

Toyota Technological Institute at Chicago

Academic Catalog



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**Academic Catalog
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I. INSTITUTIONAL MISSION AND GOALS

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

This overall mission has two components --- research and educational missions.

The Research Mission

TTI-C aims to achieve international impact through world-class research in fundamental computer science. Here we try to clarify the intended meaning of ``impact'', ``fundamental'', and ``computer science''.

Impact. The mission statement focuses on academic impact. Objective measures of academic impact are difficult to define and controversial to interpret. However, the following measures help to define “academic”.

- Publication counts weighted by the strength of the venues in which the publications appear.
- Citation counts.
- The number of co-authors of TTI-C faculty at other prominent computer science institutions.
- A report of an external visiting committee where the committee members are unarguably top researchers in computer science.
- The rank of TTI-C in well established ordered listings of computer science departments.

Note that the number of patents filed is not mentioned. Patents may be a natural outcome of academic research but are not a direct goal of TTI-C regardless. The amount of extramural research funding is also absent. 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 focuses on fundamental scientific research. Intuitively, a scientific result is fundamental to the extent that it has open-ended implications.

Computer Science. Computer science is viewed as the creation and application of knowledge about computation. Algorithms and complexity theory are both fundamental to the engineering of computer systems. Conversely, potential applications, such as automated speech recognition, have challenged people to make theoretical advances. The mission of TTI-C is to contribute fundamental knowledge that is relevant to computer technology.

The Educational Mission

The educational mission of TTI-C is to achieve international impact through the accomplishments of its Ph.D. graduates.

Diversity at TTI-C

Success in the research and educational mission of TTI-C requires a diverse faculty and strong interactions with the multicultural international academic computer science community. However, the research mission alone does not recognize the intrinsic value in diversity. To serve society well, TTI-C should exploit the intellectual abilities of all segments of society. TTI-C recognizes the intrinsic value of diversity in its faculty, staff, and student body.

Goals and Priorities

To pursue its overall Mission, TTI-C has set a first goal of recruiting thirty faculty members in fundamental computer science by 2010. This faculty will consist of twelve regular faculty (tenured and tenure-track) and eighteen limited-term research faculty. The faculty members are expected to be first-rate computer scientists having the quality equivalent to corresponding professors at top ten departments of computer science or information technologies.

Vision and Values

The 20th century saw enormous progress in automation. The 21st century will see more. Automated systems may drive cars, do housekeeping, and translate between spoken languages. But technological progress raises social concerns. Technology must not extinguish our right to privacy, make people unemployable, or destroy cultural diversity. While technology presents dangers, it also holds promise. Language translation can reduce misunderstanding. Information management can improve medical care. Communication systems can bring people together. If we can reap the benefits while avoiding the pitfalls, technology may create and sustain harmony and prosperity for humankind. At TTI-C, the vision is to discover fundamental principles of computation and change the world through the technologies those principles enable. At the same time, TTI-C is committed to the values of human freedom, dignity, prosperity, and diversity. The mission of TTI-C is formulated to be consistent with this vision and these values.

II. ADMISSIONS POLICIES AND PRACTICES

TTI-C ACADEMIC CALENDAR

2009 SUMMER QUARTER	
June 22	Quarter Begins
July 3	Independence Day Observed
August 29	Quarter Ends
2009 AUTUMN QUARTER	
February 18	Application Deadline-Ph.D. Program
September 21	Student Orientation/Class Registration Begins
September 28	Quarter Begins
November 26-27	Thanksgiving
December 12	Quarter Ends
2010 WINTER QUARTER	
January 4	Quarter Begins
January 18	Martin Luther King, Jr. Day
March 20	Quarter Ends
2010 SPRING QUARTER	
March 29	Quarter Begins
May 31	Memorial Day
June 13	Quarter Ends
2010 SUMMER QUARTER	
June 21	Quarter Begins
July 5	Independence Day Observed
August 28	Quarter Ends
2010 Autumn Quarter	
February 18	Application Deadline-Ph.D. Program
September 20	Student Orientation/Class Registration Begins
September 27	Quarter Begins
November 25-26	Thanksgiving
December 11	Quarter Ends
2011 WINTER QUARTER	
January 3	Quarter Begins
January 17	Martin Luther King, Jr. Day
March 19	Quarter Ends
2011 SPRING QUARTER	
March 28	Quarter Begins
May 30	Memorial Day
June 11	Quarter Ends
2011 SUMMER QUARTER	
June 20	Quarter Begins
July 4	Independence Day Observed
August 27	Quarter Ends

ADMISSION REQUIREMENTS

Applicants must have, or expect to soon receive, a Bachelor's degree and cannot enroll without such a degree. Applications are reviewed following the receipt of all credentials, including transcripts and recommendation letters. Student admission will be determined after faculty members review the applications and determine a candidate's academic ability, strength in previous academic pursuits, and motivation to perform research. Applicants who hold a Ph.D. degree from another institution will not normally be admitted.

Applicants holding a master's degree and desiring to enter the Doctoral program will be considered after review of doctoral recommendation letters, master's thesis and published papers.

English Language Requirement

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).

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 score and 2) candidate interviews. The minimum TOEFL score to be considered for admission is 85 on the internet-based test (iBT) and 563 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 English language requirement may be waived if the applicant is a native of or studied in full-time status for at least one academic year within the last five years in the U.S., the United Kingdom, Ireland, Australia, New Zealand or English medium universities in Canada or South Africa. Students who studied in English in other countries, for example, India, Pakistan, the Philippines, Hong Kong, Singapore, etc., are not exempt from the English language requirement.

Application Instructions

Current application instructions can be found at the web site www.tti-c.org.

TUITION AND FINANCIAL AID

Tuition is \$30,000.00 per year.

Ph.D. Program – Graduate Student Support

All Ph.D. students at TTI-C 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. Funding is provided either by research grants or by startup packages obtained by individual faculty members.

Part of the admissions process involves reaching 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 for the welfare of that student should they decide to attend TTI-C. However, continued support for the entire duration of a student's enrollment can not be guaranteed, although every effort will be made by TTI-C 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.

For further information contact the Administrative Office at 773.834.2500.

II. ACADEMIC POLICIES

ACADEMIC HONESTY

Students and faculty of TTI-C belong to an academic community with high scholarly standards. This community is also committed to certain fundamental ethical principles. It is contrary to justice, to academic integrity, and to the spirit of intellectual inquiry to submit the statements or ideas of work of others as one's own. To do so is plagiarism or cheating, offenses punishable under the Institute's disciplinary system. Because these offenses undercut the distinctive moral and intellectual character of the Institute, they are taken very seriously, and punishments for them may include permanent expulsion from the Institute.

Proper acknowledgment of another's ideas, whether by direct quotation or paraphrase, is expected. In particular, if any written source is consulted and material is used from that source, directly or indirectly, the source should be identified by author, title, and page number. Any doubts about what constitutes "use" should be addressed to the instructor or advisor.

OFFICIAL COMMUNICATION BY ELECTRONIC MAIL

Official communications from the Institute are sent via electronic mail (e-mail) to each student's Institute e-mail account and students are responsible for the information. If a student wishes to read that mail via a personal account, he or she assumes the responsibility to set up and maintain any forwarding functions.

CURRENT POLICIES, RULES AND REGULATIONS

In the autumn quarter the Institute publishes the current policies, rules, and regulations related to registration, student status, grades, graduation, and the like. *All students are responsible for familiarizing themselves with these policies and rules.*

STUDENT RECORDS

Directory Information

The Institute makes available without the express consent of a student only such information as would ordinarily be published in a student directory or other materials intended for public distribution: name, address, telephone listing, major field of study, awards and honors, participation in officially recognized activities, dates of attendance, degrees, the most recent educational agency or institution attended, and similar information. However, students may request that their address and telephone number be withheld. The Institute may from time to time use photographs of students in its publications and other materials.

Due to the special nature of the relationship between TTI-C and the University of Chicago, and the agreement that allows students to enroll in University courses, only that information that is necessary for University academic and administrative record keeping is shared with the appropriate University staff, without the express consent of the student.

The Institute furnishes other information from a student's file only upon written request from the student.

Record Maintenance

A student's educational records are defined under the Family Educational Rights and Privacy Act as including, subject to the limitations described in the Act, "records, files, documents, and other materials which (1) contain information directly related to a student; and (2) are maintained by an institution or by a party acting for such institution" A student's official academic record is maintained indefinitely at the Institute.

Inspection and Review of Educational Records

In furtherance of the federal Family Educational Rights and Privacy Act of 1974 as amended (FERPA), the following compliance procedures will be followed by the Institute:

1. All students who are or have been in attendance at the Institute shall have the right to inspect and review their educational records, subject to the limitations provided under FERPA and its applicable regulations.
2. Students should file a request to see their education records with the Institute. A representative from the Institute will discuss such requests with the student to assure that the appropriate records are compiled for the student's review. The representative will make arrangements for access and will notify the student of the time and place where the records may be inspected.
3. Information such as recommendations collected by the Institute, in connection with a student's admission to the Institute will be considered to have served its purpose upon a student's acceptance, and will not be part of an official record.
4. A student's medical records, maintained separately by the Institute are unavailable for non-medical use within the Institute and are unavailable for non-medical sources outside the Institute. They will not be considered part of a student's educational records. A student may of course continue to consult his or her physician about his or her medical records.
5. Parental statements of financial resources will remain confidential. Where parents indicate a willingness for the information in such statements to be shared with the student, the statements will be made available to the student upon request.

6. Notes written by a member of the faculty, an adviser, or others concerning students, for the exclusive use of the writer, will be retained by the writer and will not be considered part of the student's educational record.

Access to a student's educational records will be provided within a reasonable period of time, but in no case more than forty-five days after the request has been made.

Amendment of Educational Records: Right to a Hearing

The Institute will provide students an opportunity for a review if they believe their educational records to be inaccurate or misleading. If a student believes a record is inaccurate or misleading, he or she may write the Institute official responsible for the record or the Chief Academic Officer, clearly identifying the part of the record he or she wishes changed and specifying why the record is inaccurate and misleading. A conciliation conference between the student, the Chief Academic Officer, and the author of the challenged material will first try to reach a reasonable solution. Such a solution might be the correction or deletion of the challenged material, or the insertion by the student of a written explanation of the material.

Should the results of this conference prove unsatisfactory to the student, and if he or she so requests, a hearing will be conducted. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing. Note: such a challenge to a record does not include a student's disagreement with the grade received in a course, except if it involves a typographical error in the recording of the grade.

Complaints regarding alleged violations of FERPA may be submitted to The Family Policy Compliance Office, U. S. Department of Education, 400 Maryland Avenue SW, Washington, DC 20202-5920.

Cost of Copies

Where required by federal regulations issued under the Family Educational Rights and Privacy Act of 1974 as amended, students may obtain copies of their educational records at a cost of ten cents per page, with the following exceptions: transcripts will be available at a cost of \$7 per copy and can be requested in person, by fax or mail; credentials and reference letter files with the Institute are \$10 to establish for students and alumni, and mailing of reference letters to graduate schools and employers costs \$7 per set.

Release of Students' Records

Under current federal regulations, except for "directory information" about a student, a student's records may be released without his or her prior written consent only to other school officials, including teachers, who have "legitimate educational interests." A "school official" is a person employed by the Institute in an administrative, supervisory, academic, research, or support staff position (including law enforcement and health staff); a person or company with whom the Institute has contracted (such as an attorney, auditor, or collection agent); a person serving on the Board of Trustees or another Institute committee; a student serving on an official Institute committee (such as a disciplinary

committee) or who is assisting another school official in performing his or her tasks; and any other person determined by the Institute to have a need to know the information in order to perform their administrative tasks, provide a service or benefit for a student, or to fulfill a legitimate educational interest of the Institute. A school official has a “legitimate educational interest” if the official needs to review an educational record or have access to the information in the educational record in order to fulfill his or her responsibilities for or on behalf of the Institute.

A student’s educational records may also be disclosed without his or her prior written consent: (1) to specified federal and state officials subject to certain conditions; (2) to officials of another school, school system, or institute of postsecondary education that has requested the record and where a student seeks or intends to enroll; (3) in connection with a student’s application for or receipt of financial aid; (4) to state officials who, pursuant to state statute prior to November 19, 1974, had access to records; (5) to organizations such as the Educational Testing Service and the College Entrance Examination Board for the purpose of “developing, validating, or administering predictive tests”; (6) to accrediting organizations for the purposes of accrediting; (7) to parents of a student who is dependent for income tax purposes; (8) to “appropriate persons” in the event of health and safety emergencies; and (9) in response to a judicial order or subpoena.

THE TTI-C ID CARD and the UNIVERSITY OF CHICAGO ID CARD

The TTI-C ID card is an official identification card and is subject to the regulations of TTI-C. The card identifies a person as either a student or an employee, but not both. The card is not transferable and must be presented upon demand to an Institute official. Misuse of the card will result in its forfeiture and may be subject to disciplinary action.

Students will also be assigned a University of Chicago ID card, called the Chicago Card. This card allows students access and use privileges of the University of Chicago libraries, athletic facilities, and other University services. Students will also be assigned a CNet-ID, which allows access to the University's email system and other administrative student systems.

ADDRESS AND NAME CHANGES

Students are responsible for notifying the Institute in a timely manner of any change of name or address, whether campus, local, or permanent. Changes of name must be notarized. If the Institute mails a grade report, registration form, or bill to the address on file with the Institute and if the mail is returned to the Institute because the student no longer resides at that address, the item will not be mailed again, nor will late payment nor late registration fees be waived.

Students wishing to withhold the release of their addresses and phone numbers to third-parties may request this in writing or in person to the Institute.

PETITIONS

Any student who wishes to appeal for special consideration under an Institute regulation or an interpretation thereof must file a petition with the Chief Academic Officer.

IV. EDUCATIONAL PROGRAMS, POLICIES AND GRADUATION REQUIREMENTS

INTRODUCTION

This section describes policies and requirements for Ph.D. Degrees. Any questions regarding these requirements should be directed to the Chief Academic Officer.

Under a special arrangement with the University of Chicago, TTI-C students are allowed to enroll in University of Chicago courses without additional tuition charges.

DEFINITIONS OF STUDENT STATUS

The following categories define the status options for students enrolled at TTI-C.

Graduate: Student in a Graduate degree program leading to a Ph.D. degree.

Student-at-Large: Registered for special study but not a candidate for a TTI-C degree. Students from TTI Japan taking courses at TTI-C 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 combination of courses, work experience, research or special studies that is considered a full-time workload, as follows:

- All doctoral (Ph.D.) students in Residence are considered full-time.

All students are expected to be in full-time status at all times while enrolled at TTI-C.

COURSE REGISTRATION

Students must complete a TTI-C course registration form listing the courses they are enrolling in for the upcoming quarter. The form must be approved by their advisor. TTI-C's course registration period each quarter coincides with the University of Chicago registration period.

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 the third week 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.

Accordingly, the Add/Drop deadline is the third Friday of each quarter. Adding or dropping classes after the deadline can incur a late registration fee payable by the student.

GRADING POLICIES

All core 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 receive approval from the Chief Academic Officer by the end of the fifth week of the quarter.

In computing GPA's, the Institute uses the following system:

A=4, B=3, C=2 D=1, with a "+" or "-" counting as 1/3 of a point. There are no A+ grades recorded in the official student transcripts.

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 stay on the student's record indefinitely or until such time as he/she completes the coursework.

WITHDRAWAL FROM COURSES AFTER ADD/DROP DEADLINE

A student may withdraw from a course in the first three weeks of the quarter and it will not appear on his or her transcript. After the third week 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. The instructor is obligated to grant a W as requested. This grade is permanent and appears on the transcript but is not calculated in the official GPA.

THE PH. D. PROGRAM

The Ph.D. Program is designed to prepare students for academic or research careers. To complete the 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. dissertation. In addition to the thesis, there are course, programming and examination requirements for the completion of the program as described below. Students should keep in mind that these formal requirements are actually only a small part of 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.

Master's Degree Within the Ph.D. Program

TTI-C does not offer a dedicated master's program. A master's degree within the Ph.D. Program is granted to students who fulfilled the course and programming requirements (see *Course Requirements* and *Programming Requirement* sections below). Passing the qualifying exam is not required in order to receive a master's degree.

The deadline for completion of the master's degree is the last day of summer quarter. All requirements must be met and approved by this date. Specifically, the core courses and programming requirement should be completed and approved with the forms received by the registrar. Students completing all requirements as noted by this date will receive their degrees in early autumn. Students completing the degree after this date will receive their degrees the following autumn.

Advisors

Upon entry to the program the Institute assigns each student, in consultation with the student, an interim advisor.

Before a student takes the qualifying exam, and in any case no later than the end of the second year, the student must choose a regular advisor. The research advisor must be tenured or tenure track TTI-C 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) TTI-C faculty member as a secondary advisor. In such cases, the TTI-C 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 by a form signed by both the student and the advisor. In the case of two research advisors (University and TTI-C), a form must be completed for both advisors. The form will be reviewed and signed off on by the Director of Graduate Studies. The student submits this completed form to the Registrar.

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 or Chief Academic Officer. The Director of Graduate Studies is responsible for verifying that each graduating Ph.D. has fulfilled the Ph.D. requirements. The Director of Graduate Studies and the Chief Academic Officer shall be notified of all changes in advisors.

When the advisor of a student is also the Director of Graduate Studies, then any action or approval that is normally required by the Director of Graduate Studies will instead be required by the Chief Academic Officer.

Residence Requirements

TTI-C'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 satisfactory completion of the Ph.D. degree requires the student to:

- 1) Be in residence as a full-time regular Ph.D. student for all required core & elective courses;
- 2) Register for three consecutive academic quarters--Autumn, Winter, and Spring—for the first two years of study.

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

Academic and Research Requirements

There are four main required components of the Ph.D. program, as follows.

- Course requirements (required also for a master's)
- Programming requirements (required also for a master's)
- Qualifying exam
- Doctoral thesis and defense

Each of these requirements are discussed in turn below.

Course Requirements

All Ph.D. students must successfully complete (pass) at least eight courses.

The Core

The course requirement is divided into a core requirement and electives. The core requirement is expected to be completed before the spring quarter of a student's second year. Each core course has a designated "faculty in charge" (appointed by the Chief Academic Officer, and typically the faculty teaching the course, if taught at TTI-C).

Students are required to have a grade of “B” or higher in every core course, with no more than two B’s or B+’s overall. If a student does not receive an A in a course, he or she may retake the course once in order to improve the grade. The student’s academic record and transcript will list both courses taken and the grade received for each.

Alternatively, the student may be granted an opportunity to satisfy the requirements for an A for that course in a manner to be determined by the faculty in charge of the core course. In this case, the student’s academic record and transcript will reflect the original grade received in the course with a notation in the internal academic record that the grade requirement was satisfied in another manner.

The core consists of the following five courses:

TTIC 101	Algorithms
TTIC 102	Discrete Mathematics
TTIC 103	Artificial Intelligence
TTIC 104	Programming Languages
TTIC 105	Computer Architecture and Operating Systems

The above courses will have corresponding UOC course numbers and may be taught by either TTI-C or UOC faculty.

Electives

Students must take at least three technical elective courses in addition to those required by the core. These elective courses are typically in computer science but may be courses offered by another department such as mathematics, statistics, or economics. They should be technical courses and need to be approved by a student's advisor.

Course Exemptions

All exemptions and substitutions must be approved by the faculty member in charge of the course.

Core course exemptions for classes taken at another institution may be considered. Identical or very similar courses should have been taken within the last five years. Exemptions based on courses taken over five years ago require special approval from the Chief Academic Officer. Petitions must be submitted by the end of the student’s first quarter at TTI-C. Petitions received at a later date will be reviewed only under special circumstances, as determined by the Director of Graduate Studies.

For all course exemption petitions, students are to petition the faculty member in charge of that course. The relevant faculty may meet with the student to discuss their level of knowledge of the subject. The faculty in charge of the course makes the final determination and reports it to the Director of Graduate Studies.

Exemptions will be awarded only when the student clearly performed at or above a grade level of "A" in the course at the other institution. Such courses that are exempted will not be recorded in the student's official TTI-C transcript. However, a course exemption form will be placed in the student's file and record will be kept of those courses the student enrolled in and completed, and those courses they were exempted from.

Course Substitutions

Course substitutions are handled similarly, but less formally, than course exemptions. Substitutions for particular core courses must be approved in writing by the faculty member in charge of that course, preferably before the student enrolls in the substituted course.

Programming Requirement

Ph.D. 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.

TTI-C 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.

Qualifying Exam

Each Ph.D. student must pass a qualifying exam administered by an Examination Committee. The core course and programming requirements must be completed before the exam is scheduled, generally by the end of the second week of the Spring Quarter of the student's second year. Extensions for special circumstances can only be approved by the Chief Academic Officer.

The main purpose of the exam is to analyze the student's mastery of concepts and approaches relevant for Ph.D. research, and the student's ability to apply these concepts and approaches in understanding research. The exam does not need to cover all topics or touch on all courses taken by the student. However, it is expected the exam will cover

both the direct area in which the student intends to do research, as well as other relevant areas.

The Director of Graduate Studies will appoint an examination committee for each student taking the exam. The student should then schedule the exam at a time convenient for themselves as well as the examiners, prior to the end of June.

The examiners can request the student's transcript from the Registrar in order to decide on the topics and focus of the exam. The examiners will assign the student reading material at least three weeks prior to the exam. The exam will focus on the research presented in this reading, as well as related issues (e.g. methods used by the papers, or alternative approaches the paper mentions).

The examiners may also provide the student with specific questions or issues they would like the student to consider and discuss in the exam. The examiners should be explicit about whether the student is allowed to discuss these questions with others in preparing for the exam. At the examiners' discretion, specific questions can be provided to the students less than three weeks prior to the exam date, but the student should be told in advance to expect such questions.

The oral exam is expected to last approximately one hour. The student should be prepared to present the research described in the assigned reading, and address the issues and questions assigned. This typically includes slides or other presentation aids. Examiners may ask additional follow-up questions during the exam.

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 must still complete the exam to continue in the Ph.D. program. A continuation of the examination must be scheduled, possibly with additional reading material.
- Failure. The student may not continue in the PhD Program.

The examiners will provide formal feedback orally to the student regarding their performance in the exam, as well as via a qualifying exam evaluation form, which will become part of the student's record at TTI-C.

Candidacy

To become a Ph.D. candidate and therefore allowed to continue in the program, a student must have fulfilled the core course requirements, the programming requirement, passed the qualifying exam, and have a (non-interim) advisor willing to supervise the student's Ph.D. thesis. If all these requirements are met, the Director of Graduate Studies will notify the student that they have become a Ph.D. Candidate. If the requirements have not all been satisfied by the end of the Autumn quarter of the student's third year, the student will be asked to leave the program. Extension may be granted by the Chief Academic Officer.

Doctoral Thesis and Defense

The institute requires each student to write a Doctoral Thesis that includes significant original research in computer science.

The student's thesis committee must consist of at least three faculty members, with at least two TTI-C tenured and/or tenure-track faculty. The third and any further members may be any TTI-C 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 Agreement to Serve form available on the intranet. The student presents their thesis proposal defense orally to the committee and the committee either approves or makes recommendations. The student is advised of this both orally and on a thesis proposal defense evaluation form which is provided to the registrar to be placed in the student's file.

The student must successfully defend his or her thesis in a public forum before the thesis committee and any other interested faculty 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 mailing lists.

Dissertation Publication Requirements

Doctoral dissertations 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, all doctoral dissertations 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 purchased from ProQuest Information and Learning.

An abstract is published in “Dissertation Abstracts” and made available electronically through ProQuest Digital Dissertations along with the digitized full text of the dissertation itself.

After the student receives the degree, one copy of the dissertation is added to the Institute Library's collections. The other copy and the abstract are sent to ProQuest Information and Learning. All students are required to execute a publication agreement with ProQuest. Because the dissertation is published, students should be aware that they must obtain permission from the holder of the copyright to include copyrighted material in the dissertation. The publication agreement available at the Institute has details. The Institute will require documentary evidence that the student has obtained all necessary permissions or has made a good faith effort to do so.

Ph.D. Degree Completion

The deadline for the PhD 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. Specifically, in addition to the core courses and programming requirement met for the master’s degree, the final thesis should be submitted and signed by the student’s advisor and thesis committee, and the forms received by the registrar.

Faculty Reviews of Student Progress

To ensure students are on track to meet the requirements discussed above, regular student progress reviews are conducted by faculty.

At the end of each quarter, students complete a review of their work in the previous quarter and a brief self-evaluation of their performance in academic activities and submit an academic/research plan for the upcoming quarter. This plan must be discussed with and approved by the student’s advisor.

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

The faculty will decide for each student whether that student is making sufficient progress to continue in the Ph.D. Program. If not, either a letter of warning may be served to the student 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.

V. COURSES

Many of the courses listed below are offered in alternate years. Please contact the Institute for current information.

TTIC 101 (CMSC 37000) Algorithms

Design and analysis of efficient algorithms, with emphasis on ideas rather than on implementation. Algorithmic questions include sorting and searching, discrete optimization, algorithmic graph theory, algorithmic number theory and cryptography. Design techniques include "divide-and-conquer" methods, dynamic programming, greedy algorithms, graph search, as well as the design of efficient data structures. Methods of algorithm analysis include asymptotic notation, evaluation of recurrent inequalities, the concepts of polynomial-time algorithms and NP-completeness.

TTIC-102 (CMSC 17400) Discrete Mathematics

This is a directed course in mathematical topics and techniques needed by students taking Algorithms (CMSC 27000). It is also a prerequisite to several other courses, including Honors Combinatorics and Probability (CMSC 27400). The course emphasizes mathematical discovery and rigorous proof, which are illustrated on a refreshing variety of accessible and useful topics. Basic counting is a recurring theme and provides the most important source for sequences, another recurring theme. Further topics to be covered include proof by induction; recurrences; and Fibonacci numbers; graph theory and trees; number theory, congruences and Fermat's little theorem, counting, factorials and binomial coefficients; combinatorial probability; random variables, expected value and variance; and limits of sequences, asymptotic equality, and rates of growth.

TTIC-103 Artificial Intelligence

A high level overview of a range of related topics: Shannon's channel capacity theorem. Hypothesis testing. Statistical inference. Statistical perception in speech and vision. Probably Approximately Correct (PAC) learning. The Minimum Description Length (MDL) principle. Inference in Bayesian networks. Probabilistic relational models (PRMs). Logistic Regression. Neural Networks. Support Vector Machines.

TTIC 104 (CMSC 32100) Programming Languages

Covers the foundations of programming languages and gives an introduction to high-level languages using Standard ML. The topics covered include syntax, untyped lambda calculus, typed lambda calculus, static semantics, operational semantics, and type safety. The student is expected to develop a thorough understanding of the Standard ML language by means of biweekly projects.

TTIC 105 (CMSC 33000) Computer Architecture and Operating Systems

This course covers basic concepts of operating systems. Among the topics discussed are the notion of a process, interprocess communication and synchronization, main memory allocation, segmentation, paging, linking and loading, scheduling, file systems, and security and privacy. This course is taught on Sun workstations using UNIX.

TTIC-200 Logics, Languages, Types, and Inference

A high-level overview of a range of related topics: Syntax and compositional semantics. Typed-logical semantics of natural language. The simply typed lambda calculus. Types and type inference in programming languages. The general notions of soundness and completeness for inference. Higher order logic as the foundation for mathematics. Godel's incompleteness theorem. Deductive databases. The situation calculus.

TTIC 800 Independent Research Student engages in research under guidance of research advisor.

TTIC 900 Independent Reading Student engages in reading and research assignments under guidance of faculty.

CMSC 32200 Computer Architecture

Survey of contemporary computer organization covering: early systems, CPU design, instruction sets, control, processors, busses, ALU, memory, pipelined computers, multiprocessors, networking and case studies. We focus on the techniques of quantitative analysis and evaluation of modern computing systems, such as the selection of appropriate benchmarks to reveal and compare the performance of alternative design choices in system design. The emphasis is on the major component subsystems of high performance computers: pipelining, instruction level parallelism, memory hierarchies, input/output, and network-oriented interconnections. We also may cover topics such as portable computers, high-performance parallel computers, graphics computers and performance modeling.

CMSC 33600 Types for Programming Language

Course information not available at time of Catalog publication. Contact the Institute for further information.

CMSC 35000 Introduction to Artificial Intelligence

Catalog Description: This course is an introduction to the theoretical, technical, philosophical aspects of Artificial Intelligence. The emphasis will be on computational and mathematical modes of inquiry into the structure and function of intelligent systems. Topics include learning and inference, speech and language, vision and robotics, reasoning and search.

CMSC 35100 Natural Language Processing

An introduction to the theory and practice of natural language processing, with applications to both text and speech. Topics include regular expressions, finite state automata, morphology, part-of-speech tagging, context-free grammars, parsing, semantics, discourse, and dialogue. Symbolic and probabilistic models are presented. Techniques for automatic acquisition of linguistic knowledge are emphasized.

CMSC 35400 Machine Learning

An introduction to the theory and practice of machine learning. The course will emphasize statistical approaches to the problem. Topics covered will range from pattern recognition, empirical risk minimization and the Vapnik Chervonenkis theory, neural networks, decision trees, genetic algorithms, unsupervised learning, and multiple classifiers.

CMSC 35500 Computer Vision

Deformable models for detecting objects in images will be discussed in detail. One-dimensional models to identify object contours and boundaries; two-dimensional models for image matching; sparse models for efficient detection of objects in complex scenes. Various mathematical tools needed to define the models and the associated algorithms will be developed. Applications include, detecting contours in medical images, matching brains, detecting faces in images and more.

Methods for object recognition and classification related to the sparse detection models will be covered with applications to handwritten character recognition and recognition of rigid objects in scenes.

Neural network implementations of some of the algorithms will be presented and some connections to the functions of the biological visual system will be discussed.

CMSC 38000 Computability Theory I

We investigate recursive (such as computable) functions and sets generated by an algorithm (recursively enumerable sets). Topics include various mathematical models for computations, including Turing machines and Kleene schemata; enumeration and s-m-n theorems; and priority methods for the construction of recursively enumerable sets and degrees.

CMSC 38600 Complexity Theory A

Catalog Description: Topics in computational complexity theory with an emphasis on machine-based complexity classes.

CMSC 38700 Complexity Theory B

Topics in computational complexity theory with an emphasis on combinatorial problems in complexity.

CMSC 32600 Compilers for Computer Languages

This course covers principles of modern compiler design and implementation. Topics include lexical analysis, parsing, type systems, code generation and optimization. This is a project-oriented course in which students construct a fully working compiler. Students should be familiar with topics from algorithms, programming languages, computer architecture, and programming in UNIX.

CMSC 33300 Networks and Distributed Systems

This course focuses on the principles and techniques used in the development of networked and distributed software. Topics include programming with sockets, remote procedure calls (RPC), inter-process communication (IPC), distributed objects (CORBA and DCOM), and commonly used network protocols including TCP/IP, UDP, FTP, and HTTP. In addition, data encoding, encryption, and compression algorithms are presented. This is a project-oriented course in which students are required to develop software in the UNIX programming environment.

CMSC 34700 Scalable Internet Services

The demands and opportunities of the World Wide Web present challenges for operating and distributed systems research in wide-area, Internet-scale systems. This class surveys current research in this area, including work in wide-area caching, prefetching, replication, naming, distributed computation, scalable servers, and security and communication protocols. A primary goal is to provide the background necessary for doing research on these topics. We read and evaluate research papers selected from the literature. In addition to lectures, students are asked to evaluate the papers as a basis for discussion. Students enrolled for full credit will also do a class project in small groups.

CMSC 38300 Numerical Solutions to PDEs

This course will cover the basic mathematical theory behind numerical solution of partial differential equations. The course will investigate the convergence properties of finite element, finite difference and other discretization methods for

solving partial differential equations. A brief introduction to Sobolev spaces and polynomial approximation theory will be given. Special emphasis on error estimators, adaptivity and optimal-order solvers for linear systems arising from PDEs. Special topics will include (from time to time) PDEs of fluid mechanics, max-norm error estimates, and Banach-space operator-interpolation techniques.

CMSC 34000 Scientific Parallel Computing

The use of multiple processors cooperating to solve a common task. We study issues related to this general problem in the areas of computer architecture, performance analysis, prediction and measurement, programming languages, and algorithms for large-scale computation. The course will involve programming at least one parallel computer. Possibilities include one of the clusters of workstations connected by high-speed networks currently at the University of Chicago. We focus on the state of the art in parallel algorithms for scientific computing. Specific topics are chosen based on student interest. General principles of parallel computing are emphasized.

CMSC 34500 Optimization

Optimization is an important tool in an enormous range of applications in the sciences, engineering, and finance. In mathematical terms, optimization algorithms seek to find the minimum or maximum of a function of several (possibly many) variables, where the variables often must satisfy certain constraints.

In this course, we describe algorithms for solving several types of optimization problems, discussing their mathematical properties, their software implementations, and key applications. The particular choice of topics will depend on the interest of students in the class, and will be drawn from the following areas: Unconstrained Optimization, Constrained Optimization Theory, Linear Programming, Quadratic Programming, Constrained Optimization Algorithms.

VI. LEARNING RESOURCES

TTI-C provides a state-of-the-art computational facility for the purposes of education and research. Students are provided with a personal cubicle including their own personal PC. MAT-LAB, Mathematica, MS Office and other software as needed will be installed on the computers. A Sharp NoteVision projector and screen are provided in the conference room for presentations. TTI-C has a library on the premises. In addition, students and faculty of TTI-C are granted full privileges at the University of Chicago libraries.

VII. Faculty and Administrators

ADMINISTRATORS

Mitsuru Nagasawa

President, Toyota Technological Institute at Chicago

President Nagasawa received his Ph.D. in 1951 from Tokyo Institute of Technology. In the same year, he became an Assistant Professor at Nagoya University in Nagoya, Japan where he was promoted to Associate Professor in 1952. He spent from 1959 to 1961 as a postdoctoral fellow in Chemistry at the University of Chicago. After his return to Nagoya University he was appointed to a Full Professor in 1962.

In 1977 President Nagasawa received the distinguished Japan Academy Award for his research, and in 1983 he was elected to Vice President of the Chemical Society of Japan. President Nagasawa joined Toyota Technological Institute as a Professor in 1986 and was the President of the Institution from 1996 to 2004. He has served as the President of Toyota Technological Institute at Chicago since 2002.

Motohisa Noguchi

Treasurer/Secretary, Toyota Technological Institute at Chicago

Motohisa Noguchi received his B.A. degree from the School of Political Science and Economics, Waseda University in Tokyo, Japan. Upon graduation he began his career with Toyota Motor Corporation in Toyota City, Japan, in the Personnel Division. In 1986 he was promoted to Manager of Administration at a U.S. subsidiary, a position he held until 1989. During the period of 1990 through 2008 he was appointed to manager of various overseas operations: United Kingdom, Africa, Asia Division, Japan-Korea Economic Association, and Oceania and Near East Division. He has served as Treasurer and Secretary to the Board of TTI-C since May 2009.

Stuart Rice

Dean, Toyota Technological Institute at Chicago

Dr. Rice is the Frank P. Hixon Distinguished Service Professor, Emeritus, in the Department of Chemistry and The James Franck Institute of The University of Chicago. Born in New York City in 1932, he received a B.S. degree from Brooklyn College in 1952 and A.M. and Ph.D. degrees from Harvard University in, respectively, 1954 and 1955. His graduate research was carried out with Paul Doty. He was elected to the Society of Fellows, Harvard University, in 1955. After two years as a Junior Fellow he joined the faculty of The University of Chicago, where he has remained. He was selected to be the Frank P. Hixon Distinguished Service Professor in 1977.

He has carried out theoretical and experimental research in diverse areas of physical chemistry. He and his coworkers have published nearly 700 papers dealing with polyelectrolyte solutions, helix-coil transitions in polypeptides and DNA, the transport of mass, energy and charge in liquids, diffusion in crystals, the equilibrium properties of dense fluids, the fluid-solid transition, exciton-exciton interactions in molecular crystals and polymers, exciton and charge carrier band structures of molecular crystals and liquids,

structure of the liquid metal-vapor interface, pseudopotential theory of atomic and molecular electronic structure, radiationless transitions, non-statistical behavior in unimolecular reactions, structure and properties of water, quantum and classical deterministic chaos, collision induced mode specific state-to-state vibrational energy transfer, shaped laser field active control of molecular dynamics, structure of Langmuir monolayers, structure, phase transitions and diffusive motion in quasi-one and quasi-two-dimensional colloid assemblies, and miscellaneous other subjects. He has also coauthored four books: *Polyelectrolyte Solutions* with Mitsuru Nagasawa, *The Statistical Mechanics of Simple Liquids*, with Peter Gray, *Optical Control of Molecular Dynamics*, with Meishan Zhao, and *Physical Chemistry*, with R. Steven Berry and John Ross.

Amongst other public service activities, he has served on numerous advisory boards for Federal Agencies, was a member of the National Science Board from 1980-1986 and a member of the Board of Directors of the Bulletin of the Atomic Scientists for about twenty years.

He is a Fellow of the American Academy of Arts and Sciences, the National Academy of Sciences, and the American Philosophical Society, and a Foreign Fellow of the Royal Danish Academy of Sciences and the Royal Irish Academy of Arts and Sciences. He has received four medals from the American Chemical Society (the Award in Pure Chemistry, the Baekland Award, the Debye Award, and the Hildebrand Award), as well as the Hirschfelder Prize in Theoretical Chemistry, the Centennial Medal of Harvard University and the National Medal of Science.

Gary J. Hamburg

Chief Administrator, Toyota Technological Institute at Chicago

Gary Hamburg received his B. A. Degree from Valparaiso University and his M. P. A. degree from the University of Kansas. Following over four years of service in the Army Medical Service Corps, reaching the rank of Captain, he began a career in city management. He served as the city administrator in three cities, ranging in size from 7,000 to 50,000 residents. He was responsible for the entire municipal operation in each assignment, administered many grants, and was accountable for annual budgets up to \$32 million.

He then moved into the field of Human Resources and was a county personnel director responsible for 800 employees, a labor relations director for a technical college with over 1400 fulltime and 2700 part-time employees, and then human resources director for Northeastern Illinois University, a state school with over 1200 fulltime employees. In the technical college assignment, he implemented and administered one of the first collective bargaining agreements in the United States for adjunct faculty (2700 members) without the filing of one grievance.

He has served on several professional and community boards and commissions during his career.

FACULTY

David McAllester

Chief Academic Officer and Professor, Toyota Technological Institute at Chicago

Professor McAllester received his B.S., M.S., and Ph.D. degrees from the Massachusetts Institute of Technology in 1978, 1979, and 1987 respectively. He served on the faculty of Cornell University for the academic year of 1987-1988 and served on the faculty of MIT from 1988 to 1995. He was a member of technical staff at AT&T Labs-Research from 1995 to 2002. He has been a fellow of the American Association of Artificial Intelligence (AAAI) since 1997 and is currently a trustee of the Conference on Automated Deduction (CADE). He served as program chair for CADE in 2000 and was a member of the executive council of AAAI from 1998 to 2001. He has served as guest editor for the Journal of Automated Reasoning and as associate editor for Journal of Artificial Intelligence Research. His Ph.D. thesis was published as a book from MIT Press and he has authored over 50 refereed publications.

Professor McAllester's research areas include machine learning theory, the theory of programming languages, automated reasoning, AI planning, computer game playing (computer chess), and computational linguistics. A 1991 paper on AI planning proved to be one of the most influential papers of the decade in that area. A 1993 paper on computer game algorithms influenced the design of the algorithms used in the Deep Blue system that defeated Gary Kasparov. A 1998 paper on machine learning theory introduced PAC-Bayesian theorems which combine Bayesian and nonBayesian methods and whose influence continue to grow rapidly. His plans for future research are focused on the integration of semantics into statistical approaches to computational linguistics.

Umut Acar

Assistant Professor, Toyota Technological Institute at Chicago

Born in Istanbul, Turkey, Umut Acar received his B.S. in Computer Science from Bilkent University-Turkey in 1997, his M.A. from University of Texas at Austin in 1999, and his Ph.D. from Carnegie Mellon University in 2004.

Acar's research interests are in the areas of programming languages and algorithms, and include both theory and practice. For his thesis, Acar developed algorithmic and language techniques for self-adjusting computation where computations automatically adjust their internal state and output to changes in their environment. He also worked on multithreaded computations, computational geometry, and extending the GHC Haskell compiler with polymorphic records. In the future, he plans to develop compiler support for self-adjusting computation, broaden its applications, and develop analysis techniques for determining its performance and limitations.

Julia Chuzhoy

Assistant Professor, Toyota Technological Institute at Chicago

Julia Chuzhoy received her Ph.D. from Technion - Israel Institute of Technology. She has spent three years as a postdoc at MIT, University of Pennsylvania and Institute for Advanced Study.

Chuzhoy's broad field of research is theoretical computer science, with the main focus on the design and the analysis of approximation algorithms for computationally hard problems, and on proving lower bounds on approximability of such problems. The types of problems she has been working on include problems arising in network design and routing, clustering, scheduling, and embedding of metric spaces.

Karen Livescu

Assistant Professor, Toyota Technological Institute at Chicago

Dr. Livescu received her B.A. in Physics from Princeton University in 1996 and spent the following year as a visiting student in Electrical Engineering at the Technion, Israel. She received her M.S. and Ph.D. in Electrical Engineering and Computer Science at the Massachusetts Institute of Technology, in 1999 and 2005. In 2005-2007 she was a post-doctoral lecturer in the Electrical Engineering and Computer Science department at the Massachusetts Institute of Technology.

Dr. Livescu's research interests are in speech and language processing, recently focusing on speech recognition. She is particularly interested in statistical modeling techniques that can take advantage of both large stores of data and knowledge from linguistics and speech science.

Makarychev, Yury

Assistant Professor, Toyota Technological Institute at Chicago

Yury Makarychev received his MS degree in Mathematics from Moscow State University in 2001 and his PhD degree in Computer Science from Princeton University in 2008. He spent the following two years as a Postdoctoral Researcher at Microsoft Research in Redmond, WA and Cambridge, MA.

Yury's research interests include combinatorial optimization, approximation algorithms, semi-definite programming, and low-distortion metric embedding. He has recently worked on developing approximation algorithms for unique games, constraint satisfaction, graph partitioning, and vertex ordering problems, investigating tradeoffs between local and global properties of metric spaces, and studying lift-and-project hierarchies of mathematical relaxations.

Research Interests: Theoretical computer science including combinatorial optimization, approximation algorithms, semi-definite programming, unique games, low-distortion metric embeddings, and lift-and-project methods.

Greg Shakhnarovich

Assistant Professor, Toyota Technological Institute at Chicago

Dr. Greg Shakhnarovich received a PhD in Electrical Engineering and Computer Science from MIT in 2005, and went on to a post-doctoral position at Brown University in 2005-2007. He holds a MSc degree in Computer Science from the Technion (2001) and a BSc degree in Mathematics and Computer Science from the Hebrew University in Jerusalem (1994).

Dr. Shakhnarovich's primary research interests are in machine learning and its applications, focusing on two domains: machine vision and brain-machine interfaces. Much of his work has been on recognition and tracking of complex objects in images and videos. More recently, in his work on brain-machine interfaces, he has been developing methods for decoding cortical signals and using them to control artificial devices.

Stephen Smale

Professor Part Time, Toyota Technological Institute at Chicago

Born in Michigan, USA, Professor Smale received his Ph.D. degree from the University of Michigan in 1957, and within four years became a full Professor at Columbia University. In 1964, he was named a Professor at the University of California, Berkeley and held the post for 30 years before joining City University as a Distinguished University Professor.

Professor Smale has made significant contributions in the fields of dynamical systems, geometry, econometrics, operational research, topology and the mathematical theory of computer science. These contributions have resulted in a number of academic awards and achievements including his holding of the prestigious Alfred Solan Research Fellowship from 1960-62. In 1966, Professor Smale won a Fields Medal - an international medal awarded once every four years for outstanding discoveries in mathematics. This honor is comparable to a Nobel Prize and is traditionally awarded to mathematicians less than 40 years of age. Important honors bestowed upon Professor Smale during his distinguished academic career include the 1965 Veblen Prize for Geometry, awarded every five years by the American Mathematical Society; in 1988, the Chauvenet Prize by the Mathematical Association of America; and in 1989, the Von Neumann Award by the Society for Industrial and Applied Mathematics.

Professor Smale is a member of both the National Academy of Sciences and the American Academy of Arts and Sciences. He is recognized internationally in many fields of Mathematics, and has been invited as Visiting Professor to such esteemed institutions as College de France, Paris (Spring 1962), University of Paris, Orsay (Fall 1972-73), Yale University (Fall 1974) and Columbia University (Fall 1987).

Nathan Srebro

Assistant Professor, Toyota Technological Institute at Chicago

Professor Srebro received his B.A. in Computer Sciences and B.A. in Mathematics from Technion in 1993 and 1995, respectively. He received an MSc in Computer Science and Ph.D. in Computer Science from MIT in 2000 and 2004, respectively. Professor Srebro is interested in understanding the mathematical aspects of learning and finding structure and regularities, and developing and studying efficient and effective methods for learning and data analysis tasks. He works on both algorithmic and statistical aspects of machine learning. He has worked on applications in computational biology, text analysis and collaborative filtering.

Raquel Urtasun

Assistant Professor, Toyota Technological Institute at Chicago

Professor Urtasun received her Ph.D. from Ecole Polytechnique Federal de Lausanne in 2006. In 2006-2008 she was a post-doctoral associate at the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology. In 2008-2009 she was a postdoctoral research scientist at the University of California at Berkeley in the Electrical Engineering and Computer Science department and the International Computer Science Institute.

Professor Urtasun's research areas include machine learning, computer vision and computer graphics. Her Ph.D. thesis focused on the development of statistical models of human motion. She is particularly interested in non-parametric Bayesian statistical methods, latent variable models, and their application to human motion analysis, tracking, visual scene understanding, behavior analysis and biology.

Jinbo Xu

Assistant Professor, Toyota Technological Institute at Chicago

Born in JiangXi, China, Jinbo Xu received his B.S. in Computer Science from the University of Science and Technology of China in 1996, his M.Sc. from Chinese Academy of Sciences in 1999, and his Ph.D. from the University of Waterloo in 2003. He spent one year following as a research assistant professor at the University of Waterloo and one year as a Postdoctoral Fellow in the Department of Mathematics and Computer Science and AI Laboratory at the Massachusetts Institute of Technology.

Professor Xu's primary research interest is computational biology and bioinformatics including homology search, protein structure prediction, and protein interaction prediction. He has developed several protein structure prediction tools, such as RAPTOR, ACE, and SCATD.