TTIC

TOYOTA
TECHNOLOGICAL
INSTITUTE
AT CHICAGO

ANNUAL **REPORT**
2022-2023

Table of Contents

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

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 volumes 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 the 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 encompass 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 education 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 education mission is broader than in the research mission. Graduates of TTIC may 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 education 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.

Diversity, Inclusion and Equity

TTIC is committed to effective and compliant policies that foster and expand a supportive and inclusive environment to encourage success for students, staff, and faculty. The institute should exploit the intellectual abilities and talents of all segments of society. TTIC's collective success in its research and education missions depends on the robust exchange of ideas, as well as on collaboration, innovation, creativity, and broad participation. This requires a dedication to promoting diversity, equity and inclusion in its faculty, staff, student body, and educational programs.

Vision and Values

The 21st century will see enormous progress in automation. 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 important challenges, it also holds great 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 mankind. TTIC's vision is to discover and explore fundamental principles of computation and to improve our world through the technologies those principles enable. At the same time, TTIC is committed to the values of human freedom, dignity, prosperity, and diversity. The institute's mission and its work have been formulated and are carried out consistent with this vision and these values.

People

The strength of TTIC lies in its people. Whether directly involved in research and education, such as faculty and students, or providing the infrastructure and support needed for these activities to take place, all of our people are important to the success of TTIC's mission. TTIC acknowledges the value provided by each member of its community and aims to provide all its members with the tools and support they need to do their part in advancing the institute's mission.

Message from the President

TTIC had a great 2022-2023 academic year, undertaking important and impactful research, teaching vital subjects in our areas of expertise to many students from TTIC and the University of Chicago, hosting several internships bringing students from various universities and high schools to work with us, having numerous visitors and collaborations, and generally working in a myriad of ways to fulfill our mission of research and education at the highest level. We continued to do great work and distinguish ourselves as one of the top academic institutions in our fields.

TTIC students and faculty again had many research accomplishments, important publications, and completed dissertations in 2022-2023. We held a variety of interesting seminars and distinguished lectures discussing state-of-the-art research, had a number of successful qualifying exams (an important step on the way to a Ph.D.), and hosted many visitors, staying with us from a day to several months.

Overall, we continued to provide a stellar environment for our students and faculty to excel in their work, pushing forward the boundaries of knowledge in multiple areas of computing and information technology, and our reputation continues to grow due to the accomplishments of our faculty, students, and alumni.

We had a new group of exceptional Ph.D. students who started at TTIC in Autumn 2022, and they have integrated well into our academic community in their first year, making progress in their coursework and research. Our new Research Assistant Professors (RAPs) have also added greatly to the intellectual atmosphere at TTIC, pushing their research agendas and working with TTIC students and faculty as well as other collaborators.

We were saddened by the passing of former TTIC Trustee and advisor Mark Hogan in April. Mark brought an abundance of experience in the automotive industry, including with General Motors, Magna International, and Toyota, to the TTIC Board of Trustees, and we greatly appreciated his insight and contributions.

TTIC's partnership with TTI in Nagoya, Japan remains strong. In 2022-2023, we had TTI students with us in Chicago, Prof. David McAllester taught a remote machine learning course for TTI students in the spring, and a group of TTIC faculty and students visited TTI in Nagoya to teach a course. Our interactions with the University of Chicago continued to be important this academic year, including cross course registration, cross advising, and a joint research funding initiative.

Congratulations are in order to Prof. Madhur Tulsiani, who received a promotion to Full Professor this year. Madhur, who received his Ph.D. from UC Berkeley in 2009 and was a postdoctoral researcher at Princeton University and the Institute for Advanced Study before joining TTIC, is one of the top researchers in the world in complexity theory and information and coding theory. In addition to his excellent research and mentoring, Madhur contributes greatly to TTIC as the Director of Graduate Studies.

TTIC continues to be a special place for students, faculty, and staff to learn, collaborate, discover, and work. Our reputation and positive impact on our fields continue to grow. I enjoy learning about the cutting edge in our fields of computing from highly accomplished faculty and students on a daily basis.

As TTIC heads to its 20th anniversary, we can be proud of what we have accomplished and excited about what is to come.

Matthew Turk
President

Message from the Chief Academic Officer

It's been an exciting year at TTIC. To start with some bragging, Jinbo Xu was named Fellow of the International Society for Computational Biology, Siddharth Bhandari was awarded the ACM India 2022 Doctoral Dissertation Award, Karen Livescu's paper "Deep Canonical Correlation Analysis" was Runner Up for the ICML 2023 Test-of-Time Award, and student Chung-Ming Chien was awarded a Taiwan Ministry of Education GSSA Award. Congratulations to all! Also, special congratulations to Madhur Tulsiani for his promotion to Full Professor. As you will see in this report, TTIC faculty and students were highly productive in their research this past year, publishing in major AI and Theory research venues including AAAI, ACL, AISTATS, COLT, CVPR, ECCV, EMNLP, FOCS, FORC, ICASSP, ICLR, ICML, ITCS, NAACL, NeurIPS, RSS, SODA, STOC, and UAI.

TTIC is also proud to be a member of the new IDEAL NSF TRIPODS Phase II institute, bringing together researchers from TTIC, Northwestern, UIC, UChicago, and Illinois Tech, from disciplines including CS, Math, EE, Statistics, Law, and Economics. This is one of only four NSF TRIPODS Phase II institutes nationwide.

TTIC hosted a range of activities and workshops over the course of the past academic year. These include summer workshops on online decision making and representation learning in July and August, the Annual Student Workshop in November, an Industry Open House also in November, the Junior Theorists Workshop in December, and the New Horizons in TCS Summer School in June. Congratulations to Kshitij Patel and Freda Shi for receiving the Best Talk Award and Anmol Kabra for Best Poster Award at the Student Workshop.

We had an especially successful hiring season, hiring one new Assistant Professor, Shiry Ginosar from UC Berkeley, and seven new Research Assistant Professors: Anand Bhattad (Ph.D. University of Illinois), Emily Diana (Ph.D. University of Pennsylvania), Jungo Kasai (Ph.D. University of Washington), Theodor Misiakiewicz (Ph.D. Stanford), Liren Shan (Ph.D. Northwestern), Santhoshini Velusamy (Ph.D. Harvard), and Jiwei (Joe) Zhou (Ph.D. Harvard). Their research areas include Computer Vision, NLP, Machine Learning, Theoretical Computer Science, and social issues in computing. Shiry will join us in Fall 2024. We are also very pleased to welcome new Assistant Professor Zhiyuan Li, hired last year, who will join us this Fall 2023.

Congratulations to TTIC's 2023 Ph.D. graduates Falcon Dai (advised by Matt Walter), Andrea Daniele (advised by Matt Walter), Omar Montasser (advised by Nathan Srebro), Rachit Nimavat (advised by Julia Chuzhoy), Shane Settle (advised by Karen Livescu), Bowen Shi (advised by Karen Livescu), and Qingming Tang (advised by Karen Livescu). This will be TTIC's largest graduating class to date. Congratulations also to Omar and Bowen for having their theses named as Theses of Distinction.

Next year will be TTIC's 20th anniversary, and we look forward to an exciting series of academic and social events in celebration. Please join us!

Avrim Blum
Chief Academic Officer
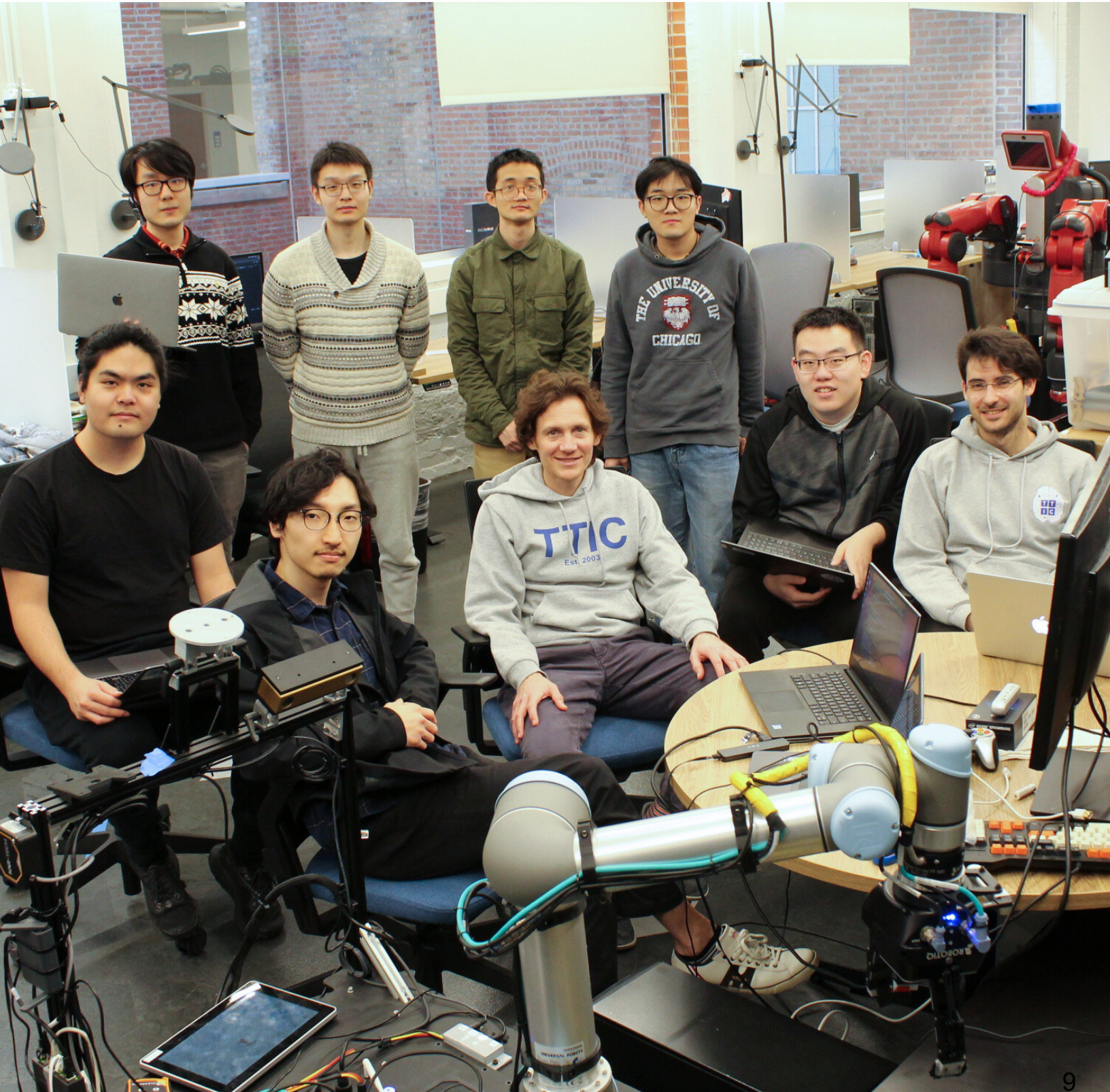
Institute Overview

Faculty and Staff

Professors	9
Associate Professors	2
Assistant Professors	1
Research Assistant Professors	10
Adjoint Faculty	9
Administrative Staff	11
Postdocs	5

Ph.D. Program

Students enrolled 2022-23	41
New matriculants for 22-23	6
Master's degrees awarded (in September 2022)	4
Ph.D. degrees awarded (in September 2022)	4
Applicants for 2021-22 Academic Year	205
Anticipated Enrolling 2023-24	3

Awards and Honors

April 2023 - Chung-Ming Chien
Chung-Ming Chien, a Ph.D. student at TTIC, was awarded as a recipient of the 2023 Government Scholarship to Study Abroad (GSSA) from the Taiwan Ministry of Education. According to the Ministry of Education in Taiwan, the GSSA was created "in order to strengthen the strength of the country, strengthen the international experience of outstanding young people in [Taiwan], reward students from disadvantaged groups, and encourage outstanding young people in Taiwan to study for postgraduate degrees in well-known foreign universities."

January 2023 - Jinbo Xu
Professor Jinbo Xu was selected as an ISCB (International Society for Computational Biology) Fellow in the Class of 2023 for the discovery of computational methods and development of software programs that have revolutionized protein structure prediction.

January 2023 - Siddharth Bhandari
Professor Siddharth Bhandari, TTIC Research Assistant Professor, was announced the recipient of the ACM India 2022 Doctoral Dissertation Award for his dissertation, titled "Exact Sampling and List Decoding." His dissertation developed new techniques, analyses and tools in two areas of theoretical computer science, including sampling colorings of graphs and list-decoding error-correcting codes. Professor Bhandari's doctoral dissertation work was done at Tata Institute of Fundamental Research in Mumbai, India.

December 2022 - Jinbo Xu
Professor Jinbo Xu was announced a recipient of a Marshall and Arlene Bennett Family Research Program funding award in partnership with the University of Chicago and the Weizmann Institute of Science (WIS) in Israel to support collaborative research in artificial intelligence.

November 2022 - Freda Shi, Kshitij Patel, and Anmol Kabra
At the sixth Annual Student Workshop at TTIC, the Best Talk Award was awarded to Kshitij Patel for his talk, "Distributed Online and Bandit Convex Optimization," and to Freda Shi for her talk, "Language Models are Multilingual Chain-of-Thought Reasoners." The award for Best Poster was given to Anmol Kabra and his poster, "Exponential Family Model-Based Reinforcement Learning via Score Matching."

September 2022 - Mary Marre
Mary Marre, Administrative Assistant to Faculty, was the recipient of the 2022 Latrice Richards Outstanding Administrative Award, which was announced at TTIC's 2022 Diploma and Awards Ceremony on Sept. 20, 2022. This award is given each year to recognize an administrative staff member's hard work and dedication, and the recipient is chosen based on nominations from the TTIC community.

September 2022 - Haochen Wang and Max Ovsiankin
TTIC's 2022 Outstanding TA Award, which recognizes a student's dedication and effort as a teaching assistant, was awarded to Max Ovsiankin and Haochen Wang at TTIC's 2022 Diploma and Awards Ceremony.

August 2022 - Melissa Dutz
Incoming Ph.D. student Melissa Dutz was awarded a National Science Foundation CSGrad4US Ph.D. Fellowship. The CSGrad4US program aims to increase the number of diverse, domestic graduate students pursuing research and innovation careers in the Computer and Information Science and Engineering (CISE) fields.

July 2022 - David McAllester
Open Philanthropy has awarded TTIC's Prof. David McAllester $700k for two years to research in the area of AI safety. Open Philanthropy identifies outstanding giving opportunities, makes grants, follows the results, and publishes its findings. Its mission is to give as effectively as it can.

July 2022 - Avrim Blum, Julia Chuzhoy, Yury Makarychev, Nathan Srebro
The National Science Foundation (NSF) has awarded a TRIPODS Phase II award to TTIC faculty Avrim Blum, Julia Chuzhoy, Yury Makarychev, and Nathan Srebro, along with researchers from UIC, Northwestern, the University of Chicago, and the Illinois Institute of Technology, and in partnership with researchers at Google NYC, together forming the Institute for Data, Econometrics, Algorithms, and Learning (IDEAL).

New Faculty

Siddharth Bhandari | Ph.D., Tata Institute of Fundamental Research

Sam Buchanan | Ph.D., Columbia University

Lee Cohen | Ph.D., Tel Aviv University

Ohad Trabelsi | Ph.D., Weizmann Institute of Science

Saeed Sharifi-Malvajerdi | Ph.D., University of Pennsylvania

Ali Vakilian | Ph.D., Massachusetts Institute of Technology

Faculty Promotion

At the May 2023 meeting of the Board of Trustees, Madhur Tulsiani's promotion to Full Professor was approved.

Professor Tulsiani received a B. Tech. in Computer Science and Engineering from IIT Kanpur in 2005 and a Ph.D. in Computer Science from UC Berkeley in 2009. He spent two years as a postdoc at the Institute for Advanced Study and Princeton University, before joining TTIC in 2011.

Tulsiani's research interests include complexity theory, approximation algorithms, hardness of approximation and pseudorandomness. His dissertation focussed on studying the effectiveness and limitations of various convex relaxations in approximating combinatorial optimization problems.

His work focussed on studying various hierarchies of linear and semidefinite programs, and understanding their usefulness for designing approximation algorithms. He has also worked on understanding the notions of pseudorandomness in computer science and arithmetic combinatorics. He explored connections between different proof techniques used in the two areas.

Faculty by Area

Algorithms and Complexity

Siddharth Bhandari
Avrim Blum
Julia Chuzhoy
Yury Makarychev
Saeed Sharifi-Malvajerdi
Ohad Trabelsi
Madhur Tulsiani
Ali Vakilian

Computational Biology

Derek Reiman
Jinbo Xu

Computer Vision and Computational Photography

Greg Shakhnarovich
Matthew Turk

Machine Learning

Sam Buchanan
Lee Cohen
David McAllester
Hongyuan Mei
Nathan Srebro
Lingxiao Wang

Robotics

Matthew Walter

Speech and Language Technologies

Kevin Gimpel (on leave)
Kartik Goyal
Karen Livescu

Post-Docs

Saba Ahmadi | Ph.D., University of Maryland College Park

Chen Dan | Ph.D., Carnegie Mellon University

Suprovat Ghoshal | Ph.D., Indian Institute of Science, Bangalore

Jafar Jafarov | Ph.D., University of Chicago

Gal Vardi | Ph.D., Hebrew University

Sponsored Research

In FY 22-23, TTIC faculty were awarded two grants totaling $339,707, and federal grant expenditures were $2.1M. Additionally, one student received a National Science Foundation CSGrad4US Fellowship. The current grants portfolio includes:

- 8 National Science Foundation basic and collaborative research awards
- 3 National Institutes of Health awards
- 2 Department of Defense awards
- 2 Simons Foundation awards
- 2 National Science Foundation Graduate Research Fellowship awards
- 1 National Science Foundation CSGrad4US Fellowship award
- 1 Google Ph.D. Fellowship
- Recent awards from Adobe and AI+Science Collaborative Research Program

A New Strategic Plan

As its 20th anniversary approached, the institute undertook a comprehensive strategic planning process that involved the whole TTIC community, including discussions with faculty, administrative staff, students, and the Board of Trustees, guided and informed by the institute's academic mission and understanding of its resources, partnerships, and fiducial responsibilities. This process provided an opportunity for TTIC to reflect on its past, consider its present status, and think strategically about priorities for the coming years. Discussions focused on the institute's core mission, vision, and values, key opportunities and challenges, and strategic priorities and initiatives to help guide and propel the institute forward in the near future.

The resulting Strategic Plan 2022-2027 identified ten areas that represent strategic priorities, grouped into two categories: (1) Priority Aspirations – guiding principles to help guide decisions and direction, and (2) Priority Actions – actions to focus on. These were intended to highlight key motivations and desired outcomes that should inform decisions in the coming years. The plan also identified six strategic initiatives as special projects or areas to focus on in the coming years: (1) Increase Awareness of TTIC, (2) Special Research-Themed Programs of Activity, (3) Develop Strategic Partnerships with Industry and Academia, (4) Strengthen Outreach Activities and Opportunities, (5) Increase the Diversity of Our Academic Staff and Students, and (6) Improve Internal Communication and Processes to Enhance Our Environment and Organizational Effectiveness.

The Board of Trustees approved the strategic plan soon after the May 2023 Board meeting, and planning and actions for the initiatives are underway.

Recognizing Service Milestones

A new recognition was offered at the September 2022 Diploma and Awards Ceremony: service milestones. President Turk recognized the years of service that faculty and administrative staff members have given to TTIC (in 5-year measurements) and the institute's mission.

5 Years
Avrim Blum
Kevin Gimpel
Matt Walter
Rose Bradford
Erica Cocom
Jessica Jacobson
Mary Marre
Amy Minick

10 Years
Karen Livescu
Yury Makarychev
Greg Shakhnarovich
Madhur Tulsiani

15 Years
Adam Bohlander
Chrissy Coleman

15 Years
Julia Chuzhoy
Nathan Srebro
Jinbo Xu

20 Years
David McAllester
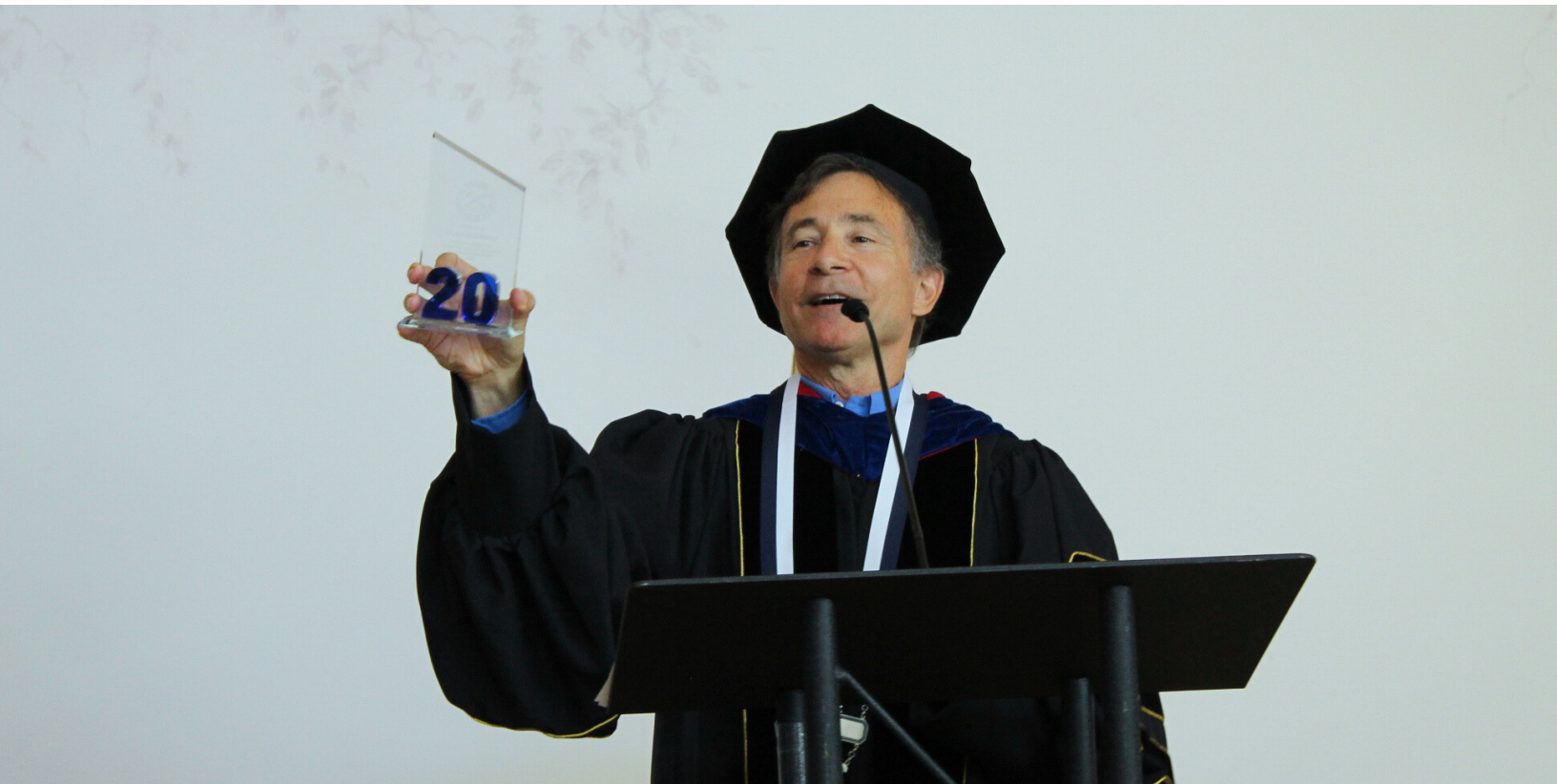
Research Philosophy

Research is the heart and soul of activity at the Toyota Technological Institute at Chicago. The institute has an energetic and determined team of professors, visiting professors, assistant professors, research assistant professors, adjoint professors, and post-docs encompassing many areas of research interests, and from many countries and backgrounds, each bringing their own specialty to the Institute.

With a generous budget, distinguished professors, and an environment that promotes learning and sharing, there are ample opportunities for collaborative research. Being on the campus of the University of Chicago, there is opportunity for close and cooperative research with not only the Computer Science Department, but with the departments of Mathematics, Statistics, and the Booth Graduate School of Business. There are also many guests and visitors who come to TTIC to give talks, participate in workshops, and share their research findings, all heightening the feeling of enthusiasm that pulses through the Institute.

The mission of TTIC includes "…achieving international impact through world-class research and education in fundamental computer science and information technology." The research component of the mission is implemented through high quality research in high impact areas. Currently, there are active research programs in six areas: machine learning, algorithms and complexity, computer vision and computational photography, speech and language technologies, computational biology, and robotics. The areas are introduced below, and in some, TTIC's strategy for achieving impact is also described. A key part of the strategy for achieving impact in all areas is to foster collaboration and communication between these areas.

Algorithms and Complexity

One of the central tasks in all areas of computer science is the writing of efficient software to perform required computation. In order to write such software, one must first design an efficient algorithm for the computational task at hand. The area of algorithms focuses on designing algorithms, and more generally developing powerful algorithmic tools, for solving fundamental computational problems that frequently occur in different areas of computer science. Complexity theory is the study of the power and limits of efficient computation. The central problem studied by complexity theorists is "Which computational problems can, and which cannot, be solved efficiently?" The study of algorithms and complexity is a part of a broader area called "theory of computer science," or just "theory." The area of theory works on developing theoretical foundations for computer science, which lead to a deeper understanding of computation in general, and specific computational tasks in particular, which include better algorithms and faster software. Below is a list of the work done at TTIC this year in the area of Algorithms and Complexity.

Siddharth Bhandari
Research Assistant Professor
ttic.edu/bhandari

PUBLISHED/SUBMITTED PAPERS
Siddharth Bhandari, Prahladh Harsha, Mrinal Kumar and Aparna Shankar, "Algorithmizing the Multiplicity Schwartz-Zippel Lemma. In the Proceedings of the ACM-SIAM Symposium on Discrete Algorithms," (SODA) 2023. [arXiv:2111.11072 |eccc:TR21-163]
Siddharth Bhandari, Prahladh Harsha, Mrinal Kumar and Madhu Sudan, "Ideal theoretic Explanation of Capacity-achieving Decoding." [arXiv:2103.07930 |eccc:TR21-036]
Siddharth Bhandari, Prahladh Harsha, Mrinal Kumar and Madhu Sudan, "Decoding Multivariate Multiplicity Codes on Product Sets." [arXiv:2012.01530|eccc:TR20-179]

TALKS
"Recent advances in trifference codes." IIT Gandhinagar, March 2023.

HONORS/AWARDS
ACM India 2022 Doctoral Dissertation Award

MISCELLANEOUS
Hosted intern: Peter Manohar (Carnegie Mellon University)

Avrim Blum
Professor and Chief Academic Officer
ttic.edu/blum

PUBLISHED/SUBMITTED PAPERS
Han Shao, Omar Montasser, Avrim Blum. "A Theory of PAC Learnability under Transformation Invariances." Neural Information Processing Systems (NeurIPS), 2022.
Avrim Blum, Omar Montasser, Greg Shakhnarovich, Hongyang Zhang. Boosting Barely Robust Learners. "A New Perspective on Adversarial Robustness." Neural Information Processing Systems (NeurIPS), 2022.
Maria-Florina Balcan, Avrim Blum, Steve Hanneke, Dravyansh Sharma. "Robustly-Reliable Learners under Poisoning Attacks." Conference on Learning Theory (COLT), 2022.
Saba Ahmadi, Hedyeh Beyhaghi, Avrim Blum, Keziah Naggita. "Setting Fair Incentives to Maximize Improvement". Symposium on Foundations of Responsible Computing (FORC), 2023.
Maria-Florina Balcan, Avrim Blum, Dravyansh Sharma, Hongyang Zhang. "An Analysis of Robustness of Non-Lipschitz Networks." Journal of Machine Learning Research 24(98):1−43, 2023.

TALKS
"On learning in the presence of biased data and strategic behavior." Distinguished Lecture Series, University of Illinois at Chicago. September 2022.
"On learning in the presence of biased data and strategic behavior." Weizmann Institute of Science, Rehovot, Israel. October 2022.
"Robustly-reliable learners for unreliable data." 70th Birthday Celebration for Ravi Kannan, Georgia Tech. March 2023.

"On learning in the presence of biased data and strategic behavior." Second Smart Information Technology Symposium, Toyota Technological Institute, Nagoya, Japan. December 2022.

"Robustly-reliable learners for unreliable data." Retirement celebration for Ronald Rivest, MIT. October 2022.

INVOLVEMENT

Editorial board: Journal of the ACM.

Steering Committee: Symposium on Foundations of Computer Science (FOCS), Innovations in Theoretical Computer Science (ITCS), Foundations of Responsible Computing (FORC), Algorithmic Learning Theory (ALT).

Advisory Board: TheoretiCS Journal.

Scientific and Academic Advisory Committee: Subcommittee for Computer Science and Applied Mathematics, Weizmann Institute of Science.

External Advisory Board, TILOS (The Institute for Learning-enabled Optimization at Scale).

RESEARCH FUNDING AWARDS

DARPA: Theoretical Foundations for Highly Robust Learning Systems, $3,088,765, 12/6/2019- 2/16/2024.

NSF: AF:Small: Foundations for Societal Machine Learning, $597,194, 10/1/2022-9/30/2025.

NSF: Institute for Data, Econometrics, Algorithms, and Learning (IDEAL), $1,664,441, 9/1/2022-8/31/2027.

Simons Foundation: Simons Collaboration on the Theory of Algorithmic Fairness, $480,000, 9/1/2020-8/31/2024.

OUTREACH/DIVERSITY

"Markov Chains: (some of the) math behind Google and ChatGPT." Presentation at the May 2023 IDEAL/Math Circles of Chicago High School Teacher Workshop.

CLASSES/SEMINARS

TTIC 31150/CMSC 31150 - Mathematical Toolkit (Spring 2023).

MISCELLANEOUS

Ph.D. Advisor for: Melissa Dutz, Naren Manoj (co-advised with Yury Makarychev), Keziah Naggita (co-advised with Matt Walter), Kavya Ravichandran, Han Shao, Kevin Stangl.

Ph.D. Thesis Committee: Falcon Dai (TTIC), Gabriele Farina (CMU), Ben Lai (TTIC), Gene Li (TTIC), Omar Montasser (TTIC), Kumar Kshitij Patel (TTIC), Dravyansh Sharma (CMU), Tom Yan (CMU).

Hosted summer interns: 2022: Kunhe Yang (Ph.D. student at University of California, Berkeley), Princewill Okoroafor (Ph.D. student at Cornell University). 2023: Roy Long (undergraduate student at the University of Chicago, co-hosted with Saeed Sharifi-Malvajerdi), Vaidehi Srinivas (Ph.D. student at Northwestern University).

Internal service: Chief Academic Officer.

Julia Chuzhoy
Professor
ttic.edu/chuzhoy

PUBLISHED/SUBMITTED PAPERS
Julia Chuzhoy and Ruimin Zhang. "A New Deterministic Algorithm for Fully Dynamic All-Pairs Shortest Paths," STOC 2023. Oral presentation.
Julia Chuzhoy, Mina Dalirrooyfard, Vadim Grinberg and Zihan Tan. "A New Conjecture on Hardness of 2-CSP's with Implications to Hardness of Densest k-Subgraph and Other Problems," ITCS 2023. Oral presentation.
Julia Chuzhoy. "A Distanced Matching Game, Decremental APSP in Expanders, and Faster Deterministic Algorithms for Graph Cut Problems," SODA 2023. Oral presentation.

TALKS
"New Approximation Algorithms for Graph Crossing Number." Invited talk at SODA 2023, January 2023.

RESEARCH FUNDING AWARDS
NSF HDR TRIPODS award 2216899 "Institute for Data, Econometrics, Algorithms and Learning (IDEAL)," $1,967,500, September 1, 2022 to August 31, 2027 (split among a number of institutions and PI's).
NSF grant "AF: Small: Graph Theory and Its Uses in Algorithms and Beyond," $398,163, Jul. 1, 2020 to Jun. 30, 2024.

CLASSES/SEMINARS
TTIC 31010/CMSC 37000: Algorithms.

INVOLVEMENT
Reviewer: STOC 2023, FOCS 2023.
Steering committee member: SODA, ITCS.

MISCELLANEOUS
Ph.D. advisor: Ron Monsenzon (TTIC), Rachit Nimavat (TTIC).
Hosted summer intern: Rhea Jain (University of Illinois Urbana-Champaign, co-hosted with Ohad Trabelsi).
Internal service: faculty representative at management meetings, member of Outstanding TA Award committee, faculty liaison for curriculum.

Yury Makarychev
Professor
ttic.edu/makarychev

PUBLISHED/SUBMITTED PAPERS
Eden Chlamtáč, Yury Makarychev, and Ali Vakilian. "Approximating Red-Blue Set Cover and Minimum Monotone Satisfying Assignment." To appear in the Proceedings of APPROX 2023.
Charlie Carlson, Jafar Jafarov, Konstantin Makarychev, Yury Makarychev, and Liren Shan. "Approximation Algorithm for Norm Multiway Cut." To appear in the Proceedings of ESA 2023.

TALKS
"Approximation algorithms for the socially fair clustering problem." Virtual Theory Seminar, the Max Planck Institute for Informatics, Saarbrucken, Germany, December 2022.

INVOLVEMENT
Executive committee: IDEAL.
Director of the Postdoctoral Program at IDEAL.
Reviewer: STOC, FOCS, SODA, SICOMP, Theoretical Computer Science, and other top-tier journals.

RESEARCH FUNDING AWARDS
NSF HDR TRIPODS Award ECCS- 2216899, jointly with A. Blum, J. Chuzhoy,
M. Walter, N. Srebro, and our colleagues at partnering institutions. TTIC's share is $1,967,500 (2022-27).
NSF Medium Award CCF-1955173, jointly with K. Makarychev (Northwestern). TTIC's share is $475,645 (2020-2024).
NSF HDR TRIPODS Award CCF-1934843, jointly with N. Srebro and our colleagues at Northwestern University and the University of Chicago. TTIC's share is $511,610 (2019–2023).

CLASSES/SEMINARS
TTIC 31100/CMSC 39010-1: Computational and Metric Geometry.

MISCELLANEOUS
Advisor/co-advisor: Naren Manoj (TTIC, jointly with Avrim Blum), Max Ovsiankin (TTIC).
Mentored postdocs: Suprovat Ghoshal (jointly with K. Makarychev), Jafar Jafarov (University of Chicago).
Co-hosted summer interns: Peter Manohar (Carnegie Mellon University), Madhusudhan Pittu (Carnegie Mellon University).
Internal service: served on faculty hiring committee, in charge of programming requirement.

Saeed Sharifi-Malvajerdi
Research Assistant Professor
ttic.edu/sharifi-malvajerdi

PUBLISHED/SUBMITTED PAPERS
Sequential Strategic Screening. Lee Cohen, Saeed Sharifi-Malvajerdi, Kevin Stangl, Ali Vakilian, Juba Ziani. "International Conference on Machine Learning." ICML, 2023.

INVOLVEMENT
Reviewer: ITCS 2023, AISTATS 2023.
Organizer: TOC4Fairness Virtual Seminar Series.

MISCELLANEOUS
Mentor: Roy Long (University of Chicago, intern), Kevin Strangl (TTIC).

Madhur Tulsiani
Professor and Director of Graduate Studies
ttic.edu/tulsiani

PUBLISHED/SUBMITTED PAPERS
G. Rajendran, M. Tulsiani. "Concentration of polynomial random matrices via Efron-Stein inequalities," SODA 2023.
F. Jeronimo, S. Srivastava, M. Tulsiani, J. Xu. "List Decoding of Tanner and Expander Amplified Codes via Distance Certificates," FOCS 2023.
V. Bhattiprolu, M. Ghosh, V. Guruswami, E. Lee, M. Tulsiani. "Inapproximability of Matrix p→qNorms."

TALKS
"Hypergraph Expansion, CSPs, and Codes." IIT Bombay theory seminar, January 2023.

INVOLVEMENT
Managing Editor: Theory of Computing journal.
Program committee member: STOC 2023, RANDOM 2023.
Reviewer: FOCS, ICALP, CCC, APPROX, RANDOM, JACM.

RESEARCH FUNDING AWARDS
NSF 2326685. Understanding Expansion Phenomena: Graphical, Hypergraphical, Geometric, and Quantum.

CLASSES/SEMINARS
TTIC 31200/CMSC 37220, Information and Coding Theory, Autumn 2022.

OUTREACH/DIVERSITY
Co-organizer of "New Horizons in Theoretical Computer Science" summer school aimed at increasing participation from under-represented groups.

MISCELLANEOUS
Advisor: Shashank Srivastava (TTIC), Tushant Mittal (University oif Chicago), June Wu (University of Chicago).
Internal service: Director of Graduate Studies.

Computational Biology

Computational biology studies biological systems (e.g., cell, protein, DNA and RNA) through mathematical modeling and optimization. Machine learning methods (e.g., probabilistic graphical model and deep learning) and optimization techniques (e.g., linear programming and convex optimization) have significant applications in this field. Algorithm design and complexity analysis also play an important role, especially when we want to know if there is an efficient algorithm that can find an exact or approximate solution to a specific biological problem. Below is a list of the work done at TTIC this year in the area of Computational Biology.

Derek Reiman
Research Assistant Professor
ttic.edu/reiman

PUBLISHED/SUBMITTED PAPERS
Funsten MC, Yurkovetskiy LA, Kuznetsov A, Reiman D, Hansen CH, Senter KI, Lee J, Ratiu J, Dahal-Koirala S, Antonopoulos DA, Dunny GM, Sollid LM, Serreze D, Khan AA, Chervonsky AV. "Microbiota-dependent proteolysis of gluten subverts diet-mediated protection against type 1 diabetes." Cell Host & Microbe. 2023; 31(2):213-27. doi: 10.1016/j.chom.2022.12.009
Pachpor K, Priyadarshini M, Reiman D, Layden BT, Dai Y. "MOMMI-MP: A Comprehensive Database for Integrated Analysis of Metabolic and Microbiome Profiling of Mouse Pregnancy." Preprints. 2022, 2022120378. doi:10.20944/preprints202212.0378.v1

TALKS
"DiRLaM: Diversity-Regularized Autoencoder for Modeling Longitudinal Microbiome Data." Short talk and poster at GLBIO 2023. May 16, 2023. Montreal, Quebec, Canada.

INVOLVEMENT
Guest Editor for Special Issue of Metabolites: "Impact of Microbiome Community Changes on Host Health through Metabolic Dysregulation."
Journal Peer Review: PLOS One.
Conference Proceeding Peer Review: RECOMB 2023, EMBC 2023.

CLASSES/SEMINARS
Co-instructor for MSPH 44000: Computational Systems Biology, Spring 2023.

MISCELLANEOUS
Hosted intern: Tina Khajeh (Summer 2023 Intern).

Jinbo Xu
Professor (on sabbatical)
ttic.edu/xu

PUBLISHED/SUBMITTED PAPERS
B Chen, Z Xie, J Qiu, Z Ye, J Xu, J Tang. "Improved the heterodimer protein complex prediction with protein language models". Briefings in Bioinformatics, bbad221, 2023.

M McPartlon, J Xu. "An end-to-end deep learning method for protein side-chain packing and inverse folding". Proceedings of the National Academy of Sciences 120 (23), e2216438120. 2023.

H Gao, et al. " The landscape of tolerated genetic variation in humans and primates". Science 380 (6648), eabn8153. 2023.

X Jing, F Wu, X Luo, J Xu. "RaptorX-Single: single-sequence protein structure prediction by integrating protein language models".
bioRxiv, 2023.04. 24.538081. 2023.

F Wu, H Qin, W Gao, S Li, CW Coley, SZ Li, X Zhan, J Xu. "InstructBio: A Large-scale Semi-supervised Learning Paradigm for Biochemical Problems", arXiv preprint arXiv:2304.03906. 2023.

M McPartlon, J Xu. "Deep Learning for Flexible and Site-Specific Protein Docking and Design". bioRxiv, 2023.04. 01.535079. 2023.

F Wu, D Radev, J Xu. "When Geometric Deep Learning Meets Pretrained Protein Language Models". bioRxiv, 2023.01. 05.522958. 2023.

F Wu, X Jing, X Luo, J Xu. "Improving protein structure prediction using templates and sequence embedding". Bioinformatics 39 (1), btac723. 2023.

B Chen, Z Xie, J Qiu, Z Ye, J Xu, J Tang. "Improved the Protein Complex Prediction with Protein Language Models". bioRxiv, 2022.09. 15.508065. 2023.

INVOLVEMENT
Associate editor: Journal of Bioinformatics.

MISCELLANEOUS
Ph.D. advisor: Ben Lai (TTIC), Xiao Luo (TTIC), Ziwei Xie (TTIC), Matthew McPartlon (UChicago)

Computer Vision and Computational Photography

Computer vision involves getting computers to extract useful information from pictures and videos. It has applications in robotics, surveillance, autonomous vehicles, and automobile collision avoidance.

Historically, this is a central research area of computer science. Below is a list of the work done at TTIC this year in the area of Computer Vision and Computational Photography.

Greg Shakhnarovich
Professor and Director of Admissions
ttic.edu/gregory

PUBLISHED/SUBMITTED PAPERS
Bowen Shi, Diane Brentari, Greg Shakhnarovich, and Karen Livescu. "Open-Domain Sign Language Translation Learned from Online Video." EMNLP, 2022.
Vitor Guizilini, Igor Vasiljevic, Jiading Fang, Rare Ambru, Greg Shakhnarovich, Matthew R. Walter, and Adrien Gaidon. "Depth Field Networks For Generalizable Multi-view Scene Representation." ECCV, 2022 (poster).
Avrim Blum, Omar Montasser, Greg Shakhnarovich, and Hongyang Zhang. "Boosting Barely Robust Learners: A New Perspective on Adversarial Robustness." NeurIPS, 2022 (poster).
Haochen Wang, Xiaodan Du, Jiahao Li, Raymond A. Yeh, and Greg Shakhnarovich. "Score jacobian chaining: Lifting pretrained 2d diffusion models for 3d generation." CVPR, 2023 (poster).
Bowen Shi, Diane Brentari, Gregory Shakhnarovich, and Karen Livescu. "Ttic's wmt-slt 22 sign language translation system." In Proceedings of the Seventh Conference on Machine Translation (WMT), 2022.
Xiaodan Du, Raymond A. Yeh, Nicholas Kolkin, Eli Shechtman, and Greg Shakhnarovich. "Text-free learning of a natural language interface for pretrained face generators." arXiv preprint arXiv:2209.03953, (2022).
Nam Anh Dinh, Haochen Wang, Greg Shakhnarovich, and Rana Hanocka. "LoopDraw: a Loop-Based Autoregressive Model for Shape Synthesis and Editing", arXiv preprint arXiv:2212.04981 (2022).
Jiading Fang, Shengjie Lin, Igor Vasiljevic, Vitor Guizilini, Rares Ambrus, Adrien Gaidon, Gregory Shakhnarovich, and Matthew R. Walter. "NeRFuser: Large-Scale Scene Representation by NeRF Fusion", arXiv preprint arXiv:2305.13307 (2023).

INVOLVEMENT
Area Chair: ICLR 2023, CVPR 2023, ICCV 2023.
Associate Editor: IEEE Transactions on Pattern Analysis and Machine Intelligence (IEEE TPAMI).
Reviewer: NeurIPS 2023.

RESEARCH FUNDING AWARDS
IC Postdoctoral Research Fellowship (to Jim Franke), Advisor component $17,000 x 2 years.

OUTREACH/DIVERSITY
Co-chair: Diversity, Equity, and Inclusion (DEI) committee, TTIC.
Coordinator of TTIC involvement in the Leadership Alliance Program.
Involved in coordinating TTIC's collaboration with Chicago Public Schools (CPS).

CLASSES/SEMINARS
TTIC 31020, Introduction to Machine Learning, Autumn 2022.
TTIC 55000, Independent Research.
Faculty mentor for student-organized Computer Vision reading group at TTIC and the University of Chicago.

MISCELLANEOUS
Ph.D. advisor: Marcelo Sandoval-Castañeda (TTIC), Haochen Wang (TTIC), Xiaodan Du (TTIC), Jiahao Li (TTIC).
Undergraduate advisees: Josh Ahn (University of Chicago), Kevin Suk (University of Chicago), Nam Anh Dinh (University of Chicago).
Internal service: Director of Admissions; Faculty Liaison to Director of IT, co-chair of Diversity, Equity, and Inclusion (DEI) committee.
Mentored: Sudarshan Babu (TTIC).

Matthew Turk
President
ttic.edu/turk

PUBLISHED/SUBMITTED PAPERS
Book (forthcoming): Md. Ahad, U. Mahbub, Matthew Turk, and Richard Hartley (eds.), Computer Vision: Challenges, Trends, and Opportunities, CRC Press.

TALKS
Keynote talk, "Costs and Bias in Facial Recognition Technologies," IEEE Conference on Face and Gesture Recognition, Waikoloa, Hawaii, January 8, 2022.
Keynote talk, "Are We Enabling a Surveillance Dystopia?" Workshop on Demographic Variations in Performance of Biometric Algorithms, January 3, 2022.

INVOLVEMENT
Editorial Board: ACM Transactions on Interactive Intelligent Systems (TiiS), International Journal of Computer Vision and Signal Processing.
CRA Computing Community Consortium Council (CCC) member.
FG 2023 Panel, Privacy and Ethics of FG Research.
FG 2023 Best Paper Selection Committee.
International Advisory Board member for IDIAP (Switzerland), 2021-2025.

MISCELLANEOUS
Ph.D. advisor for: Pushkar Shukla (TTIC).
Committee member: Brandon Huynh (University of California, Santa Barbara), Yi Ding (University of California, Santa Barbara).
TTIJ Board of Councilors member.

Machine Learning

Machine Learning generally refers to an engineering or design paradigm where systems are built based on automatic training from examples rather than detailed expert knowledge, much in the same way humans learn how to perform tasks and interact with the world. Most of modern Machine Learning is statistical in nature, and builds on statistical and probabilistic tools, as well as on algorithmic and computational developments. Especially in recent years, as training data is becoming plentiful, and massive computational and storage resources needed for handling the data are also becoming available, Machine Learning is playing a key role in many application areas. This includes classic artificial intelligence problems, such as computer vision, robotics, machine translation, question answering and dialogue systems. There are also a variety of "non-human" problems such as information retrieval, search, bioinformatics, and stock market prediction to be considered. Below is a list of the work done at TTIC this year in the area of Machine Learning.

Sam Buchanan
Research Assistant Professor
ttic.edu/buchanan

PUBLISHED/SUBMITTED PAPERS
Brent Yi, Weijia Zeng, Sam Buchanan, Yi Ma. "TILTED: Canonical Factors for Hybrid Neural Fields." ICCV 2023 poster (accepted).
Yaodong Yu, Sam Buchanan, Druv Pai, Tianzhe Chu, Ziyang Wu, Shengbang Tong, Benjamin D. Haeffele, Yi Ma. "White-Box Transformers via Sparse Rate Reduction." arXiv preprint (submitted).
Sam Buchanan, Jingkai Yan, Ellie Haber, John Wright. Resource-Efficient Invariant Networks: Exponential Gains by Unrolled Optimization. SLowDNN 2023 workshop.

TALKS
"Deep Networks and the Multiple Manifold Problem." Dec. 8, 2022, University of Michigan CSP Seminar.
"Deep Networks and the Multiple Manifold Problem." Sept. 2022, SIAM MDS 2022 Minisymposium.
"The Role of Data Geometry in High-Dimensional Learning." Sept. 2022, SIAM MDS 2022 Minisymposium.

INVOLVEMENT
Conference organizer and web chair: Conference on Parsimony and Learning 2023.
Journal reviewer: TPAMI
Conference reviewer: NeurIPS 2022, ICLR 2023, ICML 2023, NeurIPS 2023.
Workshop reviewing: SLowDNN 2023, DeepMath 2023.
Workshop organizing: MoDL meeting 2023 at TTIC.

CLASSES/SEMINARS
"Learning Low-Dimensional Structure via Deep Networks." January 2023, SLowDNN workshop 2023 tutorial lecture.
"Learning Nonlinear and Deep Low-Dimensional Representations from High-Dimensional Data: From Theory to Practice." ICASSP 2023 short course.
"Deep Representation Learning from the Ground Up." (Tutorial).

MISCELLANEOUS
Mentor: Brent Yi (University of California Berkeley), Druv Pai (University of California Berkeley).

Lee Cohen
Research Assistant Professor
ttic.edu/cohen

PUBLISHED/SUBMITTED PAPERS
Lee Cohen, Saeed Sharifi-Malvajerdi, Kevin Stangl, Ali Vakilian, Juba Ziani. "Sequential Strategic Screening." ICML, poster.
Lee Cohen, Saeed Sharifi-Malvajerdi, Kevin Stangl, Ali Vakilian, Juba Ziani. "Sequential Strategic Screening." ICML, 2023.
Han Shao, Lee Cohen, Avrim Blum, Yishay Mansour, Aadirupa Saha, Matthew R. Walter. "Eliciting User Preferences for Personalized Multi-Objective Decision Making through Comparative Feedback." In submission.
Lee Cohen, Yishay Mansour, Michal Moshkovitz. "Finding Safe Zones of Policies Markov Decision Processes." In submission.

TALKS
"Dueling Bandits with Team Comparisons." IDEAL Weekly Talk, February 2023.

INVOLVEMENT
Program Committee member: ALT 2023.

MISCELLANEOUS
Internal service: Award Committee member for 2023 TTIC Student Workshop.

David McAllester
Professor
ttic.edu/mcallester

TALKS
"Interpretability, Control and Retrieval Models." Human Level AI workshop, Boston Ma., June 20-22.

CLASSES/SEMINARS
TTIC 31230: Fundamentals of Deep Learning.

MISCELLANEOUS
Advisor: Pedro Savarese (TTIC).
Supervisor: David Yunis (TTIC) on retrieval models.
Internal service: Website Committee member.

Nathan Srebro
Professor
ttic.edu/srebro

PUBLISHED/SUBMITTED PAPERS
N.S. Manoj, N. Srebro. "Shortest Program Interpolation Learning." COLT 2023.
S. Frei, G. Vardi, P. Bartlett, N. Srebro. "Benign overfitting in linear classifiers and leaky ReLU networks from KKT conditions for margin maximization." COLT 2023.
Patel Kshitij, K.; Wang, L.; Saha, A.; and Srebro, N. "Federated Online and Bandit Convex Optimization." ICML 2023.

Evron, I.; Moroshko, E.; Buzaglo, G.; Khriesh, M.; Marjieh, B.; Srebro, N.; and Soudry, D. "Continual Learning in Linear Classification on Separable Data." ICML 2023.

G. Li, P. Kamath, D.J. Foster, N. Srebro. "Understanding the Eluder Dimension." Advances in Neural Information Processing Systems 35. 2022.

K.K. Patel, L. Wang, B.E. Woodworth, B. Bullins, N. Srebro. "Towards optimal communication complexity in distributed non-convex optimization." Advances in Neural Information Processing Systems 35. 2022.

L. Zhou, F. Koehler, P. Sur, D.J. Sutherland, N. Srebro. "A Non-Asymptotic Moreau Envelope Theory for High-Dimensional Generalized Linear Models." Advances in Neural Information Processing Systems 35. 2022.

O. Montasser, S. Hanneke, N. Srebro. "Adversarially robust learning: A generic minimax optimal learner and characterization." Advances in Neural Information Processing Systems 35. 2022.

G. Li, C. Ma, N. Srebro. "Pessimism for Offline Linear Contextual Bandits using Confidence Sets." Advances in Neural Information Processing Systems 35. 2022.

I. Amir, R. Livni, N. Srebro. "Thinking Outside the Ball: Optimal Learning with Gradient Descent for Generalized Linear Stochastic Convex Optimization." Advances in Neural Information Processing Systems 35. 2022.

G. Vardi, O. Shamir, N. Srebro. "The sample complexity of one-hidden-layer neural networks." Advances in Neural Information Processing Systems 35. 2022.

G. Li, J. Li, A. Kabra, N. Srebro, Z. Wang, Z. Yang. "Exponential family model-based reinforcement learning via score matching." Advances in Neural Information Processing Systems 35. 2022.

G. Vardi, O. Shamir, N. Srebro. "On margin maximization in linear and ReLU networks." Advances in Neural Information Processing Systems 35. 2022.

I. Evron, E. Moroshko, R. Ward, N. Srebro, D. Soudry. "How catastrophic can catastrophic forgetting be in linear regression?" COLT 2022.

M.S. Nacson, K. Ravichandran, N. Srebro, D. Soudry. "Implicit Bias of the Step Size in Linear Diagonal Neural Networks." ICML 2022.

Kumar Kshitij Patel, Margalit Glasgow, Lingxiao Wang, Nirmit Joshi, Nathan Srebro. "On the Still Unreasonable Effectiveness of Federated Averaging for Heterogeneous Distributed Learning." ICML 2023 FL Workshop.

K.K. Patel, A. Saha, L. Wang, N. Srebro. "Distributed online and bandit convex optimization." OPT 2022: Optimization for Machine Learning (NeurIPS 2022 Workshop).

G. Li, Z. Jia, A. Rakhlin, A. Sekhari, N. Srebro. "When is Agnostic Reinforcement Learning Statistically Tractable?" ICML 2023 Workshop on New Frontiers in Learning, Control, and Dynamical Systems.

Arjevani, Yossi, Yair Carmon, John C. Duchi, Dylan J. Foster, Nathan Srebro, and Blake Woodworth. "Lower bounds for non-convex stochastic optimization." Mathematical Programming 199, no. 1-2: 165-214. 2023.

L. Zhou, F. Koehler, D.J. Sutherland, N. Srebro. "Optimistic rates: A unifying theory for interpolation learning and regularization in linear regression." ACM/IMS Journal of Data Science 1, no 1. 2023 (invited paper).

N. Sengupta, M. Udell, N. Srebro, J. Evans. "Sparse Data Reconstruction, Missing Value and Multiple Imputation through Matrix Factorization." Sociological Methodology 53, no 1: 72-114. 2023.

TALKS
"Benign Overfitting: Analysis and Implications." New York University Courant Institute, September 2023.
"A Contemporary View of Learning Theory for Deep Neural Net Learning." Information Theory and Applications (ITA), February 2023, Plenary Talk.

"Interpolation Learning with Linear Predictors and Short Programs." Yale University Statistics and Data Science Colloquium, March 2023."
"Interpolation Learning with Minimum Description Length." Tel Aviv University, March 2023.

"Learning by Overfitting: A Statistical Learning view of Benign Overfitting." Columbia University Statistics and Machine Learning Symposium, April 2023.
"Benign Overfitting: Analysis and Implications." Simons Symposium on New Directions in Theoretical Machine Learning, September 2023.
"Interpolation Learning with Minimum Description Length." Information Theory and Applications (ITA), February 2023.
"Benign Overfitting: Analysis and Implications." Les Houches Optimization and Statistical Learning Workshop, March 2023.
"Interpolation Learning with Short Programs." EPFL, June 2023.
"Implicit Bias of Optimization: Going Beyond Mirror Descent?" SIAM OP 2023, June 2023.
"Interpolation Learning with Linear Models, Kernels, Neural Nets and Short Programs." Statistical Physics and Machine Learning: Back Together Again workshop, July 2023.
"Distributed and Federated Learning/Stochastic Optimization." Simons Institute, July 2023.
"Interpolation Learning with Linear Models, Kernels, Neural Nets and Short Programs." RIKEN AI, Tokyo, August 2023.
"From Empirics to Theory: Understanding Deep Laarning via Optimization Geometry." ICIAM 2023, August 2023.

INVOLVEMENT
Steering committee: FAacT, Midwest Machine Learning Symposium.
Senior area chair: NeurIPS 2022, ICL 2023.
Co-organizer: Simons Workshop on Federated Learning.

CLASSES/SEMINARS
TTIC 31120: Statistical and Computational Learning Theory, Winter 2022.
Machine Learning and Optimization Reading Group.

OUTREACH/DIVERSITY
Bessie Coleman Library Computer Science Club mentor.

MISCELLANEOUS
Advisor: Omar Montasser (TTIC), Anmol Kabra (TTIC), Kavya Ravichandran (TTIC), Donya Saless (TTIC), Marko Medvedev (University of Chicago), Xiaohan Zhu (University of Chicago), Lijia Zhou (University of Chicago).
Mentored RAPs: Lingxiao Wang, Saeed Sharifi-Malvajerdi, Sam Buchanan, Theo Misiakiewicz.
Hosted postdoc: Gal Vardi.

Lingxiao Wang
Research Assistant Professor
ttic.edu/wang

PUBLISHED/SUBMITTED PAPERS

Kumar Kshitij Patel, Lingxiao Wang, Blake Woodworth, Brian Bullins, Nathan Srebro, "Towards Optimal Communication Complexity in Distributed Non-convex Optimization" Proc. of the 36th Advances in Neural Information Processing Systems (NeurIPS), 2022.

Lingxiao Wang, Boxin Zhao, Mladen Kolar, "Differentially Private Matrix Completion through Low-rank Matrix Factorization". in Proc. of the 25th International Conference on Artificial Intelligence and Statistics (AISTATS), 2023.

Kumar Kshitij Patel, Lingxiao Wang, Aadrirupa Saha, Nathan Srebro, "Federated Online and Bandit Convex Optimization". in Proc. of the 40th International Conference on Machine Learning (ICML), 2023.

Lingxiao Wang, Bargav Jayaraman, David Evans, Quanquan Gu, "Efficient Privacy-Preserving Stochastic Nonconvex Optimization". in Proc. of the 39th International Conference on Uncertainty in Artificial Intelligence (UAI), 2023.

Kumar Kshitij Patel, Margalit Glasgow, Lingxiao Wang, Nirmit Joshi, Nathan Srebro, "On the Still Unreasonable Effectiveness of Federated Averaging for Heterogeneous Distributed Learning". ICML 2023 workshop on Federated Learning and Analytics in Practice: Algorithms, Systems, Applications, and Opportunities.

Katriona Shea, ... , Lingxiao Wang, ... , Michael C. Runge. "Multiple Models for Outbreak Decision Support in the Face of Uncertainty". Proceedings of the National Academy of Sciences (PNAS), Volume 120, No. 18, 2023.

TALKS

"Private Matrix Completion through Low-rank Matrix Factorization." Research at TTIC Seminar, 2022.

"On the Still Unreasonable Effectiveness of Federated Averaging for Heterogeneous Distributed Learning." ICML 2023 Workshop on Federated Learning and Analytics in Practice: Algorithms, Systems, Applications, and Opportunities.

INVOLVEMENT

Area Chair: NeurIPS 2023.
Conference review: AISTATS 2023, ICML 2023, UAI 2023.

MISCELLANEOUS

Mentor: Kumar Kshitij Patel (TTIC), Lawrence Tang (University of Chicago).

Robotics

Robotics can generally be defined as a field concerned with the development and realization of intelligent, physical agents that are able to perceive, plan, and act intentionally in an uncertain world. Robotics is a broad field that includes mechanical design, planning and control, perception, estimation, and human-robot interaction among others. At TTIC, robotics research currently focuses on developing advanced perception algorithms that endow robots with a rich awareness of, and the ability to act deliberately, within their surroundings. Researchers are particularly interested in algorithms that take multi-modal observations of a robot's surroundings as input, notably image streams and natural language speech, and infer rich properties of the people, places, objects, and actions that comprise a robot's environment. Integral to these technologies is their reliance on techniques from machine learning in developing probabilistic and statistical methods that are able to overcome the challenge of mitigating the uncertainty inherent in performing tasks effectively in real-world environments. These tasks include assistive technology for people living with physical and cognitive impairments, healthcare, logistics, manufacturing, and exploration. Below is a list of the work done at TTIC this year in the area of Robotics.

Matthew Walter
Professor
ttic.edu/walter

PUBLISHED/SUBMITTED PAPERS
V. Guizilini, I. Vasiljevic, J. Fang, R. Ambrus, G. Shakhnarovich, M. R. Walter, and A. Gaidon, "Depth field networks for generalizable multi-view scene representation," in Proceedings of the European Conference on Computer Vision (ECCV), October 2022.
X. Liu, T. Yoneda, C. Wang, M. R. Walter, and Y. Chen, "Active policy improvement from multiple black-box oracles," in Proceedings of the International Conference on Machine Learning (ICML), Jul. 2023.
C. Schaff, A. Sedal, and M. R. Walter, "Soft robots learn to crawl: Jointly optimizing design and control with sim-to-real transfer," in Proceedings of Robotics: Science and Systems (RSS), Jul. 2022.
T. Yoneda, L. Sun, G. Yang, B. Stadie, and M. Walter, "To the noise and back: Diffusion for shared autonomy," February 2023.
T. Yoneda, G. Yang, M. R. Walter, and B. Stadie, "Invariance through latent alignment," in Proceedings of Robotics: Science and Systems (RSS), Jul. 2022.
C. Schaff, A. Sedal, and M. R. Walter, "Learning to design and control soft crawling robots with zero-shot sim-to-real transfer," in Proceedings of the CoRL Workshop on Sim-to Real Robot Learning, 2022.
D. Yunis, K. K. Patel, P. H. P. Savarese, G. Vardi, J. Frankle, M. Walter, K. Livescu, and M. Maire, "On convexity and linear mode connectivity in neural networks," in Proceedings of the NeurIPS Workshop on Optimization for Machine Learning (OPT), 2022.
A. Phung, G. Billings, A. F. Daniele, M. R. Walter, and R. Camilli, "Enhancing scientific exploration of the deep sea through shared autonomy in remote manipulation," Science Robotics, vol. 8, no. 81, 2023.
C. Schaff, A. Sedal, S. Ni, and M. R. Walter, "Sim-to-real transfer of co-optimized soft robot crawlers," Autonomous Robots, 2023.

TALKS
"Joint Optimization of Robot Design and Control via Reinforcement Learning," Workshop on New Models in Online Decision Making for Real-World Applications, July 2022.

Design & Computational Reasoning," Northeastern University, March 2023.

"Learning Better Ways to Measure and Move: Joint Optimization of an Agent's Physical Design & Computational Reasoning," International Workshop on Symbolic-Neural Learning (SNL), March 2023.

"Collaborating Trust & Expectations in Shared Autonomy: Reinforcement Learning for Autonomous Vehicles," Auto.AI Conference, June 2023.

"Recent Robotics Research at TTI-Chicago," Toyota Technological Institute at Japan, November 2022.

"Trustworthy AI: Calibrating Capabilities and Expectations," Summit on AI in Society, October 2023.

INVOLVEMENT

Associate editor: IEEE Robotics and Automation Letters (RA-L), IEEE Transactions on Robotics (T-RO), ACM Transactions on Human-Robot Interaction (THRI), Transactions on Machine Learning Research.

Area chair: International Conference on Learning Representations (ICLR), Neural Information Processing Systems (NeurIPS), International Conference on Machine Learning (ICML).

Board member: Duckietown Foundation.

Reviewer: Conference on Robot Learning (CoRL), Robotics: Science and Systems (RSS), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE International Conference on Robotics and Automation (ICRA), Autonomous Robots, Journal of Field Robotics, IEEE Robotics and Automation Letters (RA-L).

Senior member: IEEE.

Steering committee: Northeast Robotics Colloquium.

Panelist: NSF Safe Learning-Enabled Systems Panel, Summit on AI in Society, October 2023.

Program committee: Artificial Intelligence and Statistics (AISTATS).

Co-organizer: ECCV Workshop on Frontiers of Monocular 3D Perception: Explicit vs. Implicit, 2022.

CLASSES/SEMINARS

TTIC 31170: Robot Learning and Estimation, TTIC/University of Chicago.

"Self-Driving Cars with Duckietown," edX MOOC (with Andrea Censi, Liam Paull, and Jacopo Tani) involving approximately 7000 students from across the world.

Robotics reading group.

OUTREACH/DIVERSITY

Diversity, Equity, and Inclusion (DEI) Committee member.

IDEAL High School Teacher Workshop speaker, May 2023.

University of Chicago Collegiate Scholars Program speaker and host, July 2023.

TTIC + ChiS&E Robotics and Autonomy Course organizer for high-school students from underrepresented groups.

Exhibitor, National Robotics Week Robot Block Party at the Museum of Science and Industry, April 2023.

Co-organizer, Robot Summer Camp, Chicago Park District.

MISCELLANEOUS

Internal service: TTIC Diversity, Equity and Inclusion (DEI) committee member, TTIC Hiring Committee member, TTIC Industrial Affiliates Program czar.

Qualifying exam committee member: Ju-Chieh Chou (TTIC).

Ph.D. advisor: Zhongtian "Falcon" Dai (TTIC), Andrea Daniele (TTIC), Jiading Fang (TTIC), Shengjie Lin (TTIC), Keziah Naggita (TTIC, co-advised by Avrim Blum), Charles "Chip" Schaff (TTIC), Takuma Yoneda (TTIC), David Yunis (TTIC).

Visiting student advisee: Lorand Cheng (University of Southern California), Betsy Gonzalez (Chicago Public Schools) Asher Grossman (University of Chicago Laboratory School), Davida Iafrate (Polytecnico di Milano), Tianchong Jiang (University of Chicago), Justin Jung (University of Chicago), Peng Li (Fudan University, co-advised by Hongyuan Mei), Emma Quansah (Chicago Public Schools), Alea Ritchie (Illinois Math and Science Academy), Nikita Rudrapati (Illinois Math and Science Academy), Benjamin Stoddart (University of Michigan), Dylan Sumaya Lobo (Chicago Public Schools), Luzhe Sun (University of Chicago), Xiangshan "Vincent" Tan (Zhejiang University), Daksh Vermareddy (Chicago Public Schools), Huanyu Zhang (University of Chicago).

RAP Mentor: Hongyuan Mei.

Thesis committee member: Jacob Arkin (University of Rochester), Igor Vasilijevic (TTIC), Andrea Daniele (TTIC), Zhongtian "Falcon" Dai (TTIC), Charles "Chip" Schaff (TTIC).

Speech and Language Technologies

This area is concerned with getting computers to analyze and extract information from spoken language, as well as to generate spoken audio. At TTIC, current speech research focuses mainly on the analysis side. For example, speech recognition is the problem of transcribing the words being spoken in an audio signal, such as that recorded from a microphone. Speech processing heavily relies on techniques from machine learning and statistics, as well as ideas from linguistics and speech science, and shares algorithms with computer vision and computational biology. This area has applications such as automated telephone information centers, dictation systems, machine translation, archiving and search of spoken documents, assistance for the visually or hearing-impaired, and other human-computer interface systems. Below is a list of the work done at TTIC this year in the area of Speech and Language Technologies.

Kartik Goyal
Assistant Professor
ttic.edu/goyal

PUBLISHED/SUBMITTED PAPERS
Nikolai Vogler, Kartik Goyal, K.P. Reddy, Elizaveta Pertseva, Samuel Lemley, Christopher Warren, Max G'Sell, Taylor Berg-Kirkpatrick. "Contrastive Attention Networks for Attribution of Early Modern Print." AAAI. 2023.

Fatemehsadat Mireshghallah, Kartik Goyal, Archit Unyal, Taylor Berg-Kirkpatrick, Reza Shokri. "Quantifying Privacy Risks of Masked Language Models Using Membership Inference Attacks." EMNLP. 2022.

"Who Rpinted Shakespeare's Fourth Folio?" Christopher N Warren, Samuel V Lemley, DJ Schuldt, Elizabeth Dieterich, Laura S DeLuca, Max G'Sell, Taylor Berg-Kirkpatrick, Kari Thomas, Kartik Goyal, Nikolai Vogler. Shakespeare Quarterly. 2023.

TALKS
"Controllable generative models for natural language and related phenomena." Midwest Machine Learning Symposium, May 2023.

"Controllable generative models for natural language and related phenomena." Faculty job talk, Georgia Institute of Technology, March 2023.

"Beyond the autoregressive paradigm for probabilistic text generation." Research at TTIC, January 2023.

"Natural language processing and controllability." TTIC Industry Open House, December 2022.

INVOLVEMENT
Reviewer: Neurips 2023, ICML 2023, ICLR 2023, ACL 2023, EMNLP 2023, CoNLL 2022, Repl4NLP Workshop 2023.

CLASSES/SEMINARS
Co-organizer: Weekly reading group on Speech and Natural Language processing with participants from TTIC and the University of Chicago.

MISCELLANEOUS
Mentor: Joe Chaplowski (University of Chicago), Henry Herzog (University of Chicago), Marziyeh Mohavedi (University of Chicago), Nolan Pozzobon (University of Chicago), Gerald White (University of Chicago), Jiamin Yang (University of Chicago), Davis Yoshida (TTIC), David Yunis (TTIC).

Karen Livescu
Professor
ttic.edu/livescu

PUBLISHED/SUBMITTED PAPERS
A. Pasad, B. Shi, and K. Livescu. "Comparative layer-wise analysis of self-supervised speech models." ICASSP, 2023.

S. Shon, F. Wu, K. Kim, P. Sridhar, K. Livescu, S. Watanabe. "Context-aware fine-tuning of self-supervised speech models." ICASSP, 2023

S. Toshniwal, S. Wiseman, K. Livescu, and K. Gimpel. "Baked-in State Probing", Findings of EMNLP, 2022.

B. Shi, D. Brentari, G. Shakhnarovich, and K. Livescu. "Open-domain sign language translation learned from online video." EMNLP, 2022.

A. Pasad, F. Wu, S. Shon, K. Livescu, and K. J. Han. "On the use of external data for spoken named entity recognition." NAACL, 2022.

D. Yunis, K. K. Patel, P. Savarese, G. Vardi, K. Livescu, M. Walter, J. Rankle, and M. Maire. "On Convexity and Linear Mode Connectivity in Neural Networks." NeurIPS Workshop on Optimization for Machine Learning (OPT), 2022.

B. Shi, D. Brentari, G. Shakhnarovich, and K. Livescu. "TTIC's WMT-SLT 22 Sign Language Translation System." Proc. 7th Conference on Machine Translation (WMT) 2022.

A. Srivastava et al. "Beyond the imitation game: Quantifying and extrapolating the capabilities of language models." Transactions on Machine Learning Research 2023.

A. Mohamed, H. Lee, L. Borgholt, J. D. Havtorn, J. Edin, C. Igel, K. Kirchhoff, S.-W. Li, K. Livescu, L. Maaløe, T. N. Sainath, and S. Watanabe. "Self-supervised speech representation learning: A review." IEEE Journal of Selected Topics in Signal Processing 16(6):1179-1210, October, 2022.

TALKS
"Toward Sign Language Understanding in the Real World." ICASSP Perspectives Talk, Rhodes, Greece, June 7, 2023.

"What Do Self-Supervised Speech Representation Models Know? A Layer-Wise Analysis." CMU LTI Colloquium, April 2023.

"Toward Understanding Open-Domain Sign Language in Natural Environments." IEEE SPS Distinguished Lecture at IEEE Silicon Valley, July 2022.

"Toward Understanding Open-Domain Sign Language in Natural Environments." VGG Sign Language Seminar, July 2022.

"Spoken language understanding, with and without pre-training." FAIR seminar, Meta, July 2022.

"What Do Self-Supervised Speech Representation Models Know? A Layer-Wise Analysis." ICASSP Workshop on Self-Supervision in Audio, Speech and Beyond, Rhodes, Greece, June 2023.

"What Do Self-Supervised Speech Representation Models Know? A Layer-Wise Analysis." NeurIPS Workshop on Self-Supervised Learning: Theory and Practice, December 2022.

INVOLVEMENT
Associate Editor: TPAMI.
Action Editor: TACL.
Technical Program Co-Chair: Interspeech 2022.
Reviewer: ICASSP 2023.

CLASSES/SEMINARS
TTIC 31220: Unsupervised Learning and Data Analysis.
"Self-supervised Representation Learning for Speech Processing." Tutorial at Interspeech, September 2022.
"Self-supervised Representation Learning for Speech Processing." Tutorial at NAACL, July 2022.
"Speech Processing: Automatic Speech Recognition and beyond." Invited short course at International School on Deep Learning (DeepLearn), Bournemouth, January 16-20, 2023.

MISCELLANEOUS
Thesis committee member: Robin Algayres (École Normale Supérieure/INRIA), Lingyu Gao (TTIC), Davis Yoshida (TTIC).
Ph.D. advisor: Qingming Tang (TTIC), Bowen Shi (TTIC), Shane Settle (TTIC), Freda Shi (TTIC), Ankita Pasad (TTIC), Ju-Chieh Chou (TTIC), Chung-Ming Chien (TTIC).
Internal service: Colloquium Coordinator, Student Support Coordinator, Student Workshop faculty advisor, faculty hiring committee chair.

Visiting and Adjoint Faculty

Visiting Professors

Aditya Bhaskara
Associate Professor, University of Utah
Ph.D. - Princeton University

Eden Chlamtac
Assistant Professor, Ben Gurion University
Ph.D. - Princeton University

Graciela Perera
Associate Professor, Northeastern Illinois University
Ph.D. - University of South Florida

Aadirupa Saha
Research Scientist at Apple
Ph.D. - Indian Institute of Science

Adjoint Professors

David Forsyth
Professor, University of Illinois at Urbana-Champaign
Ph.D. - Balliol College, Oxford

Sanjeev Khanna
Professor, University of Pennsylvania
Ph.D. - Stanford University

Svetlana Lazebnik
Professor, University of Illinois at Urbana-Champaign
Ph.D. - University of Illinois at Urbana-Champaign

Robert Nowak
Professor, University of Wisconsin-Madison
Ph.D. - University of Wisconsin-Madison

Alexander Razborov
Professor, University of Chicago
Ph.D. - Steklov Mathematical Institute

Alexander Razborov
Professor, University of Chicago
Ph.D. - Steklov Mathematical Institute

Yutaka Sasaki
Professor, TTI-Japan
Ph.D. - University of Tsukuba

Norimichi Ukita
Professor, TTI-Japan
Ph.D. - Kyoto University

Stephen Wright
Professor, University of Wisconsin-Madison
Ph.D. - University of Queensland

Courtesy Faculty

László Babai
George and Elizabeth Yovovich Professor, University of Chicago
Ph.D. - Hungarian Academy of Sciences, Budapest

Allyson Ettinger
Assistant Professor, University of Chicago
Ph.D. - University of Maryland, College Park

Michael Franklin
Liew Family Chair of Computer Science, University of Chicago
Ph.D. - University of Wisconsin

Rana Hanocka
Assistant Professor, University of Chicago
Ph.D. - Tel Aviv University

Mladen Kolar
Associate Professor of Econometrics and Statistics, University of Chicago
Ph.D. - Carnegie Mellon University

Risi Kondor
Assistant Professor, University of Chicago
Ph.D. - Columbia University

Michael Maire
Assistant Professor, University of Chicago
Ph.D. - University of California, Berkeley

Rad Niazadeh
Assistant Professor of Operations Management, University of Chicago
Ph.D. - Cornell University

Aaron Potechin
Assistant Professor, University of Chicago
Ph.D. - Massachusetts Institute of Technology

Janos Simon
Professor and Director of Graduate Studies, University of Chicago
Ph.D. - Cornell University

Chenhao Tan
Assistant Professor, University of Chicago
Ph.D. - Cornell University

Rebecca Willett
Professor, University of Chicago
Ph.D. - Rice University

Collaboration and Cooperation

Professor Avrim Blum, Professor Julia Chuzhoy, Professor Yury Makarychev, and Professor Nathan Srebro are collaborating with researchers from University of Illinois at Chicago, Northwestern University, the University of Chicago, and the Illinois Institute of Technology, and in partnership with researchers at Google NYC, together forming the Institute for Data, Econometrics, Algorithms, and Learning (IDEAL), which was awarded a TRIPODS Phase II award by the National Science Foundation. IDEAL involves more than 50 researchers working on key aspects of the foundations of data science across multiple disciplines. The research centers around the foundations of machine learning, high-dimensional data analysis and inference, and data science and society.

Professors Avrim Blum, Lee Cohen, and Matt Walter and student **Han Shao** are collaborating with Professor Yishay Mansour at Tel-Aviv University on algorithms for eliciting user preferences in order to quickly develop optimal personalized policies in multi-objective decision-making scenarios.

Professor Jinbo Xu is collaborating with Professor Tali Dekel (WIS) and Professor Sarel Fleishman (WIS). Professor Fleishman (WIS) has developed cutting-edge atomistic methods PROSS and FuncLib for optimizing protein stability and activity, Professor Xu developed the first deep-learning method for protein structure prediction, revolutionizing the field and inspiring DeepMind's AlphaFold, and Professor Dekel (WIS) developed cutting-edge deep-learning methods for image and video analysis. The completion of their project, "Deep learning for protein optimization and design," will furnish innovative, experimentally validated deep-learning approaches for protein design and broaden participation among students from under-represented groups in both Chicago and Israel.

Professor Karen Livescu is collaborating with researchers at Carnegie Mellon University, National Taiwan University, and ASAPP Inc. to develop a broad benchmark to measure performance of artificial intelligence systems on spoken language understanding.

Professor Greg Shakhnarovich, together with **Professor Karen Livescu**, continued long-standing collaboration with Professor **Diane Brentari** at the University of Chicago on automated recognition of sign languages. Work done as part of this effort won the sign language translation challenge at WMT-2023.

Joint work between **Professor Shakhnarovich's** group and Nick Kolkin (Adobe Research) explored properties of modern generative models for images. Another effort, joint with colleagues at Toyota Research Institute, introduced novel methods for composing and understanding 3D scenes.

Talks and Seminars

Talks and seminars are an important part of any academic institution. They are both a way for researchers to promote their research, and to keep abreast of recent developments. They allow students to be exposed to ideas and researchers that may play a role in shaping their academic views, research direction, or even career. Talks and seminars play an important role in establishing the level of intellectual activity and influx of innovative ideas at an institution: research is more likely to be productive in an active environment with significant interaction between researchers.

The table below lists seminars given at TTIC, many of which are given by speakers from other universities and research institutions, as part of the TTIC Colloquium: a forum for talks by invited speakers on work of current relevance and broad interest to the computer science community. Other talks may be a part of the Research at TTIC series: a weekly seminar series presenting research currently underway at the Institute. Every week a different TTIC faculty member will present their research. The lectures are intended both for students seeking research topics and advisers, and for the general TTIC and University of Chicago communities interested in hearing what their colleagues are currently involved in. The Young Researcher Seminar Series features talks by Ph.D. students and postdocs whose research is of broad interest to the computer science community. The series provides an opportunity for early-career researchers to present recent and promising work and to meet with students and faculty at TTIC and nearby universities. Some speakers may be part of research Reading Groups: people presenting papers that are of interest to a particular group, such as the theory group or the programming languages group. Most seminars are advertised outside of TTIC and are intended to be for a broad audience in computer science. In the spring quarter there are a large number of recruiting seminars which are talks given by candidates for faculty positions.

The TTIC Event Calendar can be accessed from the main website: www.ttic.edu
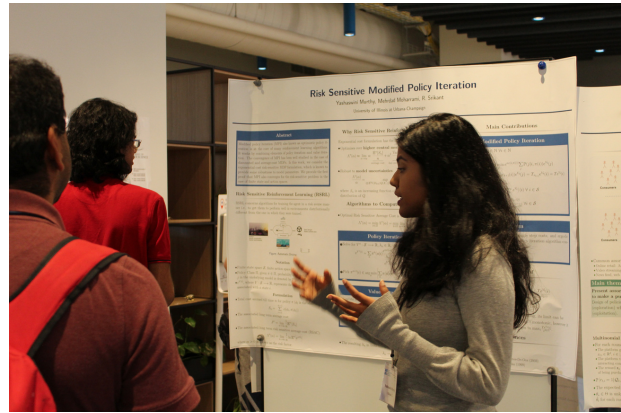
2022-2023	87 speakers
2021-2022	87 speakers
2020-2021	90 speakers
2019-2020	123 speakers
2018-2019	123 speakers
2017-2018	89 speakers

Speaker	Institute	Title	Date
Mingda Chen	Toyota Technological Institute at Chicago	Leveraging Natural Supervision for Language Representation Learning and Generation	7/8/22
Ravi Kannan	Microsoft Research India	Random Separating Hyperplanes and Applications	7/11/22
Itai Lang	Tel Aviv University	Learning-Based Manipulation of 3D Point Clouds	7/19/22
Siddharth Bhandari	University of California, Berkeley	Vanishing Spaces of Random Sets and Applications	7/29/22
Hung-yi Lee	National Taiwan University	Recent Progress of Self-supervised Learning for Speech Processing	8/12/22
Chip Schaff	Toyota Technological Institute at Chicago	Thesis Defense: Neural Approaches to Co-Optimization in Robotics	8/17/22
Aadirupa Saha	Toyota Technological Institute at Chicago	Learning to Make Context-Dependent Predictions Through Preference Elicitation	8/17/22
Shubham Toshniwal	Toyota Technological Institute at Chicago	Thesis Defense: Efficient and Interpretable Neural Models for Entity Tracking	8/24/22
Falcon Dai	Toyota Technological Institute at Chicago	Thesis Defense: On Reward Structures of Markov Decision Processes	9/7/22
Kshitij Patel	Toyota Technological Institute at Chicago	Towards Optimal Communication Complexity in Distributed Non-Convex Optimization	9/14/22
Davoud Ataee Tarzanagh	University of Michigan	Federated Bilevel Optimization and its Applications in Machine Learning	9/16/22
Pragya Sur	Harvard University	A New Perspective on High-Dimensional Causal Inference	9/19/22
Svetlana Lazebnik	University of Illinois at Urbana-Champaign	Playing with GANs for Virtual Try-On and Face Stylization	9/30/22
John C. Duchi	Stanford University	How many labelers do you have? Some perspectives on "gold standard" labels	10/3/22
David McAllester	Toyota Technological Institute at Chicago	The Neurosymbolic conundrum	10/7/22
Divyarthi Mohan	Tel Aviv University	Simplicity and Optimality in Multi-Dimensional Mechanism Design	10/13/22
Baba C. Vemuri	University of Florida	ManifoldNet: A Deep Neural Network for Manifold-valued Data with Applications	10/14/22
Bowen Shi	Toyota Technological Institute at Chicago	Toward American Sign Language Processing in the Real World: Data, Tasks, and Methods	10/17/22
Aadirupa Saha	Toyota Technological Institute at Chicago	Dueling-Opt: Convex Optimization with Relative Feedback	10/21/22
Yoav Artzi	Cornell University	Interaction and Natural Language Learning	10/24/22

Sam Buchanan	Toyota Technological Institute at Chicago	Deep Networks and the Multiple Manifold Problem	10/28/22
Avrim Blum	Toyota Technological Institute at Chicago	Robustly-reliable learners for unreliable data	11/4/22
June Vuong	Stanford University	Optimal Sublinear Sampling of Spanning Trees and Determinantal Point Processes via Average-Case Entropic Independence	11/7/22
Elisa Celis	Yale University	Mitigating Bias in Data Science	11/7/22
Lingxiao Wang	Toyota Technological Institute at Chicago	Private Matrix Completion through Low-rank Matrix Factorization	11/11/22
Paul Valiant	Purdue University	Mean Estimation in Low and High Dimensions	11/14/22
Mari Ostendorf	University of Washington	A Discussion with Toyota Technological Institute at Chicago Trustee Mari Ostendorf: Get to Know your Board	11/09/22
Lisa Li	Stanford University	Diffusion-LM Improves Controllable Text Generation	11/16/22
Jacob Andreas	Massachusetts Institute of Technology	Toward Natural Language Supervision	11/17/22
Saeed Sharifi-Malva	Toyota Technological Institute at Chicago	Machine Unlearning: Algorithms for Data Deletion in Machine Learning	12/2/22
Qingming Tang	Toyota Technological Institute at Chicago	Representation Learning for Speech Data	12/7/22
Noam Aigerman	Adobe Research	Neural shape mapping: modifying, manipulating, and synthesizing geometry through deep learning	1/4/23
Allyson Ettinger	University of Chicago	Understanding" and prediction: Disentangling meaning extraction and predictive processes in NLP models and in humans	1/6/23
David Held	Carnegie Mellon	Relational Affordance Learning for Robot Manipulation	1/9/23
Leon Bottou	Facebook	Out-of-distribution generalization, causation, and features	1/9/23
Elena Voita	FAIR	A Journey on Interpretability Methods in NLP: Inside-Out and Back	1/11/23
Andrea Daniele	Toyota Technological Institute at Chicago	Accessible Interfaces for the Development and Deployment of Robotic Platforms	1/13/23
Greg Shakhnarovich	Toyota Technological Institute at Chicago	What can natural language do for computer vision?	1/13/23
Kartik Goyal	Toyota Technological Institute at Chicago	Beyond the autoregressive paradigm for text generation	1/20/23

Victor Zhong	University of Washington	Reading to Learn: Improving Generalization by Learning From Language	1/23/23
Enric Boix	MIT	The staircase property and the leap complexity	1/25/23
Theodor Misiakiewicz	Stanford University	New statistical and computational phenomena from Deep Learning	1/27/23
Hongyuan Mei	Toyota Technological Institute at Chicago	Logical Reasoning with Language Models	1/27/23
Benjamin Eysenbach	Carnegie Mellon University	Self-Supervised Reinforcement Learning	1/30/23
Matt Walter	Toyota Technological Institute at Chicago	Robots Play Video Games and with Blocks	2/3/23
Elijah Cole	California Institute of Technology	Learning from Real-World Data	2/6/23
Lydia T. Liu	Cornell University	Towards Responsible Machine Learning in Societal Systems	2/8/23
Tanya Goyal	University of Texas at Austin	Building Reliable Text Generation Capabilities for Large Language Models	2/10/23
Alexander Razborov	University of Chicago	Convergence of Shallow Neural Networks in the NTK Regime	2/10/23
Ariel Holtzman	University of Washington	Controlling Large Language Models: Generating (Useful) Text from Models We Don't Fully Understand	2/13/23
Jungo Kasai	University of Washington	Democratized Natural Language Processing: Efficiency, Evaluation, and Beyond	2/15/23
Ohad Trabelsi	Toyota Technological Institute at Chicago	Bridge Girth: A Unifying Notion in Network Design	2/17/23
Yuntian Deng	Harvard University	Structural Coherence in Text Generation	2/20/23
Ali Vakilian	Toyota Technological Institute at Chicago	Individual Preference Stability for Clustering	2/24/23
Jamie Simon	University of California at Berkeley	The Eigenlearning Framework: A Conservation Law Perspective on Kernel Regression and Wide Neural Networks	2/24/23
Naomi Saphra	New York University	Interpreting Training	2/27/23
Ofir Press	University of Washington	Guidance Helps Where Scale Doesn't in Language Modeling	3/1/23
Karen Livescu	Toyota Technological Institute at Chicago	What Do Speech Representation Models "Know"?	3/3/23
Adam Kalai	Microsoft Research	The Power of Intelligent Language Models	3/8/23

Lianhui Qin	University of Washington	Constrained, Casual, and Logical Reasoning for Neural Language Generation	3/20/23
Shiry Ginosar	University of California at Berkeley	Toward Artificial Social Intelligence	3/22/23
Aaron Potechin	University of Chicago	Graph Matrices and the Ellipsoid Fitting Conjecture	3/24/23
Kuan Fang	University of California at Berkeley	Scalable Robot Intelligence: Self-Supervised Learning through Generation	3/24/23
Ohad Shamir	Weizmann Institute	Implicit bias in machine learning	3/24/23
Gal Vardi	Toyota Technological Institute at Chicago/Hebrew University	On Implicit Bias and Provable Generalization in Overparameterized Neural Networks	3/31/23
Derek Reiman	Toyota Technological Institute at Chicago	Methods for modeling the complex immune system	3/31/23
Matthew Turk	Toyota Technological Institute at Chicago	Multimodal Classification for Context-Aware Mixed Reality	4/7/23
Moïse Blanchard	MIT	Convex optimization with constrained memory: Is cutting planes optimal?	4/12/23
Lee Cohen	Toyota Technological Institute at Chicago	Finding Safe Zones of Policies Markov Decision Processes	4/14/23
Nathan Srebro	Toyota Technological Institute at Chicago	Interpolation learning with linear predictors and short programs: How I learned to stop worrying and love the overfitting.	4/21/23
Fred Zhang	University of California at Berkeley	Online Prediction in Sub-linear Space	4/21/23
Aleksandrina Goeva	Broad Institute of MIT and Harvard	Machine Learning Methods for Inferring Changes in Cells Across Space, Time, Health and Disease	4/24/23
Mubarak Shah	University of Central Florida	Beyond Supervised Human Action Recognition: Learning with Limited Labels and Privacy Preservation	4/27/23
Rebecca Willett	University of Chicago	Machine Learning in Science and Engineering	4/28/23
David Forsyth	University of Illinois Urbana-Champaign	Intrinsic images, lighting, and relighting without any labelling	5/3/23
Shane Settle	Toyota Technological Institute at Chicago	Neural Approaches to Spoken Content Embedding	5/4/23
Omar Montasser	Toyota Technological Institute at Chicago	Theoretical Foundations of Adversarially Robust Learning	5/4/23
Julia Chuzhoy	Toyota Technological Institute at Chicago	On Fixing Some Issues with Expanders	5/5/23

Johannes Schmidt-Hieber	University of Twente	A statistical analysis of an image classification problem	5/5/23
Jason Eisner	John Hopkins University	Putting Planning and Reasoning Inside Language Models	5/10/23
Yury Makarychev	Toyota Technological Institute at Chicago	Higher-Order Cheeger Inequality for Partitioning with Buffers	5/12/23
Ankita Sarkar	Dartmouth University	Approximation Algorithms for Continuous Clustering and Facility Location Problems	5/12/23
Pedro Lopes	University of Chicago	Integrating interactive devices with the User's Body	5/15/23
Madhur Tulsiani	Toyota Technological Institute at Chicago	Decoding Codes via Proofs	5/19/23
Francesca Mignacco	Princeton University	Statistical physics insights into the dynamics of learning algorithms	5/24/23
Rachit Nimavat	Toyota Technological Institute at Chicago	Graph Theory and Its Uses in Graph Algorithms and Beyond	6/1/23
Haifeng Xu	University of Chicago	The Economics of Machine Learning	6/2/23
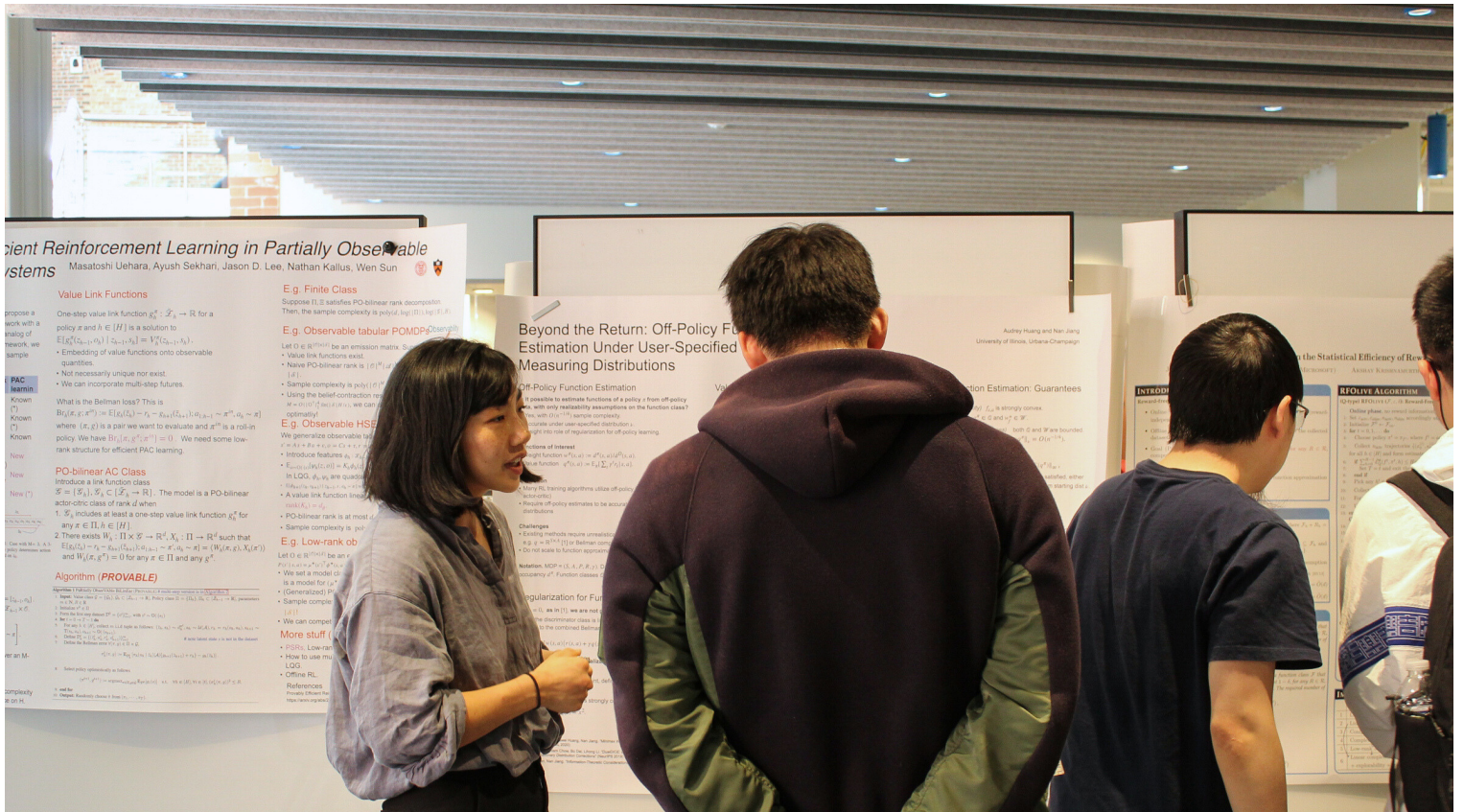
Workshops

New Models in Online Decision Making for Real-World Applications

[July 13-15, 2022] As the first workshop of TTIC's 2022 Summer Workshop Program, this workshop presented a broad overview of the contemporary decision-making models that are being actively researched, and provide a networking forum for researchers and practitioners. This year's theme, New Models in Online Decision Making for Real-World Applications, pervades machine learning at large, and with our aim of bridging practice and theory this workshop will find general appeal.

Representation Learning Theory Workshop

[August 4-5, 2022] As the second part of TTIC's 2022 Summer Workshop Program, this workshop was organized and hosted at TTIC and served as a platform to foster discussion and collaboration for understanding the theoretical foundations of representation learning in modern machine learning.

Sixth Annual Student Workshop

[November 18, 2022] The sixth Annual Student Workshop was held in person on Friday, November 18, 2022, at TTIC. The agenda included student talks, a poster session, and an invited talk from the University of Chicago Assistant Professor Aly Azeem Khan. Talk/Award Committee, Professors Ali Vakilan, Lee Cohen, and Hongyuan Mei. Organizing Committee: Ph.D. candidates Ben Lai and Max Ovsiankin, Professors Karen Livescu and Madhur Tulsiani, and Student Services and Admissions Administrator Erica Cocom. The Best Talk Award was a tie between Kshitij Patel for his talk, "Distributed Online and Bandit Convex Optimization," and Freda Shi for her talk, "Language Models are Multilingual Chain-of-Thought Reasoners." The award for Best Poster was given to Anmol Kabra and his poster, "Exponential Family Model-Based Reinforcement Learning via Score Matching."

Junior Theorists Workshop

[January 5-6, 2023] The Junior Theorists Workshop was jointly hosted by TTIC and Northwestern University to focus on and highlight junior researchers in all areas of theoretical computer science. This workshop was organized by Professor Ali Vakilian and postdoctoral researcher Suprovat Ghoshal.

IDEAL Workshop on Machine Learning, Interpretability, and Logic

[April 10-14, 2023] This workshop was co-sponsored and co-hosted by TTIC, Northwestern University, and the University of Chicago with The Institute for Data, Econometrics, Algorithms, and Learning (IDEAL), an NSF-supported collaborative institute featuring speakers from TTIC's faculty and students. This workshop explored connections between this topic and the program's theme of machine learning and logic.

Midwest Machine Learning Symposium

[May 16-17, 2023] TTIC co-sponsored the Midwest ML Symposium, which aims to convene regional machine learning researchers for stimulating discussions and debates, to foster cross-institutional collaboration, and to showcase the collective talent of ML researchers at all career stages.

New Horizons in Theoretical Computer Science

[June 12-16, 2023] Professor Madhur Tulsiani was an organizer for the workshop, "New Horizons in Theoretical Computer Science," which is an annual, week-long online summer school which aimed to expose under-represented undergraduates in theoretical computer science to exciting research areas in the area of theoretical computer science and its applications. The school contained several mini-courses from top researchers in the field. The courses were free of charge, held remotely, and applications from undergraduates majoring in computer science or related fields who are currently under-represented were encouraged to apply.

Distinguished Lecture Series 2023

David Forsyth

Wednesday, May 3, 2023
Fulton-Watson-Copp Chair and Professor, Computer Science Dept., University of Illinois Urbana-Champaign
Talk Title: "Intrinsic images, lighting and relighting without any labeling."

Jason Eisner

Wednesday, May 10, 2023
Professor, John Hopkins University, ACL Fellow
Talk Title: Putting Planning and Reasoning inside Language Models."

Yejin Choi

Monday, October 16, 2023
Professor, University of Washington, MacArthur Fellow, ACL Fellow, Distinguished Research Fellow at Institute for Ethics in AI at Oxford
Talk Title: "Possible Impossibilities and Impossible Possibilities."

Education

The Ph.D. Program

The TTIC Ph.D. Program is designed to prepare students for modern academic or research careers in computer science. To complete the program, a student must make an original and significant contribution to the field of computer science, conducting high-level, responsible, and original research that culminates in a doctoral thesis which can be successfully defended in a public forum and published. In addition to the thesis, there are course, experiential, and examination requirements to complete the program. The main component of the program is the process by which the student learns to do quality research and becomes a part of the academic community.

As part of the associated partnership between TTIC and the University of Chicago, students of TTIC can take and receive credit for courses through the University, and University of Chicago students can take advantage of classes that TTIC offers as well. Students of both institutions have taken full advantage of this opportunity. TTIC students also have full access to the University of Chicago library system, athletic facilities, the student health center, and transportation on campus. TTIC students enjoy the benefits and great rewards of an intimate learning, study, and research setting, exposure to state-of-the-art research, opportunities in the greater computer science community, and still maintain the traditional shared experiences that come with a large university.

Graduates, Diplomas and Awards

TTIC held the 2022 Diploma and Graduation Ceremony at a new campus hotel, The Study, conveniently located about one block west of the institute. This new venue allowed for increased capacity for attendees to celebrate diploma and award recipients, and share a lunch reception directly following the ceremony.

4 doctoral diplomas were awarded at the September 2022 ceremony to:

Mingda Chen, who studied under Professor Kevin Gimpel, with research interests in Machine Learning and Natural Language Processing. Mingda is currently a Research Scientist at Meta AI

Chip Schaff, who studied under Professor Matt Walter, with research interests in Machine Learning and its applications, especially in Robotics. Chip is currently an Autopilot Engineer at Tesla. Chip's thesis was awarded the honor: thesis of distinction.

Shubham Toshniwal, who studied under Professors Kevin Gimpel and Karen Livescu, with research interests in machine learning and its applications to natural language processing. Shubham is currently employed by Meta AI.

Igor Vasiljevic, who studied under Professor Greg Shakhnarovich, with research interests in Computer Vision. Igor is currently a Machine Learning Research Scientist at Toyota Research Institute.

TTIC expects seven Ph.D. Candidates to be eligible for doctoral degrees in the September 2023 diploma ceremony.

Students Xiaodan Du, Jiahao Li, Max Ovsiankin, and Kavya Ravichandran fulfilled all requirements to complete the Master's portion of the Ph.D. Program, and received Master's diplomas at the September 2022 diploma ceremony at the start of the academic year.

Quality Curriculum

TTIC instructors serve the TTIC student population in their courses, and under the TTIC-University of Chicago Agreement, University students may enroll in TTIC's courses and receive credit through the University, and vice-versa. TTIC views this as part of serving the Education Mission of the Institute. The amount of University students who register for TTIC courses remains high.

TTIC instructors are proud to offer a quality, modern curriculum and rigorous courses to institute Ph.D. students and the students from the University who take part.

Enrollment Numbers for TTIC Courses

Legend:
- TTIC Students (blue)
- UChicago Students (gray)

Years: 2018-2019, 2019-2020, 2020-2021, 2021-2022, 2022-2023
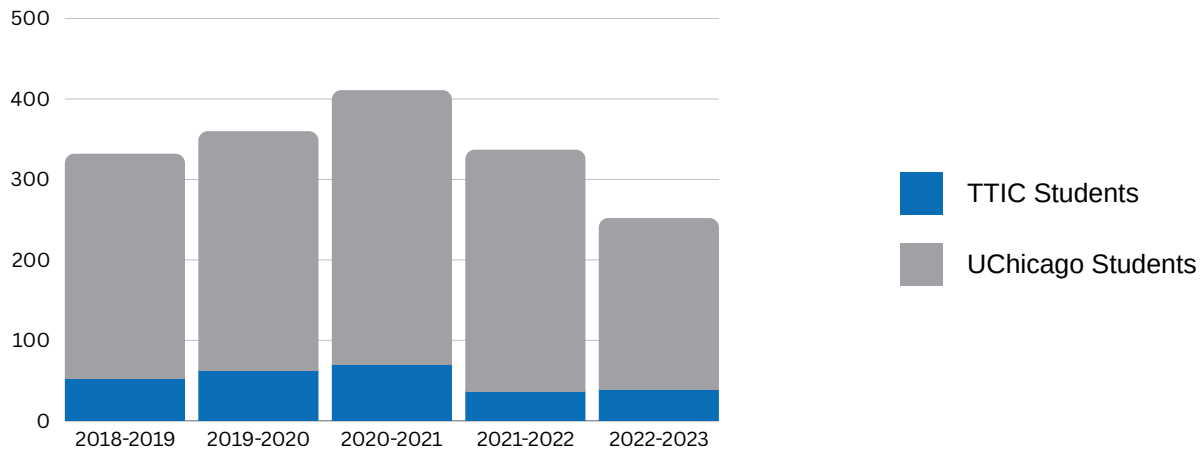
Financial Support for Students

Full financial support is offered to all enrolled students in good academic standing, in residence, and making progress in the program, guaranteed for up to five years.

The tuition for an academic year is $30,000. TTIC provides support funding that covers tuition, health services, health insurance and campus student services fees, a new student equipment allowance, and a stipend for research assistance. There is additional funding support for English as a second language study, women's conferences, and emergency aid.

TTIJ Exchange Students

This year TTIC welcomed two exchange students from the Toyota Technological Institute located in Nagoya, Japan (TTIJ). The students enrolled in courses during their one-quarter stays and became full participating members of institute life, both academic and social.

Kohei Makino and Yuta Yanai arrived in September 2022 and returned to TTIJ in late December.

TTIC remains pleased with the exchange program with TTIJ, as the experience continues to be a success for all involved. New exchange student plans are underway at the institute for 2023-24.

Student Publications, Posters, and Abstracts

Babu, Sudarshan, Richard Liu, Avery Zhao, Michael Maire, Greg Shakhnarovich, and Rana Hanocka. "Hyperfields: Towards Zero Shot Generation of NeRFs from Text." Paper to be presented at the International Conference on Computer Vision (ICCV), Paris, France, October 2023.

Wang, Haochen, Xiaodan Du, Jiahao Li, Raymond A. Yeh, and **Greg Shakhnarovich**. "Score Jacobian Chaining: Lifting Pretrained 2D Diffusion Models for 3D Generation." Paper presented at the Conference on Computer Vision and Pattern Recognition (CVPR), Vancouver, Canada, June 2023.

Guizilini, Vitor, Igor Vasiljevic, **Jiading Fang**, Rares Ambrus, Sergey Zakharov, Vincent Sitzmann, and Adrien Gaidon. "DeLiRa: Self-Supervised Depth, Light, and Radiance Fields." Paper to be presented at the International Conference on Computer Vision (ICCV), Paris, France, October 2023.

Fang, Jiading, Shengjie Lin, Igor Vasiljevic, Vitor Guizilini, Rares Ambrus, Greg Shakhnarovich, Adrien Gaidon, and Matthew R. Walter. "NeRFuser: Fusing NeRFs by Registration and Blending." Paper to be presented at the International Conference on Computer Vision (ICCV), Paris, France, October 2023.

Gao, Lingyu, Debanjan Ghosh, and Kevin Gimpel. "'How is the climate changing?' A Study on Type-Controlled Inquisitive Question Generation." Paper presented at the Society for Experimental Mechanics Conference (SEM), Pittsburgh, PA, June 2022.

Ma, Xiaomeng, and **Lingyu Gao**. "How do we get there? Evaluating transformer neural networks as cognitive models for English past tense inflection." Paper presented at the Asia-Pacific Chapter of the Association for Computational Linguistics (AACL), virtual, November 2022.

Ma, Xiaomeng, and **Lingyu Gao**. "Evaluating Transformer Models and Human Behaviors on Chinese Character Naming." Paper presented at Annual Meeting for the Association of Computational Linguistics (ACL), Toronto, Canada, July 2023.

Gao, Lingyu, Aditi Chaudhary, Krishna Srinivasan, Kazuma Hashimoto, Karthik Raman, and Michael Bendersky. "Ambiguity-Aware In-Context Learning with Large Language Models." Paper presented at the Conference of the European Chapter of the Association for Computational Linguistics (EACL), Dubrovnik, Croatia, May 2023.

Lai, Boqiao, Matt McPartlon, and Jinbo Xu. "End-to-End deep structure generative model for protein design." Preprint submitted on July 11, 2022. doi:10.1101/2022.07.09.499440.

Wen, Jia, Gang Li, Jiawen Chen, Quan Sun, Weifang Liu, Wyliena Guan, **Boqiao Lai**, Jin P Szatkiewicz, Xin He, Patrick F Sullivan, and Yun Li. "DeepGWAS: Enhance GWAS Signals for Neuropsychiatric Disorders via Deep Neural Network." Preprint submitted on February 14, 2023. doi:10.21203/rs.3.rs-2399024/v1.

Wu, Fandi, Xiaoyang Jing, **Xiao Luo**, and Jinbo Xu. "Improving protein structure prediction using templates and sequence embedding." Bioinformatics 39, no. 1 (2023). doi: 10.1093/bioinformatics/btac723.

Manoj, Naren Sarayu, and Nathan Srebro. "Interpolation Learning With Minimum Description Length." Paper presented at the Conference on Learning Theory (COLT), Bangalore, India, July 2023.

Makarychev, Yury, **Naren Sarayu Manoj,** and **Max Ovsiankin**. "Streaming Algorithms for Ellipsoidal Approximation of Convex Polytopes." Paper presented at the Conference on Learning Theory (COLT), London, UK, July 2022.

Gupta, Meghal, and **Naren Sarayu Manoj**. "An Optimal Algorithm for Certifying Monotone Functions." Paper presented at SOSA 2023, Florence Italy, January 2023.

Ahmadi, Saba, Avrim Blum, **Omar Montasser**, and **Kevin Stangl**. "Certifiable Robustness Against Patch Attacks Using an ERM Oracle." Paper presented at the NeurIPS Machine Learning Safety Workshop, Virtual, December 2022.

Ahmadi, Saba, Avrim Blum, **Omar Montasser**, and **Kevin Stangl**. "Certifiable (Multi) Robustness Against Patch Attacks Using ERM." Preprint submitted on March 15, 2023. arXiv:2303.08944v1.

Schoeffer, Jakob, Alexander Ritchie, **Keziah Naggita**, Faidra Monachou, Jessica Finocchiaro, and Marc Juarez. "Online Platforms and the Fair Exposure Problem Under Homophily." Paper presented at the AAAI Conference on Artificial Intelligence (AAAI), Washington, DC, February 2023.

Naggita, Keziah, Elsa Athiley, Beza Desta, and Sarah Sebo. "Parental Responses to Aggressive Child Behavior towards Robots, Smart Speakers, and Tablets." Paper presented at the International Conference on Robot and Human Interactive Communication (RO-MAN), Naples, Italy, August 2022.

Pasad, Ankita, Felix Wu, Suwon Shon, Karen Livescu, and Kyu J Han. "On the Use of External Data for Spoken Named Entity Recognition." Paper presented at the Conference of the North American Chapter of the Association for Computational Linguistics (NAACL), Seattle, WA, July 2022.

Xie, Shuo, Jiahao Qiu, **Ankita Pasad**, Li Du, Qing Qu, and Hongyuan Mei. "Hidden State Variability of Pretrained Language Models Can Guide Computation Reduction for Transfer Learning." Poster presented at the Conference on Empirical Methods in Natural Language (EMNLP), Virtual, December 2022.

Pasad, Ankita, Bowen Shi, and Karen Livescu. "Comparative Layer-Wise Analysis Of Self-Supervised Speech Models." Paper presented at the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Rhodes Island, Greece, June 2023.

Patel, and Kumar Kshitij, Lingxiao Wang, Blake Woodworth, Brian Bullins, and Nathan Srebro. "Towards Optimal Communication Complexity in Distributed Non-convex Optimization." Poster presented at the Conference on Neural Information Processing Systems (NeurIPS), New Orleans, LA, November 2022.

Patel, Kumar Kshitij, Aadirupa Saha, Nathan Srebro, and Lingxiao Wang. "Distributed Online and Bandit Convex Optimization." Poster presented at the Conference on Neural Information Processing Systems (NeurIPS), New Orleans, LA, November 2022.

Yunis, David, Kumar Kshitij Patel, Pedro Savarese, Gal Vardi, Jonathan Frankle, Matthew Walter, Karen Livescu, and Michael Maire. "On Convexity and Linear Mode Connectivity in Neural Networks." Poster presented at the Conference on Neural Information Processing Systems (NeurIPS), New Orleans, LA, November 2022.

Nacson, Mor Shpigel, **Kavya Ravichandran**, Nathan Srebro, and Daniel Soudry. "Implicit Bias of the Step Size in Linear Diagonal Neural Networks." Paper presented at the Conference on Machine Learning (ICML), Baltimore, Maryland, July 2022.

Yuan, Xin, **Pedro Savarese**, and Michael Maire. "Accelerated Training via Incrementally Growing Neural Networks using Variance Transfer and Learning Rate Adaptation." Preprint submitted on June 22, 2023. arXiv:2306.12700v1.

Shao, Han, Lee Cohen, Avrim Blum, Yishay Mansour, Aadirupa Saha, and Matthew R. Walter. "Eliciting User Preferences for Personalized Multi-Objective Decision Making through Comparative Feedback." Preprint submitted on February 7, 2023. arXiv:2302.03805.

Shi, Freda, Daniel Fried, Marjan Ghazvininejad, Luke Zettlemoyer, and Sida I. Wang. "Natural Language to Code Translation with Execution." Paper presented at Conference on Empirical Methods in Natural Language Processing (EMNLP), Abu Dhabi, December 2022.

Fried, Daniel, Armen Aghajanyan, Jessy Lin, Sida Wang, Eric Wallace, **Freda Shi**, Ruiqi Zhong, Wen-tau Yih, Luke Zettlemoyer, and Mike Lewis. "nCoder: A Generative Model for Code Infilling and Synthesis." Paper presented at the International Conference on Learning Representations (ICLR), Kigali, Rwanda, May 2023.

Shi, Freda, Mirac Suzgun, Markus Freitag, Xuezhi Wang, Suraj Srivats, Soroush Vosoughi, Hyung Won Chung, Yi Tay, Sebastian Ruder, Denny Zhou, Dipanjan Das, and Jason Wei. "Language Models are Multilingual Chain-of-Thought Reasoners." Paper presented at the International Conference on Learning Representations (ICLR), Kigali, Rwanda, May 2023.

Chen, Bo, **Ziwei Xie**, Jinbo Xu, Jiezhong Qiu, Zhaofeng Ye, and Jie Tang. "Improve the Protein Complex Prediction with Protein Language Models." Preprint submitted on September 17, 2022. doi:10.1101/2022.09.15.508065.

Student Admissions and Student Body Growth

In the fall of 2004, TTIC matriculated its first three students. The 2022-23 academic year saw 42 students enrolled in the Ph.D. program, 6 who enrolled as first time new students this year.

Admissions Year (Fall)	Total Applicants	Applicants Admitted	Enrolled next Fall
2023	187	20	*3 planned*
2022	205	17	5+1*
2021	227	17	5
2020	229	26	4
2019	225	27	9
2018	207	26	8
2017	135	23	8
2016	123	23	4
2015	90	22	9
2014	83	6	2

*Indicates a non-fall program start

Investment Pool Performance

TTIC's diversified yet conservative investment pool is designed to weather challenging economic events. In November 2022, the Board of Trustees approved further diversification of the investment portfolio with changes expected to increase 10-year real return from 3.8% to 4.29%. This reallocation, beginning in December 2022, was planned to occur over 12-monthly tranches to capture the benefits of dollar cost averaging in a volatile market environment. The reallocation increases the allocations to Public Equity, Private Debt, and Infrastructure by reducing the Core Fixed Income and Return Seeking Fixed Income allocations. The reallocation was on-target as of the month ending June 30, 2023.

The investment pool returned 2.5% for the year ended June 30, 2023, and 1.4% since inception, which is March 2021.

Operating Results

In fiscal year ending June 30, 2023, 24% of TTIC's operating revenue was derived from external grants, which was less than anticipated by approximately $900,000. Except for tuition paid by the University of Chicago, the remainder of TTIC's operating revenue is the board-approved distribution of investment return, which was $9.5M. Overall, operating revenue of $11.8M fell short of the budgeted $12.7M due to the grant revenue.

Expenses were also lower than budget due to less hiring and less grant spending than anticipated. Overall, TTIC ended the fiscal year operations at approximately budgeted level of slight surplus.

TTIC is fortunate to be in a strong financial position with approximately $67M in unrestricted financial assets, $57M of which represents assets with liquidity available within one year.

In conclusion, I would like to thank the TTIC administrative staff for their hard work and commitment to TTIC's continued success.

Jessica Jacobson
Chief Financial Officer

Financial Reports

Independent auditing agency:
Crowe LLP | crowe.com

Statement of Financial Position

June 30, 2022 and 2023

	2023	2022
ASSETS		
Current assets:		
Cash and cash equivalents	$ 2,890,200	$ 1,855,617
Receivables:		
Miscellaneous receivable	116,035	377,276
Grants receivable	557,462	804,604
Due from TTI (Note 9)	1,255	1,332
Interest receivable	245,154	43,643
Investment distribution receivable	-	6,025,762
Prepaid expenses and other current assets	75,380	86,243
Total current assets	3,885,486	9,194,477
Investments	264,339,349	260,590,725
Operating lease right-of-use asset (Note 7)	10,176,366	-
Furniture and equipment, net (Note 4)	5,045,085	5,623,151
Total assets	$ 283,446,286	$ 275,408,353
LIABILITIES AND NET ASSETS		
Current liabilities:		
Accounts payable	$ 357,129	$ 100,474
Accrued expenses	743,772	743,081
Operating lease liability, current (Note 7)	909,917	-
Total current liabilities	2,010,818	843,555
Operating lease liability, non-current (Note 7)	9,518,693	-
Other long-term liabilities	-	265,415
Total non-current liabilities	9,518,693	265,415
Total liabilities	11,529,511	1,108,970
Net assets:		
Without donor restrictions	66,926,774	67,256,617
With donor restrictions	204,990,001	207,042,766
Total net assets	271,916,775	274,299,383
Total liabilities and net assets	$ 283,446,286	$ 275,408,353

Statement of Activities and Changes in Net Assets

June 30, 2022 and 2023

| | 2023 | | | 2022 | | |
	Without Donor Restrictions	With Donor Restrictions	Total	Without Donor Restrictions	With Donor Restrictions	Total
Revenues, gains and other support						
Student tuition and fees, less Scholarships of $1,145,000 and $1,207,500, in 2023 and 2022, respectively	$ 37,666	$ -	$ 37,666	$ 21,231	$ -	$ 21,231
Federal grants and contracts	3,580,172	-	3,580,172	3,026,997	-	3,026,997
Other income	4,260	-	4,260	10,998	-	10,998
Net realized and unrealized gains (losses) on investments	1,275,582	3,146,461	4,422,043	(5,022,930)	(13,798,600)	(18,821,530)
Investment income (loss) – net of investment fees	108,742	1,898,602	2,007,344	(260,071)	1,174,254	914,183
Net assets released from restrictions	7,097,828	(7,097,828)	-	6,350,688	(6,350,688)	-
Total revenue, gains (losses), and other support	12,104,250	(2,052,765)	10,051,485	4,126,913	(18,975,034)	(14,848,121)
Expenses						
Education and research expenses – instruction	9,423,480	-	9,423,480	8,843,646	-	8,843,646
Management and general expenses – institutional support	3,010,613	-	3,010,613	2,744,534	-	2,744,534
Total expenses	12,434,093	-	12,434,093	11,588,180	-	11,588,180
Changes in net assets	(329,843)	(2,052,765)	(2,382,608)	(7,461,267)	(18,975,034)	(26,436,301)
Net assets at beginning of year	67,256,617	207,042,766	274,299,383	74,717,884	226,017,800	300,735,684
Net assets at end of year	$ 66,926,774	$ 204,990,001	$ 271,916,775	$ 67,256,617	$ 207,042,766	$ 274,299,383

Interns and Visiting Scholars

TTIC maintains a steady number of interns and visiting scholars who engage in study and research on the premises. Summer 2023 had 27 visiting scholars from the U.S. and abroad who came to the Institute to work on research projects in collaboration with TTIC faculty and students.

Short-term visiting scholars bring interest, energy, and enthusiasm to our academic community, and allow TTIC students access to a broad range of specialties that outside researchers bring with them, along with ideas and culture brought from the visitors' home institutions.

Visiting scholars are listed below (faculty hosts in parentheses):

Songcheng Cai (Karen Livescu, Hongyuan Mei)

Betsy Gonzalez, ChiS&E (Matt Walter)

Asher Grossman, Computer Science Summerlink Program (Matt Walter)

Davide Iafrate (Matt Walter)

Rhea Jain (Julia Chuzhoy, Ohad Trabelsi)

Justin Jung, University of Chicago (Matt Walter)

Tina Khajeh, University of Illinois Chicago (Derek Reiman)

Peng Li, Fudan University (Hongyuan Mei, Matt Walter)

Yanhong Li, University of Chicago (David McAllester)

Roy Long, University of Chicago (Avrim Blum, Saeed Sharifi-Malvajerdi)

Peter Manohar, Carnegie Mellon University (Madhur Tulsiani, Yury Makarychev, Siddharth Bhandari)

Tushant Mittal, University of Chicago (Madhur Tulsiani)

Takeru Oba, Toyota Technological Institute, Japan (Matt Walter)

Madhusudhan Pittu, Carnegie Mellon University (Ali Vakilian, Julia Chuzhoy, Yury Makarychev)

Emma Quansah, ChiS&E (Matt Walter)

Alea Ritchie (Matt Walter)

Benjamin Stoddart, University of Michigan (Matt Walter)

Dylan Sumaya Lobo, ChiS&E (Matt Walter)

Luzhe Sun, University of Chicago (Matt Walter)

Xiangshan Tan (Matt Walter)

Daksh Vermareddy, ChiS&E (Matt Walter)

Jiamin Yang, University of Chicago (Kartik Goyal)

Hongyu Zhao, University of Chicago (Hongyuan Mei)

Shester Gueuwou, (Karen Livescu, Greg Shakhnarovich)

Vaidehi Srinivas, Northwestern University (Avrim Blum)

Kirij Salij, Carleton College (Matthew Turk)
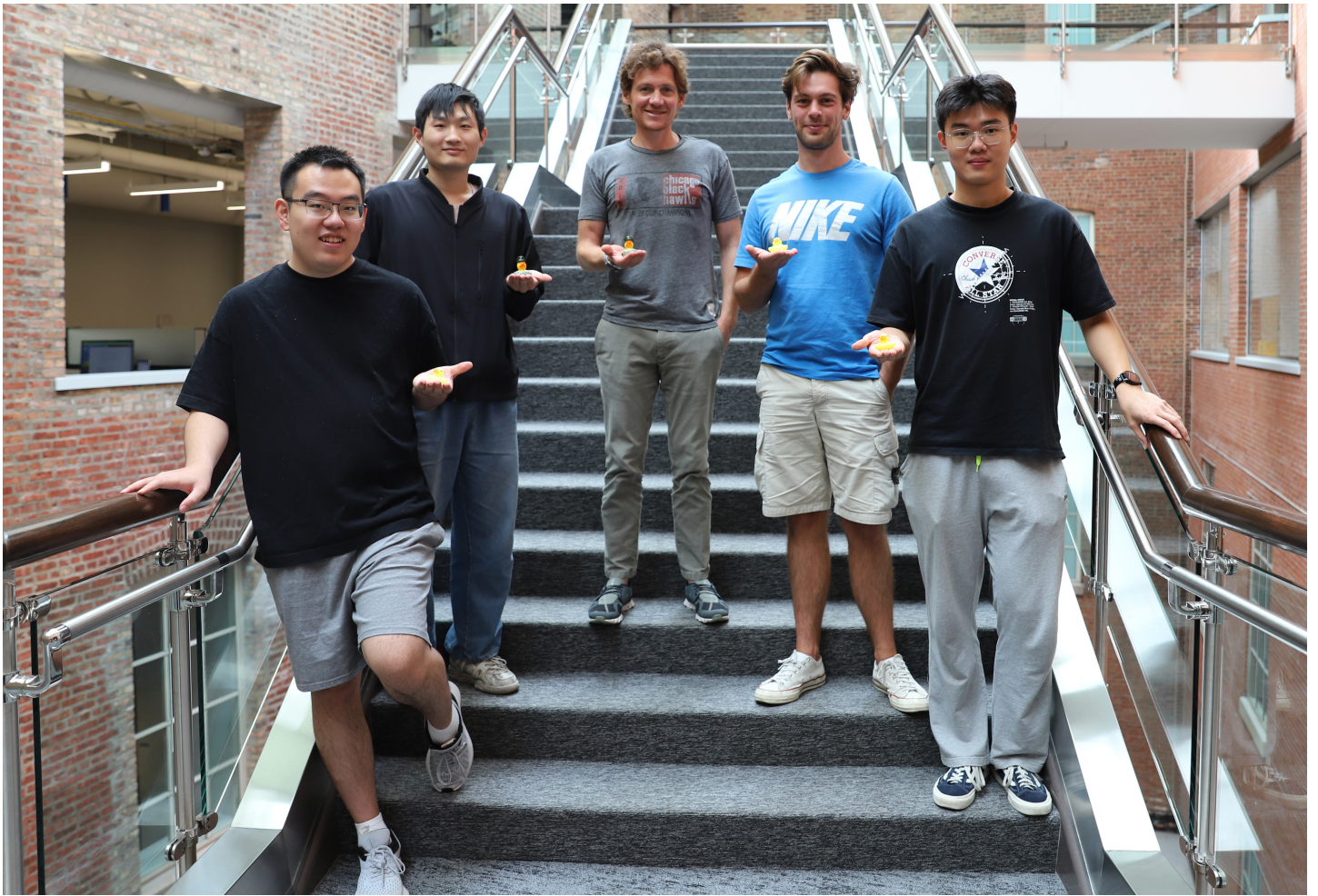
Constituent & Community Outreach

Promoting Diversity, Equity and Inclusion

The Diversity, Equity, and Inclusion (DEI) Committee at TTIC was first created in August 2020 to seek out new opportunities to educate students, faculty, and staff and make TTIC a more inclusive and welcoming place. The Committee is composed of students, faculty, and staff members, and welcomes feedback and participation from all members of the TTIC community.

The Committee has been discussing and actively exploring new avenues for outreach and for support for groups underrepresented in computing. TTIC is partnered with Duckietown and the Chicago Pre-College Science and Engineering Program (ChiS&E). Student volunteers facilitate general computer science and Girls Who Code sessions at various sites, and TTIC supports two successful computer science clubs meeting weekly with regular attendance at Kenwood Academy and the Bessie Coleman branch of the Chicago Public Library.

The Committee is also committed to more transparency in its communications to the TTIC community and has established a goal of more regular internal communications as well as updating the institute website and external communications to reflect our comment to our values in diversity, equity and inclusion in our recruiting, hiring, and admissions practices. These pages are currently under revision.

The DEI Committee has been contending with questions of further actions we can take to bolster our commitment to DEI values within the TTIC community. To this end, we have been learning from courses, surveys, and discussions, and we are currently drafting a common purpose statement that will help us and the community establish an ongoing list of top priorities to focus on, and attend to recommendations and actions that will have significant impact.

In April 2023, the DEI Committee sent a document outlining the list of recommendations to President Matthew Turk, which was discussed at the November 2023 meeting of the Board of Trustees.

Committee Members:
- Rose Bradford, Administrator (co-chair)
- Greg Shakhnarovich, Faculty (co-chair)
- Matthew Walter, Faculty
- Celeste Ki, Administrator
- Deree Kobets, Administrator
- Kavya Ravichandran, Student

Women at TTIC Group

TTIC supports a Women at TTIC group, which is a group of women faculty, research assistant professors, courtesy faculty, and Ph.D. students at TTIC, to provide opportunities for increased interaction and support among women faculty and students. Quarterly meet-ups have been a tradition where the group members have hearty conversations over lunch. This tradition has continued in remote settings during the past year with fun meet-ups including virtual games of Balderdash and Escape-Room. Beyond the usual tradition, the group also occasionally holds joint student events with University of Chicago Grad Women in Computer Science (GWiCS) which enables more interdepartmental interaction.

TTIC Internship Program

TTIC runs a robust intern/visiting scholar program, with typically 10-25 students from universities around the world spending an academic quarter or more working with faculty and students. This program creates new research and collaboration opportunities and provides valuable research experience for the participating undergraduate and graduate students.

TTIC provides matching funds for faculty to employ summer interns from underrepresented minority populations, which was new to the program starting this year.

Institute Donation to Turkey

On February 6, 2023, a 7.8 earthquake struck southern and central Turkey and northern and western Syria. It was one of the strongest earthquakes ever recorded in the Levant and of the past century, with an estimated 14 million people affected.

UNICEF, originally called the United Nations International Children's Emergency Fund in full, now officially United Nations Children's Fund, is an agency of the United Nations responsible for providing humanitarian and developmental aid to children worldwide.

TTIC employees donated $1,060 and TTIC donated an additional $860 for a total gift to UNICEF of $1,920.

TTIC Youth and Community Partnerships

TTIC Manager of Research Administration, Ms. Rose Bradford, has initiated and supports new programs of Girls Who Code, which is an after-school coding program for elementary school girls, by providing or arranging facilitation, lessons, and presentations. TTIC has worked with various area Chicago Public Schools (CPS) including Kenwood Academy, Carnegie Elementary, and Hyde Park Academy and is continuing in its role as Community Partner.

TTIC became community partners with the Bessie Coleman Library to sponsor a 3rd-8th grade Coding Club for boys and girls including a showcase at the University of Chicago Weston Game Lab.

Chicago Pre-College Science and Engineering Program (ChiS&E) is a weekend program for Chicago Public School students underrepresented in STEM fields. Professor Matt Walter and TTIC worked with ChiS&E to develop a Duckiebot-based high school robotics course for Chicago-area students for fall of 2022. Many of the students from this group are traditionally underrepresented in robotics and STEM.

Professor Madhur Tulsiani co-organized the "New Horizons in Theoretical Computer Science" workshop, which took place on June 12-16, 2023, and is an annual week-long online summer school aiming to expose under-represented undergraduates in theoretical computer science to exciting research areas in the area of theoretical computer science and its applications. The workshop contained several mini-courses from top researchers in the field, was free of charge, held remotely, and applications from undergraduates majoring in computer science or related fields who are considered under-represented in the field were encouraged to attend.

Board of Trustees

In Memoriam of Mark Hogan

TTIC is deeply saddened to share the news that Mr. Mark Hogan, former Trustee (2013-2015) and Advisor to the Board (2015-2023), passed away on April 16, 2023, at 71 years old. Mr. Hogan was born on May 15, 1951.

Mr. Hogan received a BA from the University of Illinois at Urbana-Champaign in Business Administration/Management, served as the university's football manager, and then earned his MBA from Harvard University.

A former General Motors executive, Mr. Hogan served as a Toyota Motor Corporation Board Member and as President of Dewey Investments LLC prior to his passing. Mr. Hogan also held a variety of management and executive positions, including serving as the President and CEO of Vehicle Production Group LLC, and as President of Magna International.

We are grateful to Mr. Hogan for his professional leadership, partnership, wisdom, and friendship.

Leadership

Matthew Turk, President
Avrim Blum, Chief Academic Officer
Chrissy Coleman, Secretary of the Institute
Jessica Jacobson, Chief Financial Officer

Administration

Adam Bohlander, Director of Information Technology
Rose Bradford, Manager of Research Administration
Erica Cocom, Student Services and Admissions Administrator
Chrissy Coleman, Administrative Director of Graduate Studies and Publications, Accreditation Liaison Officer,
    Deputy Title IX Coordinator
Jessica Jacobson, Chief Financial Officer and Director of Operations
Michelle Jardine, Office Manager
Brandie Jones, Administrative Assistant to Faculty
Celeste Ki, Communications Coordinator
Deree Kobets, Controller
Mary Marre, Administrative Assistant to Faculty
Amy Minick, Director of Human Resources and International Affairs, Title IX Coordinator

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Non-Discrimination Statement

TTIC is committed to providing a respectful and positive environment for all members of its community, free from all forms of discrimination and harassment.

Special Thanks

External Advisory Committee
William T. Freeman, Thomas and Gerd Perkins Professor of Electrical Engineering and Computer Science, Massachusetts Institute of Technology
Richard Karp, Founding Director, Simons Institute for the Theory of Computing, University of California Berkeley
Takeo Kanade, UA and Helen Whitaker University Professor, Robotics Institute, Carnegie Mellon University
Éva Tardos, Jacob Gould Schurman Professor of Computer Science, Cornell University

The professionals at the Higher Learning Commission

Toyota Motor Corporation

Toyota Technological Institute (Nagoya, Japan)

University of Chicago greater community
Booth School of Business
Department of Computer Science
Department of Mathematics
Department of Statistics
English Language Institute
Faculty and Administration of the Division of Physical Sciences
Office of the Bursar
Office of International Affairs
Office of Investments
Office of the Provost
Office of the Registrar
Staff of the Regenstein and Eckhart Libraries
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University Research Administration
University IT Services
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