

Neriman Tokcan

CONTACT INFORMATION

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RESEARCH INTERESTS

My research focuses on formulating novel, mathematically sound theoretical frameworks to perform **analysis of multi-modal, high-dimensional data** while preserving the integrity of their structure. I work on compression, noise elimination, and dimension reduction methods for **higher-order tensors** and the development of ML/AI tools. My expertise is at the intersection of **algebraic geometry, multi-linear algebra, combinatorics, and representation theory**. I explore applications in data science, bioinformatics, and cancer genomics.

APPOINTMENTS

Broad Institute of MIT and Harvard, Cambridge MA September 2019-present

Computational Postdoctoral Associate

Supervisors: Aviv Regev, Todd Golub, Caroline Uhler

– Regev Lab, September 2019 - August 2021

– Golub Lab, September 2020- present

– Eric and Wendy Schmidt Center, September 2021- present

Institute for Pure and Applied Mathematics (IPAM), UCLA Spring 2021

Fellow for the Tensor Methods and Emerging Applications to the Physical and Data Sciences
Spring Semester Program

University of Michigan (UMICH), Ann Arbor, MI August 2017-September 2019

Postdoctoral Assistant Professor of Mathematics

Postdoctoral Researcher at the Biomedical and Clinical Informatics Lab, Department of Computational Medicine and Bioinformatics

Supervisors: Harm Derksen, Kayvan Najarian

EDUCATION

University of Illinois at Urbana-Champaign (UIUC), Urbana IL August 2017

Dissertation Title: “Relative Waring Rank of Binary Forms”

Advisor: Bruce Reznick

University of Illinois at Urbana-Champaign (UIUC), Urbana IL August 2012

M.S. in Mathematics

Cukurova University, Adana Turkey June 2009

B.S. in Mathematics

PUBLICATIONS

1. T. Biancalani, G. Scalia, L. Buffoni, R. Avasthi, Z. Lu, A. Sanger, N. Tokcan, C. R. Vanderburg, A. Segerstolpe, M. Zhang, I. Avraham-Davidi, S. Vickovic, M. Nitzan, S. Ma, J. Buenrostro, N. B. Brown, D. Fanelli, X. Zhuang, E. Z. Macosko and A. Regev, *Deep learning and alignment of spatially-resolved whole transcriptomes of single cells in the mouse brain with Tangram*, *Nature Methods* (2021), <https://doi.org/10.1038/s41592-021-01264-7>.
2. L. Hernandez, R. Kim, N. Tokcan, H. Derksen, B.E. Biesterveld, A. Croteau, A. M. Williams, M. Mathis, K. Najarian, and J. Gryak, *Multimodal Tensor-Based Method for Integrative and Continuous Patient Monitoring During Postoperative Cardiac Care*, *Artificial Intelligence in Medicine* **113** (2021), 102032, <https://doi.org/10.1016/j.artmed.2021.102032>.
3. N. Tokcan, J. Gryak, K. Najarian, and H. Derksen, *Algebraic Methods for Tensor Data*, *SIAM Journal on Applied Algebra and Geometry*, **5** (2021), no.1, 1-27, <https://epubs.siam.org/doi/10.1137/19M1272494>.
4. C. Monical, N. Tokcan, A. Yong, *Newton polytopes in algebraic combinatorics*, *Selecta Mathematica (N.S.)* **25** (2019), no. 5, <https://doi.org/10.1007/s00029-019-0513-8>.
5. B. Reznick and N. Tokcan, *Binary forms with three different relative ranks*, *Proceedings of the American Mathematical Society* **145** (2017), 5169-5177, <https://doi.org/10.1090/proc/13666>.
6. N. Tokcan, *On the Waring rank of binary forms*, *Linear Algebra and Its Applications* **524** (2017), 250-262, <https://doi.org/10.1016/j.laa.2017.03.007>.
7. R. Mancuso, R. Pellizzoni, N. Tokcan, M. Caccamo, *WCET Derivation Under Single Core Equivalence With Explicit Memory Budget Assignment*, *Proceedings of the 29th Euromicro Conference on Real-Time Systems (ECRTS 2017)*, Dubrovnik, Croatia, pp. 3:1-3:23, <https://doi.org/10.4230/LIPIcs.ECRTS.2017.3>
8. Relative Waring Rank of Binary Forms, Ph.D. thesis, available online at <https://www.ideals.illinois.edu/handle/2142/98327>.

PATENTS

Tensor Amplification-Based Data Processing

Status: Pending

Filed: February 05, 2020

Inventors: Harm Derksen, Neriman Tokcan, Kayvan Najarian, Jonathan Gryak

GRANTS

Michigan Precision Health Scholars Award, 2018-2020

University of Michigan, Ann Arbor

Project: *A Novel Tensor Similarity Score for the Classification of Cardiac Index*

Funding: USD 240,000

Role: PI

Award Nr.: U063159

HONORS, FELLOWSHIPS, AWARDS

Fellowship at the Institute for Pure and Applied Mathematics, UCLA (March-June 2021)
–*Program on Tensor Methods and Emerging Applications to the Physical and Data Sciences*

Irving Reiner Memorial Award in Algebra, UIUC, 2017

Campus Research Board Award, UIUC, Spring 2017

AMS Graduate Student Travel Grant to the Joint Mathematics Meetings, 2016

Nominated for Departmental TA Instructional Award, UIUC, Fall 2016

Finalist for Departmental TA Instructional Award, UIUC, Fall 2015

List of Teachers Ranked as Excellent by students, UIUC, Fall 2014, Spring 2015, Summer 2015, Fall 2015, Spring 2016(with outstanding rating)

Doctoral fellowship, Council of Higher Education of Turkey, 2011

Doctoral fellowship, Republic of Turkey Ministry of National Education, 2011-2017

Doctoral fellowship, Scientific and Technological Research Council of Turkey (TUBITAK), 2009

Ranked first among the Department of Mathematics graduates, Cukurova University, 2009

Ranked first among the College of Sciences and Letters graduates, Cukurova University, 2009

High Honor Award, Cukurova University, each semester 2006-2009

SELECTED
CONFERENCES,
SEMINARS,
PRESENTATIONS

Broad Institute of MIT and Harvard, Cancer Program, October 2021
abstract title: *Tensor-based frameworks for the analysis of tumor microenvironments*

Topics in Algebra, Topology, Etc., Research Seminar, Boise State University, October 2021
abstract title: *Tensor-based frameworks for multimodal data analysis*

SIAM Conference on Applied Algebraic Geometry, August 2021
abstract title: *Algebraic Methods for Tensor Data*

Institute for Advanced and Pure and Applied Mathematics, June 2021
abstract title: *Kernelization of Tensor-Based Models*

University of Illinois at Urbana-Champaign, Teaching and Diversity Seminar, March 2021
panel title: *Life After UIUC*

Broad Institute, Cancer Data Science Platform, January 2021
abstract title: *Tensor Methods for Cancer Genomics Data*

U-M Precision Health Symposium, May 29, 2019
abstract title: *Tensor Methods for Biomedical Data Analysis*

Broad Institute of MIT and Harvard, Cambridge, MA, April 4, 2019
abstract title: *Tensors for multi-dimensional data analysis*

Joint Mathematics and Computer Science Department Seminar, Boston University,
Boston, MA, March 24, 2019
abstract title: *Tensor amplification and applications in multi-dimensional data analysis*

International Conference and Polynomial and Tensor Optimization (ICPTO), Xiangtan University,
China, December 17-12, 2018
abstract title: *Amplification of tensors and their decompositions*

AMS Joint Mathematics Meetings, Ann Arbor, October 20, 2018
abstract title: *Tensor decomposition and applications in Computational Medicine*

UMICH Michigan Institute for Clinical and Health Research (MICHR), October 18, 2018
abstract title: *Tensor Analysis for Biomedical Data Processing*

Military Health System Research Symposium, Kissimmee, FL, August 20-23, 2018
poster title: *A Novel Tensor Similarity Score for the Classification of Cardiac Index from ECG Signals*

UMICH Biomedical and Clinical Informatics Lab, Department of Computational Medicine and Bioinformatics, May 7, 2018
abstract title: *Tensors for Data Analysis*

UMICH Combinatorics Seminar, Ann Arbor, April 6, 2018
abstract title : *Newton Polytopes in Algebraic Combinatorics*

UMICH Biomedical and Clinical Informatics Lab, Department of Computational Medicine and Bioinformatics, Fall 2017
Series of talks on tensor decomposition and applications
Audience: Interdisciplinary audience composed of industry practitioners, clinicians and academicians

Midwest Algebraic Geometry Graduate Conference, University of Illinois at Chicago, April 22, 2017
abstract title : *A Lower Bound for the Waring Rank*

AMS Joint Mathematics Meetings, Atlanta, 2017
abstract title: *Relative Ranks of Binary Forms*

ALGECOM – Algebra, Geometry and Combinatorics Day, Purdue University, October 2016
poster title: *Waring’s problem for binary forms*

Summer School on Real Algebraic Geometry and Optimization, Georgia Tech University, July 2016
talk title: *Binary Forms with Three Different Relative Ranks*

UIUC Women in Mathematics Seminar, May 2015
talk title: *Length of Binary Forms*

OTHER RESEARCH EXPERIENCE

Research Assistant, Illinois Coordinated Science Laboratory, UIUC, Summer 2016
Supervisor: Negar Kiyavash, Department of Electrical and Computer Engineering
Topics: Graph deanonymization, graph matching, privacy of social graphs

Research Assistant, Department of Mathematics, UIUC, Summer 2014, 2015
Advisor: Bruce Reznick
Topics: Sum of Squares Optimization, Hilbert’s 17th problem, the Waring problem for binary forms

Research Assistant, Department of Mathematics, UIUC, Summer 2013
Supervisor: Maarten Bergvelt
Topics: Symmetric Polynomials and Representation Theory

TEACHING EXPERIENCE

Instructor, UMICH

Math 214, Applied Linear Algebra Fall 2018
Classic lecture format, 70 students
<http://www.math.lsa.umich.edu/courses/214/>

Math 217, Linear Algebra Fall 2107
IBL (Inquiry Based Learning) teaching format, 18 students
<http://www.math.lsa.umich.edu/ibl/217.html>

Project Manager in Illinois Geometry Lab, UIUC, Fall 2014

- Managed a team of 4 undergraduate students (majoring in mathematics and engineering) on the computational project “Elliptesque and hyperbolesque curves”
- Supervised progress on the project and provided both mathematical and technical support to the undergraduate student members
- Assigned responsibilities and organized regular meetings

Certificate of Recognition, Broad Institute of MIT and Harvard, Summer 2021

This certificate was given to recognize the commitment and dedication as a mentor for the 2021 Broad Summer Research Program.

CIMER Research Mentor Training Program, Certificate of Completion, Summer 2021

I completed CIMER(Center for the Improvement of Mentored Experiences in Research) Mentoring Program focusing on mentoring undergraduate students in the areas of genomics/biology.

SERVICES

Journal Reviewer, 2020-present

iScience: Cell Press

Linear and Multilinear Algebra

Book Reviews

Springer Nature, October 2019

Topic: Linear Algebra for advanced undergraduate level and graduate level

Faculty Host for American Mathematical Society Sectional Meeting, Ann Arbor, MI, October 20-21 2018

Publication Coordinator, Biomedical and Clinical Informatics Lab, UMICH, 2018

Graduate admission committee member, Department of Mathematics, UMICH, Fall 2017

Co-Organizer of the Teaching Assistant Training Program, UIUC, Fall 2016

- Assisted in organizing Math TA training for both incoming and current teaching assistants
- Organized two workshops for Math TA orientation: “Practice teaching for new TAs” and “Maximizing learning opportunities in a multi-cultural classroom”

Teaching Evaluator for Teaching Assistant Orientation, UIUC, Fall 2016

- Observed teaching demonstrations of incoming graduate students
- Made recommendations on teaching and grading assignments for the semester

Volunteer at the “4th Midwest Women in Mathematics Symposium”, UIUC, 2016

COLLABORATORS,
MENTORS

Todd Golub

Core Institute Member, Chief Scientific
Officer, Director of the Broad Institute
of MIT and Harvard
Professor of Pediatrics
Harvard Medical School
golub@broadinstitute.org

Caroline Uhler

Associate Professor
Department of Electrical Engineering and
Computer Science and Institute for Data,
Systems and Society, MIT
cuhler@mit.edu

Bruce Reznick (Ph.D. advisor)

Professor of Mathematics
University of Illinois at Urbana-Champaign
reznick@illinois.edu

Harm Derksen

Professor of Mathematics
Northeastern University
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Aviv Regev

Chair of the Faculty and Core Member
Broad Institute of MIT and Harvard
Executive Vice President of Genentech
Research and Early Development
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