctorate degree, all doctoral theses produced by students at the Institute are bound and placed in the circulating collections of the Institute Library. They are made available to researchers here through direct borrowing and copies may be accessed from [arXiv.org](http://arXiv.org).

The thesis should also be made available to researchers through [arXiv.org](http://arXiv.org). The digitized full text of the thesis and abstract should be submitted to arXiv.org, and a link to the submission provided to the TTIC Registrar.

Because the thesis is published, students should be aware that they must obtain permission from the holder(s) of the copyright(s) to include any copyrighted material in the thesis. The Institute will require documentary evidence that the student has obtained all necessary permissions or has made a good faith effort to do so, if applicable.

**Doctoral Thesis Guide**

TTIC has compiled a Doctoral Thesis Guide which thoroughly explains the thesis process, and includes more detail, descriptions and samples, to help students navigate this important step in Ph.D. degree completion.

The Guide may be accessed from the TTIC Registrar website.

**Ph.D. Degree Completion**

The deadline to qualify for the Ph.D. degree is *three weeks prior to the last day of the quarter* in which the student expects to graduate. All requirements must be met and approved by this date. The final thesis (compiled as outlined in the Doctoral Thesis Handbook, bound and signed by the student’s advisor and Thesis Committee) should be submitted to the TTIC Registrar by the student.

**Doctoral Diploma**

Once a student has completed all requirements for the Ph.D. Program, they will be notified that they will receive their diploma, and a date will be set for the diploma to be awarded. Diplomas are normally awarded the week proceeding Autumn quarter of each academic year (late September or early October.)

At the diploma ceremony, those students who have earned doctorate degrees will have a doctoral hood conferred on them by the Chief Academic Officer. Students who finish their
degrees at any time during the year are welcome to participate in the Autumn diploma ceremony.

A note on forms:
Up to date versions of all forms referenced in this Guide may be found on the TTIC Registrar site. You must have a “ttic.edu” email address to access the Registrar site’s functionality.