

PETER G. MIKHAEL

EDUCATION

- Massachusetts Institute of Technology, Cambridge, MA** 2021 – 2026 (Expected)
PhD Electrical Engineering and Computer Science
Eric & Wendy Schmidt Center PhD Fellow (2021-2022)
- Duke University, Durham, NC** 2015 – 2019
BSc Mathematics, BSc Chemistry, Concentration in Biochemistry
Phi Beta Kappa
- Richardson High School, Richardson, TX** 2011 – 2015
Valedictorian

RESEARCH

- Barzilay Lab, Computer Science and Artificial Intelligence Laboratory** 2019 – Present
Massachusetts Institute of Technology
Developing deep learning models for cancer risk assessment for various cancer types. Previously worked on building and analyzing a neural network that predicts five-year breast cancer risk from patient mammograms. Developed methods to quantify model's ability to localize breast cancer lesions with gradient-based techniques. Currently building models that can learn meaningful and efficient representations of computed tomography scans using self-supervised learning methods, and applying those models to lung and pancreatic cancer risk assessment.
- Locasale Lab, Department of Pharmacology and Cancer Biology** 2016 – 2019
Duke University
Applied machine learning and systems biology to understanding the one-carbon (SGOC) metabolic network in cancer metabolism. Analyzed the effect of methionine restriction on metabolism in humans. Used high-dimensional analysis to study the effects of methionine, serine, and cysteine restriction in a panel of MTAP-null cancer cell lines and explored the potential for therapeutic intervention via nutritional restriction. Integrated statistical testing and information theory to identify and validate metabolic biomarkers for a phase I drug in AML patients. Trained deep learning networks to predict likelihood of complete remission from pretreatment metabolic data.
- Chung Lab, Picower Institute for Learning and Memory** Summer 2014
Massachusetts Institute of Technology
Assisted in optimizing CLARITY technique for making brains transparent (slicing brains, fixing brain-clearing devices, etc.).

PUBLICATIONS

1. Yala A, **Mikhael PG**, Lehman C, Lin G, Strand F, Wan YL, Hughes K, Barzilay R. Optimizing risk-based screening policies with reinforcement learning. (In review at *Nature Medicine*)
2. Reid MA, Bose S, Xiao Z, Pladna KM, Anderson R, **Mikhael PG**, Xiao Z, Dai Z, Liu S, Liu J, Pardee TS, Locasale JW. A lipoic acid analog with clinical activity targets mitochondrial metabolism in human Acute Myeloid Leukemia. (In review at *Nature Medicine*)
3. Yala A, **Mikhael PG**, Strand F, Lin G, Satuluru S, Kim T, Banerjee I, Gichoya J, Trivedi H, Lehman CD, Hughes K, Sheedy DJ, Matthis LM, Karunakaran B, Hegarty KE, Sabino S, Silva TB, Evangelista MC, Caron RF, Souza B, Mauad EC, Patalon T, Handelman-Gotlib S, Guindy M, Barzilay R. Multi-Institutional Validation of a Mammography-Based Breast Cancer Risk Model. *Journal of Clinical Oncology* 2021.
4. Yala A, **Mikhael PG**, Strand F, Lin G, Smith K, Wan Y, Lamb L, Hughes K, Lehman C, Barzilay R. Towards Robust Mammography-Based Models for Breast Cancer Risk. *Science Translational Medicine* 2021.
5. Kim, G, **Mikhael PG**, Oseni, TO, Bahl, M. Ductal carcinoma in situ on digital mammography versus digital breast tomosynthesis: rates and predictors of pathologic upgrade. *European Radiology* 2020.
6. Gao X, Sanderson SM, Dai Z, Reid MA, Cooper D, Lu M, Richie JP, Ciccarella A, Calcagnotto A, **Mikhael PG**, Mentch SJ, Liu J, Ables G, Kirsch DG, Hsu DS, Nichenametla SN, and Locasale JW. Dietary methionine influences therapy in mouse cancer models and alters human metabolism. *Nature* 2019.
7. Sanderson SM, **Mikhael PG**, Ramesh V, Dai Z, Locasale JW. Environmental factors shape methionine metabolism in p16/MTAP deleted cells. *Science Advances* 2019.

TEACHING

- MATH 238L TA – Fundamentals of Data Analysis and Decision Science** **Spring 2019**
Helped teach course on the application of probability and statistics to the mathematical modeling of non-deterministic systems. Introduced basic machine learning algorithms such as clustering, dimension reduction, and regression to engineering and math students. Guided weekly labs and major projects where students applied data analysis on real and curated data.
- Duke Splash – Cryptography and Cybersecurity** **18 Nov 2017 & 31 Mar 2018**
Twice taught a one-day class that introduces high schoolers to the mathematics of cryptography and modern encryption systems.
- Math 431 Grader – Real Analysis** **Fall 2017, 2018**

ORGANIZATIONS

- Journal of Young Investigators, Board of Directors** **2021-Present**
Mentoring the Chief Operating Officer position. Evaluating and supervising the work and progress of the executive board.
- Journal of Young Investigators, Chief Executive Officer** **2017 – 2019**
Oversaw redesign and launch of new website (10K users/month), decrease in article review time (50 days), increase in number of publications (6 articles/issue), and launch of the journal's blog. Spearheaded efforts to establish a five-year plan, and standardize and automate staff application, hiring, and training processes for a staff size of ~70. Restructured executive meetings to incorporate internal systems of accountability. Expanded journal outreach via social media and partnerships with other journals.
- Journal of Young Investigators, Chief Operating Officer** **2016 – 2017**
Managed internal journal programs, coordinated staff applications, and monitored recruitment drives.
- Latent Image, Associate Editor** **2015 – 2018**
Judged and selected photo submissions of Duke students, faculty, and alumni. Edited and published a high-quality journal that showcased the work of Duke photographers.

POSTER PRESENTATIONS

- 1. Computational Analysis of Metabolic Alterations in p16/MTAP-Deleted Cancer Cells** **19 Apr 2019**
Presented original research at the Annual Chemistry Majors Poster Session on the interaction between the CDKN2A and MTAP genetic co-deletion and methionine metabolism. Highlighted how machine learning and high-dimensional analysis tools could establish the degrees to which environmental and genetic factors impact cancer metabolism.
- 2. Predicting Patient Response of a Novel Metabolic Therapy in Acute Myeloid Leukemia Using Machine Learning** **23 Mar 2019**
Invited to present original research at Duke's annual Machine Learning Day. Identified metabolic biomarkers for an experimental AML drug with a variety of machine learning techniques. Trained deep neural networks to predict treatment response outcome from patient bone marrow samples.
- 3. Measuring Dependence with the Mutual Information Coefficient** **7 Dec 2018**
Presented on the Mutual Information Coefficient (*Reshef et al., 2011*) for final project of Information Theory course. Introduced the algorithm for computing MIC, provided intuition for MIC properties, explored mathematical formalization of equitability, and evaluated claims made by authors. Applied MIC on cancer metabolomics data, and discussed areas for improvement.

SERVICE

- Duke President's Student Advisory Committee on Commencement** **2018 – 2019**
Advised Duke President Vince Price on potential speakers for Commencement 2019.
- Duke Relay for Life (American Cancer Society), Marketing Committee Chair** **2015 – 2017**
Organized major fundraising event each spring semester, managed organization's social media, and advertised its events.