Ali Vakilian

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Research Interests

- Fairness of Algorithms and Machine Learning
- Learning-Augmented Algorithms, Algorithms with Predictions
- Algorithms for Massive Data
- Learning in the Presence of Strategic Agents
- Approximation Algorithms and Combinatorial Optimization

Academic Positions

- **Toyota Technological Institute at Chicago**. . . . . 9/2022 – present
  Research Assistant Professor.
- **Toyota Technological Institute at Chicago**, IDEAL Institute . . . . . 9/2020 – 9/2022
  Postdoctoral Researcher hosted by Yury Makarychev and Nathan Srebro.
- **University of Wisconsin–Madison** . . . . . 9/2019 – 9/2020
  Postdoctoral Researcher hosted by Ilias Diakonikolas.

Education

- **Massachusetts Institute of Technology (MIT)** . . . . . 9/2013 – 9/2019
  Ph.D. in Computer Science, CSAIL
  Thesis Title: *New Directions in Streaming Algorithms*
  Advisors: Erik Demaine and Piotr Indyk
- **University of Illinois at Urbana-Champaign (UIUC)** . . . . . 9/2011 – 9/2013
  M.S. in Computer Science
  Thesis Title: *Prize-Collecting Survivable Network Design Problem in Node-Weighted Graphs*
  Advisor: Chandra Chekuri
- **Sharif University of Technology** . . . . . 9/2007 – 6/2011
  B.S. in Computer Engineering

Working Papers

45. **Bayesian Strategic Classification**
with Lee Cohen, Saeed Sharifi-Malvajerdi, Kevin Stangl and Juba Ziani. *May 2024*

44. **A Polynomial-Time Approximation for Pairwise Fair k-Median Clustering**
with Sayan Bandyapadhyay, Eden Chlamtáč and Yury Makarychev. *May 2024*

43. **On Socially Fair Regression and Low-Rank Approximation**
with Zhao Song, David Woodruff and Samson Zhou. *May 2024*

Conference Publications

42. **Streaming Algorithms for Connectivity Augmentation** ICALP 2024
with Ce Jin, Michael Kapralov and Sepideh Mahabadi.
Proceedings of *39th International Colloquium on Automata, Languages, and Programming.*

41. **Learning-Based Algorithms for Graph Searching Problems** AISTATS 2024
with Adela DePavia and Erasmo Tani.
Proceedings of *International Conference on Artificial Intelligence and Statistics. PMLR.*
    - **Selected as an oral paper.**
    - **Recipient of Outstanding Student Paper Highlight award.**

40. **Scalable Algorithms for Individual Preference Stable Clustering** AISTATS 2024
with Ron Mosenzon.
Proceedings of *International Conference on Artificial Intelligence and Statistics. PMLR.*

39. **Improved Frequency Estimation Algorithms with and without Predictions** NeurIPS 2023
with Anders Aamand, Justin Chen, Huy Nguyen and Sandeep Silwal.
Proceedings of *Advances in Neural Information Processing Systems.*
    - **Selected as a spotlight paper.**

38. **A Constant-Factor Approximation for Individual Preference Stable Clustering** NeurIPS 2023
with Anders Aamand, Justin Chen, Allen Liu, Sandeep Silwal, Pattara Sukprasert and Fred Zhang.
Proceedings of *Advances in Neural Information Processing Systems.*
    - **Selected as a spotlight paper.**

37. **Tight Bounds for Volumetric Spanners and Applications** NeurIPS 2023
with Aditya Bhaskara and Sepideh Mahabadi.
Proceedings of *Advances in Neural Information Processing Systems.*

36. **Approximating Red-Blue Set Cover** APPROX 2023
with Eden Chlamtáč and Yury Makarychev.
Proceedings of *Approximation, Randomization, and Combinatorial Optimization.*

35. **Sequential Strategic Screening** ICML 2023
with Lee Cohen, Saeed Sharifi-Malvajerdi, Kevin Stangl and Juba Ziani.
Proceedings of *International Conference on Machine Learning (pp. 6279-6295). PMLR.*

34. **Approximation Algorithms for Fair Range Clustering** ..... ICML 2023
with Sedjro S. Hotegni and Sepideh Mahabadi.
Proceedings of *International Conference on Machine Learning (pp. 13270-13284). PMLR.*

33. **Learning the Positions in CountSketch** ..... ICLR 2023
with Yi Li, Honghao Lin, Simin Liu and David Woodruff.
Proceedings of *the Eleventh International Conference on Learning Representations.*
  - **Selected as a Notable-top-25% paper.**

32. **Faster Fundamental Graph Algorithms via Learned Predictions** ..... ICML 2022
with Justin Chen, Sandeep Silwal and Fred Zhang.
Proceedings of *International Conference on Machine Learning (pp. 3583-3602). PMLR.*

31. **Individual Preference Stability for Clustering** ..... ICML 2022
with Saba Ahmadi, Pranjal Awasthi, Samir Khuller, Matthäus Kleindessner, Jamie Morgenstern and Pattara Sukprasert.
Proceedings of *International Conference on Machine Learning (pp. 197-246). PMLR.*
  - **Selected for a long presentation.**

30. **Multi Stage Screening: Enforcing Fairness and Maximizing Efficiency in a Pre-Existing Pipeline** FAccT 2022
with Avrim Blum and Kevin Stangl.
Proceedings of *the 2022 ACM Conference on Fairness, Accountability, and Transparency (pp. 1178-1193)*

29. **Fair Representation Clustering with Several Protected Classes** ..... FAccT 2022
with Zhen Dai and Yury Makarychev.
Proceedings of *the 2022 ACM Conference on Fairness, Accountability, and Transparency (pp. 814-823)*

28. **Improved Approximation Algorithms for Individually Fair Clustering** ..... AISTATS 2022
with Mustafa Yalçıner.
Proceedings of *International Conference on Artificial Intelligence and Statistics (pp. 8758-8779). PMLR.*

27. **Approximating Fair Clustering with Cascaded Norm Objectives** ..... SODA 2022
with Eden Chlamtáč and Yury Makarychev.
Proceedings of *the ACM-SIAM Symposium on Discrete Algorithms (pp. 2664-2683).*

26. **Approximation Algorithms for Socially Fair Clustering** ..... COLT 2021
with Yury Makarychev.
Proceedings of *Conference on Learning Theory (pp. 3246-3264). PMLR.*

25. **Learning Online Algorithms with Distributional Advice** ..... ICML 2021
with Ilias Diakonikolas, Vasilis Kontonis, Christos Tzamos and Nikos Zarifis.
Proceedings of *International Conference on Machine Learning (pp. 2687-2696). PMLR.*

24. **Individual Fairness for k-Clustering** ..... ICML 2020
with Sepideh Mahabadi.
Proceedings of *International Conference on Machine Learning (pp. 6586-6596). PMLR.*

23. **Improved Local Computation Algorithm for Set Cover via Sparsification** ..... SODA 2020
with Christoph Grunau, Slobodan Mitrović and Ronitt Rubinfeld.
Proceedings of *the ACM-SIAM Symposium on Discrete Algorithms (pp. 2993-3011).*

22. **Learning-Based Low-Rank Approximations** ..... NeurIPS 2019
with Piotr Indyk and Yang Yuan.
Proceedings of *Advances in Neural Information Processing Systems (pp. 7402-7412).*

21. **Structural Rounding: Approximation Algorithms for Graphs Near an Algorithmically Tractable Class** ..... ESA 2019
with Erik Demaine, Timothy Goodrich, Kyle Kloster, Brian Lavallee, Quanquan Liu, Blair Sulivan and Andrew van der Poel.
Proceedings of *European Symposium on Algorithms.*

20. **Tight Tradeoffs for Maximum k-Coverage Problem in the General Streaming Model** .... PODS 2019
with Piotr Indyk.
Proceedings of *the ACM SIGMOD-SIGACT-SIGAI Symposium on Principles of Database Systems (pp. 200-217).*

19. **Sample-Optimal Low-Rank Approximation of Distance Matrices** ..... COLT 2019
with Piotr Indyk, Tal Wagner and David Woodruff.
Proceedings of *Conference on Learning Theory (pp. 1723-1751). PMLR.*

18. **Scalable Fair Clustering** ..... ICML 2019
with Arturs Backurs, Piotr Indyk, Krzysztof Onak, Baruch Schieber and Tal Wagner.
Proceedings of *International Conference on Machine Learning (pp. 405-413). PMLR.*

17. **Learning-Based Frequency Estimation Algorithms** ..... ICLR 2019
with Chen-Yu Hsu, Piotr Indyk and Dina Katabi.
Proceedings of *the Seventh International Conference on Learning Representations.*

16. **Local Computation Algorithms for Spanners** ..... ITCS 2019
with Merav Parter, Ronitt Rubinfeld and Anak Yodpinyanee.
Proceedings of *10th Innovations in Theoretical Computer Science Conference.*

15. **Set Cover in Sub-linear Time** ..... SODA 2018
with Piotr Indyk, Sepideh Mahabadi, Ronitt Rubinfeld and Anak Yodpinyanee.
Proceedings of *the ACM-SIAM Symposium on Discrete Algorithms (pp. 2467-2486).*

14. **Fractional Set Cover in the Streaming Model** ..... APPROX 2017
with Piotr Indyk, Sepideh Mahabadi, Ronitt Rubinfeld, Jonathan Ullman and Anak Yodpinyanee.
Proceedings of *Approximation, Randomization, and Combinatorial Optimization.*

13. **Cost-Effective Conceptual Design Over Taxonomies** ..... WebDB 2017
with Yodsawalai Chodpathumwan, Arash Termehchy and Amir Nayyeri.
Proceedings of *the 20th International Workshop on the Web and Databases (pp. 35-40).*

12. **Towards Tight Bounds for the Streaming Set Cover Problem** ..... PODS 2016
with Sariel Har-Peled, Piotr Indyk and Sepideh Mahabadi.
Proceedings of *the 35th ACM SIGMOD-SIGACT-SIGAI Symposium on Principles of Database Systems (pp. 371-383).*

11. **On Streaming and Communication Complexity of the Set Cover Problem** ..... DISC 2014
with Erik Demaine, Piotr Indyk and Sepideh Mahabadi.
Proceedings of *28th International Symposium on Distributed Computing (pp. 484-498). Springer Berlin Heidelberg.*

10. **Which Concepts Are Worth Extracting?** ..... SIGMOD 2014

with Arash Termehchy, Yodsawalai Chodpathumwan and Marianne Winslett.
Proceedings of *the ACM SIGMOD International Conference on Management of Data (pp. 779-790).*

9. **Improved Approximation Algorithms for Degree-Bounded Network Design Problems with Node Connectivity Requirements** ..... STOC 2014
with Alina Ene.
Proceedings of *the 46th ACM Symposium on Theory of Computing (pp. 754-763).*

8. **Prize-Collecting Survivable Network Design in Node-Weighted Graphs** ..... APPROX 2012
with Chandra Chekuri and Alina Ene.
Proceedings of *International Workshop on Approximation Algorithms for Combinatorial Optimization (pp. 98-109). Springer Berlin Heidelberg.*

7. **Node-Weighted Network Design in Planar and Minor-Closed Families of Graphs** ..... ICALP 2012
with Chandra Chekuri and Alina Ene.
Proceedings of *39th International Colloquium on Automata, Languages, and Programming (pp. 206-217).*

Manuscripts

6. **(Learned) Frequency Estimation Algorithms under Zipfian Distribution** .....
with Anders Aamand and Piotr Indyk. *February 2020.*

5. **Approximation Algorithms for Nearly H-Minor-Free Graphs** .....
with Erik Demaine and Quanquan Liu. *November 2018.*

4. **Connected Domatic Packing Node-Capacitated Graphs** .....
with Alina Ene and Nitish Korula. *July 2013.*

Journal Publications

3. **Node-Weighted Network Design in Planar and Minor-Closed Families of Graphs** ..... TALG 2021
with Chandra Chekuri and Alina Ene.
ACM Transactions on Algorithms (TALG), 17(2), 1-25.

2. **Cost-Effective Conceptual Design Using Taxonomies** ..... VLDB 2018
with Yodsawalai Chodpathumwan, Arash Termehchy and Amir Nayyeri.
The VLDB Journal, 27(3), 369-394.

1. **Cost-Effective Database Design For Information Extraction Applications** ..... TODS 2015
with Arash Termehchy, Yodsawalai Chodpathumwan and Marianne Winslett.
ACM Transactions on Database Systems (TODS), 40(2), 1-39.

Mentoring

- **Interns at TTIC**
  - Madhusudhan Pittu ..... Summer 2023
    PhD student at CMU

- Erasmo Tani ..... Summer 2023
  PhD student at University of Chicago

- **Fatima Fellows**
  The Fatima Fellow program (fatimafellowship.com) *is an initiative aimed at increasing representation of students from marginalized communities in graduate schools throughout North America and Europe.*
  - Sedjro Hotegni ..... 5/2022 – 2/2023
    MS student at African Institute for Mathematical Sciences-Rwanda

- **PhD Thesis Committee Members**
  - Kevin Stangl ..... Spring 2024
    PhD student at TTIC
  - Erasmo Tani ..... Spring 2024
    PhD student at University of Chicago
  - Thy Nguyen ..... Spring 2024
    PhD student at Northeastern University
  - Zhen Dai ..... Spring 2023
    PhD student at University of Chicago

Teaching

- **Instructor at TTIC/University of Chicago:**

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

- Teaching Assistant at MIT:

  Introduction to Algorithms (6.006) ..... Spring 2017

  Introduction to Algorithms (6.006) ..... Fall 2016

  Advanced Algorithms (6.854) ..... Spring 2016

Awards and Honors

- Recipient of **ETH Zurich Fellowship** 2019
- **Siebel Scholar** 2013
  Awarded annually to 85 top students from the world's leading graduate schools.
  Siebel Scholar is the largest award offered by the College of Engineering at UIUC.
- **3rd highest** GPA among all computer engineering students of class 2011 (+150 students) .....
- **Outstanding Student Award** 2008
  Sharif University of Technology
- Ranked **38th** in the annual nationwide universities entrance exam in Iran 2007
  Among 300,000+ participants

Professional Service

- **Program Committees**

  Program Committee Member ..... ICALP 2024

  Program Committee Member ..... PODS 2022

  Area Chair ..... AISTATS 2024 & 2023

  Junior Program Committee Member ..... COLT 2024

  Junior Program Committee Member ..... ALT 2023 & 2022

- **Workshop Organization**

  Summer Workshop on "**Learning-Augmented Algorithms**" at TTIC ..... August 2024

  SoCG'23 Workshop on "**Recent Developments in Geometric Clustering**" ..... June 2023

  Chicago Junior Theorists Workshop at Northwestern University and TTIC ..... January 2023

  STOC Workshop on "**Algorithms with Predictions**", Virtual ..... June 2020

  Summer Workshop on "**Learning-Based Algorithms**" at TTIC ..... August 2019

- **Reviewer**
  - STOC, FOCS, SODA, ITCS, ICALP, APPROX, RANDOM, PODS, DISC, ESA, STACS, KDD and WG
  - ICML, NeurIPS, ICLR, AISTATS and COLT
  - JACM, TALG, SICOMP, Algorithmica, JCSS and IJCAI

Research Internships and Visits

Simons Institute, Berkeley ..... Fall 2023
Data Structures and Optimization for Fast Algorithms Program.

TTI, Chicago ..... Summer 2017
Mentored by Julia Chuzhoy.

Google Research, NYC ..... Summer 2015
Mentored by Silvio Lattanzi and Morteza Zadimoghaddam.

Recent Invited Talks

- **Algorithms for Socially Fair Clustering: Min-Max Fairness to Cascaded Norms**

  MIT, A&C Seminar 12/6/2023

  UW Seattle, Theory Seminar 11/14/2023

  INFORMS Annual Meeting 10/15/2023

  UT Austin, Theory Seminar 10/6/2023

  Stanford University, Algorithmic Fairness Seminar 10/2/2023

- **Learning-Augmented Algorithms for Massive Data**

  INFORMS Annual Meeting 10/18/2023

- **Tight Bounds for Volumetric Spanners in All Norms**

  Simons Institute at Berkeley, Sketching and Algorithm Design Workshop 10/11/2023

- **Individual Preference Stability for Clustering**

  TRIPODS Postdoc Workshop 8/22/2023

  Research at TTIC 2/24/2023

- **Graph Algorithms with Learned Duals**

  "Scheduling" Seminar at Schloss Dagstuhl 2/9/2023

- **Learning Online Algorithms with Distributional Advice**

  Algorithms Under Uncertainty Workshop at FSTTCS'22, IIT Madras 12/6/2022

- **Algorithm Design in the Machine Learning Era**

  Research at TTIC 5/13/2022

- **Individually Fair Clustering**

  IDEAL Workshop on Clustering 4/23/2022

- **Approximation Algorithms for Fair Clustering**

  University of Wisconsin—Madison, IFDS 6/10/2021

  UC San Diego, Department of Computer Science & Engineering 5/17/2021

  UWaterloo, Combinatoics & Optimization Department 5/17/2021

  MIT A&C Seminar 5/10/2021

  TOC4Fairness Seminar 4/28/2021

  Joint Purdue University and University of Michigan Theory Seminar 4/23/2021

  University of Washington, Department of Computer Science 4/20/2021

  UIUC, Department of Computer Science 4/19/2021

  Google Research 4/15/2021

- **Learning-based Algorithms For Massive Data**

  INFORMS Annual Meeting 11/10/2020