Uthsav Chitra

Eric and Wendy Schmidt Center, Broad Institute of MIT and Harvard

https://uthsavc.github.io

Academic positions

Johns Hopkins University *Starting July 2025*
Assistant Professor, Department of Computer Science

Broad Institute of MIT and Harvard *July 2024 - present*
Postdoctoral fellow, Eric and Wendy Schmidt Center

Education

Princeton University, Princeton, New Jersey *Sept 2018 - May 2024*
Ph.D., Computer Science

Brown University, Providence, Rhode Island *Sept 2013 - May 2017*
Sc.B. Mathematics, A.B. Computer Science, A.B. Applied Math GPA: 4.0/4.0

Research Interests

Computational genomics, machine learning, spatial biology, graphs and networks, genetic interactions.

Publications

** denotes joint first authorship, † denotes joint corresponding authorship.*

Decoding the causal drivers of spatial cellular topology.
Prannav Shankar, Huan Liang, **Uthsav Chitra†**, Rohit Singh†.
Accepted to *RECOMB-seq 2025*.

Anomaly Detection in Spatial Transcriptomics via Spatially Localized Density Comparison.
Gary Hu, Julian Gold, **Uthsav Chitra**, Sunay Joshi, Benjamin J. Raphael.
Accepted to *ISMB 2025*.

GASTON-Mix: a unified model of spatial gradients and domains using spatial mixture-of-experts.
Uthsav Chitra, Shu Dan, Fenna Krienen, Benjamin J. Raphael.
Accepted to *ISMB 2025*.

Spatial metabolic gradients in the liver and small intestine.
Laith Samarah, Clover Zheng, Xi Xing, Won Dong Lee, Amichay Afriat, **Uthsav Chitra**, Michael MacArthur, Wenyun Lu, Connor Jankowski, Cong Ma, Craig Hunter, Benjamin J. Raphael, Joshua Rabinowitz.
In review at *Nature*.

Mapping the topography of spatial gene expression with interpretable deep learning.
Uthsav Chitra, Brian J. Arnold, Hirak Sarkar, Cong Ma, Sereno Lopez-Darwin, Kohei Sanno, Benjamin J. Raphael.
Nature Methods (2025). Accepted to *RECOMB 2024*.

Resolving discrepancies between chimeric and multiplicative measures of higher-order epistasis.
Uthsav Chitra*, Brian J. Arnold*, Benjamin J. Raphael.
Nature Communications (2025).

A latent variable model for evaluating mutual exclusivity between driver mutations in cancer.
Ahmed Shuaibi*, **Uthsav Chitra***, Benjamin J. Raphael.
In preparation.
RECOMB Satellite Workshop on Computational Cancer Biology (RECOMB-CCB), 2024. **Best Paper Award**.

A count-based model for delineating cell-cell interactions in spatial transcriptomics data.

Hirak Sarkar*, **Uthsav Chitra***, Julian Gold, Benjamin J. Raphael.
Bioinformatics (2024). Accepted to *ISMB 2024*.

Belayer: Modeling discrete and continuous spatial variation in gene expression from spatially resolved transcriptomics.
Cong Ma*, **Uthsav Chitra***, Shirley Zhang, Benjamin J. Raphael.
Cell Systems (2022). Accepted to *RECOMB 2022*.

NetMix2: Unifying network propagation and altered subnetworks.
Uthsav Chitra*, Tae Yoon Park*, Benjamin J. Raphael.
Journal of Computational Biology (2022). Accepted to *RECOMB 2022*.

Quantifying and Reducing Bias in Maximum Likelihood Estimation of Structured Anomalies.
Uthsav Chitra, Kimberly Ding, Jasper C. H. Lee, Benjamin J. Raphael.
International Conference on Machine Learning (ICML) 2021.

NetMix: A network-structured mixture model for reduced-bias estimation of altered subnetworks.
Matthew A Reyna*, **Uthsav Chitra***, Rebecca Elyanow, Benjamin J. Raphael.
Journal of Computational Biology (2021). Accepted to *RECOMB 2020*.

Analyzing the Impact of Filter Bubbles on Social Network Polarization.
Uthsav Chitra and Christopher Musco.
ACM International Web Search and Data Mining Conference (WSDM) 2020.
Also appeared at KDD WISDOM 2019 workshop.

Random Walks on Hypergraphs with Edge-Dependent Vertex Weights.
Uthsav Chitra and Benjamin J. Raphael.
International Conference on Machine Learning (ICML) 2019.

Committee Selection is More Similar Than You Think: Evidence from Avalanche and Stellar.
Tarun Chitra and **Uthsav Chitra**.
Manuscript, 2019.

Honors and Awards

Best Overall Poster, Eric and Wendy Schmidt Center Symposium, Broad Institute of MIT and Harvard *2025*
Rising Stars in Data Science, UChicago/UC San Diego/Stanford Data Science Institutes *2024*
Best Paper Award, RECOMB Satellite Workshop on Computational Cancer Biology *2024*
Siebel Scholarship *2022*
- Award of $35,000 given annually to 85 top graduate students worldwide in computer science, bioengineering, and business.

Best Reviewer Award, International Conference on Machine Learning (ICML) *2021, 2022*
NSF Graduate Research Fellowship *2020*
Jerome Stein Memorial Award, Brown University Applied Math Department *2017*
- Given to the top two students who "show outstanding potential in an interdisciplinary area that involves applied mathematics."

Phi Beta Kappa, Brown University (elected junior year, top 2% of class) *2016*
Top 200, William Lowell Putnam Math Competition *2015*
First Place, Brown University Hartshorn-Hypatia Math Prize Exam *2013*
Semi-finalist, Siemens Competition (research project in number theory) *2012*
USA Junior Math Olympiad qualifier *2011*

Teaching

Instructor/Curriculum Developer, Princeton Prison Teaching Initiative *2019-2023*
- Taught college-accredited math classes at NJ state prisons.
- Developed and taught first-ever Java programming course for NJ state prisons.

Teaching Assistant/Grader, Brown University

- **MATH 1560:** Number Theory — *Spring 2016, Spring 2017*
- **CSCI 1570:** Design and Analysis of Algorithms — *Fall 2015, Fall 2016*
- **CSCI 1450:** Probability in Computing — *Spring 2015*
- **CSCI 0530:** Linear Algebra for CS — *Fall 2014*
- **MATH 1530:** Abstract Algebra — *Spring 2014*

Counselor, Program in Mathematics for Young Scientists (PROMYS) — *Summer 2014*

- Guided students through daily number theory problem sets, mentored a group project, and aided seminars in abstract algebra.

Teaching Assistant, Art of Problem Solving — *2012-2016*

- Assisted online, real-time math classes in algebra, number theory, combinatorics, and geometry.

Talks / Posters

Machine learning for spatial and network biology

Computational biology seminar, Carnegie Mellon University — *March 2025*
Computer science/BME seminar, Johns Hopkins University — *March 2025*
Computer science seminar, University of Maryland — *February 2025*
Rising Stars in Data Science, UC San Diego — *November 2024*

Modeling spatial gene expression with complex analysis and deep learning

Computational and Systems Biology (CSB) seminar, MIT — *November 2024*

Mapping the topography of spatial gene expression with interpretable deep learning.

Eric and Wendy Schmidt Center Symposium, Broad Institute of MIT and Harvard (poster) — *April 2025*
Models, Inference, & Algorithms seminar, Broad Institute of MIT and Harvard — *March 2025*
Conference on Research in Computational Molecular Biology (RECOMB) — *May 2024*
Single Cell Analyses, Cold Spring Harbor Laboratory (poster) — *November 2023*
Rutgers-Princeton Cancer Research Symposium (poster) — *October 2023*
NCI Junior Investigator (JI) Annual Meeting — *August 2023*

Belayer: Modeling discrete and continuous spatial variation in gene expression from spatially resolved transcriptomics

Wang Lab Meeting, Broad Institute — *July 2023*
NCI Spring School on Algorithmic Cancer Biology — *March 2023*

Algorithms for understanding the spatial and network organization of biological systems

Chen Lab, Broad Institute — *July 2024*
Campbell Lab, UToronto — *April 2024*
Final Public Oral (FPO, i.e. thesis defense), Princeton University — *March 2024*
Knowles/Azizi Lab, Columbia University — *September 2023*
Herbert Irving Comprehensive Cancer Center, Columbia University — *September 2023*
Pe'er Lab, MSKCC — *August 2023*

Modeling spatial variation in gene expression and copy number aberrations

Brigham Women's Hospital Advanced Biomedical Computation Series — *March 2023*

Leveraging network and spatial structure to model high-dimensional biological data

Sankararaman/Pimentel Labs, UCLA — *April 2023*
Pe'er Lab, Columbia — *April 2023*
Hormoz Lab, DFCI Data Science — *February 2022*

NetMix2: Unifying network propagation and altered subnetworks

Conference on Research in Computational Molecular Biology (RECOMB) — *May 2022*

Quantifying and Reducing Bias in Maximum Likelihood Estimation of Structured Anomalies

International Conference on Machine Learning (ICML) *July 2021*

NetMix: A network-structured mixture model for reduced-bias estimation of altered subnetworks
Conference on Research in Computational Molecular Biology (RECOMB) *June 2020*

Algorithms for Analyzing Networks with Vertex Weights
Princeton University Generals Exam *May 2020*

Analyzing the Impact of Filter Bubbles on Social Network Polarization
ACM International Web Search and Data Mining Conference (WSDM) *February 2020*
KDD WISDOM Workshop *August 2019*

Random Walks on Hypergraphs with Edge-Dependent Vertex Weights
SIAM Conference on Discrete Mathematics *June 2022*
International Conference of Machine Learning (ICML) *June 2019*

Students Mentored

Claire Wu, MIT undergraduate *Fall 2024-present*
- Won **Best Poster** at the 2025 MIT Biological Engineering Undergraduate Research Symposium.

Tanvi Haldiya, Princeton CS undergraduate *Fall 2023*
Jairam Hathwar, Princeton CS undergraduate *Fall 2023*
Kohei Sanno, Princeton CS undergraduate *2023-2024*
Clover Zheng, Princeton CS PhD student *2022-present*
Sunay Joshi, Princeton Math undergraduate *2022-2024*
Ahmed Shuaibi, Princeton QCB PhD student *2020-present*
- Won **Best Paper Award** at RECOMB-CCB workshop.

Madelyne Xiao, Princeton CS PhD student *2022*
Kimberly Ding, Princeton CS undergrad *2019-2021*
- Fall 2019: *Recommender Systems with Hypergraph Random Walks*
- Spring 2020: *Maximum Likelihood Estimation of Structured Anomalies*
- Senior Thesis 2020-2021: *Spatial-NetMix: Less Biased and More Flexible Anomaly Detection*
  - Received the "**Outstanding Computer Science Senior Thesis Prize**"

Shirley Zhang, Princeton CS undergrad/alumni *Summer 2020, 2021-2022*
- Received an **NSF Graduate Research Fellowship**

Service/Outreach

Conference Reviewing
Computational biology: RECOMB 2020 poster session, RECOMB 2023, ISMB 2023, RECOMB 2024, ISMB 2024
Machine learning: ICML 2021 (**Top 10% Reviewer**), NeurIPS 2021, ICML 2022 (**Top 10% Reviewer**), ICML 2023, TMLR, ICML 2024 AccMLBio workshop.

Program Committee
ISMB 2025.

Journal Reviewing
Bioinformatics, Communications Biology, Bioinformatics Advances, Frontiers in Big Data, Computational and Structural Biotechnology Journal.

Member, Princeton COS Graduate Student Committee *2022-2023*
Member, Princeton Graduate Engineering Council *2021-2023*
Member, Princeton COS Ad Hoc Committee *2021*
Officer, Brown Math Departmental Undergraduate Group *2015-2017*
Mentor, Brown Matched Advising Program for Sophomores *2016-2017*

Work Experience

Software Engineer, Facebook *2017-2018*

- Built infrastructure, machine learning models, and data pipelines for improving ad quality.

Software Engineering Intern, Facebook *Summer 2016*

- Reduced upload time for video ads by 20%.

Hobbies/interests: Bouldering, biking, crosswords and other puzzles.