

Nuo "Ivy" Liu

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Education

Massachusetts Institute of Technology (MIT)

Ph.D. candidate in Computational and systems biology, GPA: 4.9/5.0

- Advised by Prof. Alex K. Shalek (Chemistry)

Cambridge, MA, USA

Sep 2020-May 2025

Harvey Mudd College

B.S. in Mathematical and Computational Biology, GPA: 3.95/4.0

- Graduated with High Distinction, Honors in Biology, Honors in Computer Science
- Humanities concentration in *Economics*
- Dean's List for all previous applicable semesters

Claremont, CA, USA

September 2016-May 2020

Awards and Honors

2023-24 David H. Koch Graduate Fellowship,

Koch Institute, Massachusetts

Institute of Technology

2020 Computer Science Class of '94 Award,

CS Department, Harvey Mudd

College

2020 Finalist for the CRA Outstanding Undergraduate Researcher Awards,

Computing Research Association

2019 W.A. Brandenburger Biology Prize,

Biology Department, Harvey Mudd

College

2019 First-Tier Traveling Fellowship,

17th Asia Pacific Bioinformatics

Conference

2017 CRC Handbook Prize,

Chemistry Department, Harvey

Mudd College

Research Experience

Arc Institute

POST-DOCTORAL RESEARCH ADVISED BY PROF. HANI GOODARZI

Palo Alto, CA

Aug 2025- present

Massachusetts Institute of Technology

GRADUATE RESEARCHER ADVISED BY PROF. ALEX K. SHALEK

Cambridge, MA

Jun 2021- Aug 2025

- Developed a broadly applicable experimental and computational framework for scaling up phenotypic screens on *ex vivo* models ("compressed screening")
- Leveraging single-cell profiling and meta-analyses, identified molecular and cellular differences between healthy and tuberculosis (TB)-diseased human lung tissue, including a central role for myofibroblast-like populations in TB pathogenesis and lung remodeling
- Use single-cell transcriptomics to understand functional mechanism for the effect of long-term growth hormone administration on early metabolic dysfunction-associated steatotic liver disease (MASLD, or NAFLD) patients

Westlake University

Hangzhou, China

Jul-Aug 2020

SUMMER RESEARCH INTERN ADVISED BY DR. TIANNAN GUO

- Built and trained a LSTM-based deep learning model on pan-human tissues using fragment sequence and charge state to predict ion mobility value (Pearson's $r > 0.98$)
- Predicted ion mobility values for mouse liver proteomics data generated using two non-timsTOF equipments (Thermo Orbitrap, tripleTOF), compared library search results using ion mobility-supplemented libraries and timsTOF library

Harvey Mudd College

Claremont, CA

Sep 2019-May 2020

SENIOR THESIS RESEARCHER ADVISED BY PROF. ELIOT BUSH

- Year-long thesis research under the Biology Department titled *Reconstructing Gene Family Evolution in Microbes Using DTLOR Algorithm*
- Explored ways to break down a family of genes into distinct groups with similar syntenic information
- Extend the Duplication Transfer Loss model to include new events to reconstruct the evolutionary history of prokaryotic organisms more comprehensively

Baylor College of Medicine

Houston, TX

Summer 2019

SUMMER RESEARCH INTERN ADVISED BY DR. PAVEL SUMAZIN

- Researched on phylogeny Inference from Gene Expression Profiles of Multiple Sections per Tumor at the Department of Pediatrics
- Designed a method that estimates cell-type specific expression from bulk tumor profiles using a hierarchical approach that exploits a Linear Programming solution to reconstruct the transcriptional evolution of tumors

Baylor College of Medicine

Houston, TX

Summer 2018

SUMMER RESEARCH INTERN ADVISED BY DR. CRISTIAN COARFA

- Worked on RNA-Seq, microarray and gene enrichment analysis
- Built and trained a Convolutional Neural Network to predict epigenetic remarking events in rat liver genome under environmental influence
- Extracted *de novo* DNA motifs related to epigenetic reprogramming using trained model

Harvey Mudd College

Claremont, CA

Summer 2017

SUMMER RESEARCH INTERN ADVISED BY PROF. RAN LIBESKIND-HADAS, PROF. YI-CHIEH WU

- Extended the dynamic programming algorithm for phylogenetic tree reconciliation under Duplication-Loss-Coalescence(DLC) evolution model to optimize Pareto-optimal solutions

- Tested the correctness of the algorithm and built tool to visualize the event cost landscape
- Showed the reconciliation algorithm is robust to event costs and inferred event support across optimal reconciliations

Harvey Mudd College

SPRING RESEARCH INTERN ADVISED BY PROF. CATHERINE MCFADDEN

Claremont, CA
Spring 2017

- Investigated feasibility of using 28S rDNA for genetic barcoding to differentiate species within coral genus Sinularia
- Utilized computational tools to edit sequencing results and built gene tree
- Research resulted in promise for using 28S rDNA barcoding to the less economical whole-genome sequencing in coral species identification

Publication

- Liu, N.#, Mbano I. M.#, Wardsworth II, M. H., Asowata, O. E., Nyquist, S., Nargan, K., Ramsuran, D., Karim, F., Hughes, T. K., Bromley, J. D., Chambers, M. J., Krause, R., Tezera, L. B., Reichmann, M. T., Kløverpris, H. N., Dullabh, K. J., Madansein, R., Steyn, A. J. C., Berger, B., Elkington, P.*, Shalek, A. K.*, Leslie, A.*. Single-Cell and Spatial Profiling Highlights TB-Induced Myofibroblasts as Drivers of Lung Pathology. *Journal of Experimental Medicine* 223 (3): e20251067. <https://doi.org/10.1084/jem.20251067>.
- Liu, N., Gonzalez, T. A., Fischer, J., Hong, C., Johnson, M., Mawhorter, R., Mugnatto, F., Soh, R., Somji, S., Wirth, J. S., Libeskind-Hadas, R., & Bush, E. C. (2023). xenoGI 3: Using the DTLOR model to reconstruct the evolution of gene families in clades of microbes. *BMC Bioinformatics*, 24(1), 295. <https://doi.org/10.1186/s12859-023-05410-0>
- Liu, N.#, Kattan, W. E.#, Mead, B. E.#, Kummerlowe, C.#, Cheng, T., Cheah, J. H., Soule, C. K., Peters, J., Lowder, K. E., Blainey, P. C., Hahn, W. C., Cleary, B., Bryson, B., Winter, P. S., Raghavan, S., & Shalek, A. K. (2023). Compressed phenotypic screens for complex multicellular models and high-content assays. *BioRxiv*. <https://doi.org/10.1101/2023.01.23.525189>
- Raghavan, S., Winter, P. S., Navia, A. W., Williams, H. L., DenAdel, A., Lowder, K. E., Galvez-Reyes, J., Kalekar, R. L., Mulugeta, N., Kapner, K. S., Raghavan, M. S., Borah, A. A., Liu, N., Väyrynen, S. A., Costa, A. D., Ng, R. W. S., Wang, J., Hill, E. K., Ragon, D. Y., ... Shalek, A. K. (2021). Microenvironment drives cell state, plasticity, and drug response in pancreatic cancer. *Cell*, 184(25), 6119-6137.e26. <https://doi.org/10.1016/j.cell.2021.11.017>
- H. Du, Y. S. Ong, M. Knittel, R. Mawhorter, Liu, N., G. Gross, R. Tojo, R. Libeskind-Hadas, & Y. -C. Wu. (2021). Multiple Optimal Reconciliations Under the Duplication-Loss-Coalescence Model. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 18(6), 2144–2156. <https://doi.org/10.1109/TCBB.2019.2922337>
- Liu, J., Mawhorter, R., Liu, N., Santichaivekin, S., Bush, E., & Libeskind-Hadas, R. (2021). Maximum parsimony reconciliation in the DTLOR model. *BMC Bioinformatics*, 22(10), 394. <https://doi.org/10.1186/s12859-021-04290-6>
- Carothers, M., Gardi, J., Gross, G., Kuze, T., Liu, N., Plunkett, F., Qian, J., & Wu, Y.-C. (2020). An Integer Linear Programming Solution for the Most Parsimonious Reconciliation Problem under the Duplication-Loss-Coalescence Model. *Proceedings of the 11th ACM International Conference on Bioinformatics, Computational Biology and Health Informatics*. <https://doi.org/10.1145/3388440.3412474>
- Mawhorter, R., Liu, N., Libeskind-Hadas, R., & Wu, Y.-C. (2019). Inferring Pareto-optimal reconciliations across multiple event costs under the duplication-loss-coalescence model. *BMC Bioinformatics*, 20(20), 639. <https://doi.org/10.1186/s12859-019-3206-6>

Presentations

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| May. 2024 | Selected oral presentation titled Compressed phenotypic screening empowers scalable biological discovery , Single-Cell Genomics Conference GRC | Les Diablerets, Switzerland |
| Feb. 2024 | Presentation on research project Compressed Screening: High-throughput measurement and perturbation of tissues and tissue-derived cellular models , Microsoft Research New England Project ex vivo internal workshop | Cambridge, MA, USA |
| Jul. 2022 | Presentation on research project Putative drivers of cellular plasticity in glioblastoma , NCI Human Tumor Atlas Network (HTAN) internal meeting | Cambridge, MA, USA |
| Nov. 2019 | Presented on thesis proposal " Reconstructing Gene Family Evolution in Microbes Using DTLOR Algorithm ", Senior thesis proposal presentation | Claremont, CA, USA |
| Jul. 2019 | Presented on summer project " Tumor Phylogeny Inference from Gene Expression Profiles of Multiple Tumor Mixture Samples ", Baylor College of Medicine SMART program final symposium | Houston, TX, USA |
| Jan. 2019 | Presenter for paper " Multiple Optimal Reconciliations under the Duplication-Loss-Coalescence Model ", 17th Asia and Pacific Bioinformatics Conference | Wuhan, China |
| Jul. 2018 | Presented on summer project " Predicting de novo Motifs Using Convolutional Neural Network ", Baylor College of Medicine SMART program final symposium | Houston, TX, USA |

Additional Experience

MIT-China Innovation and Entrepreneurship Forum

Co-PRESIDENT, DIRECTOR OF PLANNING TEAM

Cambridge, MA, USA
May 2020 - Present

- Worked on planning online fireside chats, invited talks and day-long annual forum during pandemic
- Build a consistent program of events for MIT and local students and young professionals to learn about technology and innovation and identify entrepreneurial potentials
- Establish relationships and invite speakers from US-based and China-based venture capitals to share their knowledge on building startups and investments

CSB Application Assistance Program

EXECUTIVE BOARD, SECRETARY, FUND MANAGER

Cambridge, MA, USA

Oct 2021 - Present

- Helped establish the application assistance program for the Computational and Systems Biology PhD program at MIT
- Worked on a team to set up mentor training session, recruiting mentees and pairing mentor-mentees
- Secured Grad Student Experience Grant from Office of Graduate Education at MIT to kick-start the first year of the program

Massachusetts Institute of Technology

Cambridge, MA, USA

MENTORING

- Have served mentors to one master-level visiting student, a summer UROP, a rotation student through their stay in the Shalek Lab, provided guidance on research projects
- Helped run training on computational analysis for single-cell data for the Human Cell Atlas consortium (remote) and for collaborators from Child Health Research Foundation, Bangladesh

Massachusetts Institute of Technology

Cambridge, MA, USA

TEACHING ASSISTANT

Spring 2022

- Served as TA for Modern Biostatistics (7.093) and Modern Computational Biology (7.094)
- Designed and led weekly recitations and office hours
- Worked with instructors to design course materials and graded problem sets and exams

MIT Spark 2022

Cambridge, MA, USA

March 2022

TEACHER

- Worked with two other graduate students to devised a two-part course on immunology for 30+ local 7th and 8th grade students

APISPA-Asian Pacific Islander(API) Sponsor Program at Harvey Mudd College

Claremont, CA, USA

HEAD MENTOR, MENTOR

Fall 2017-May 2020

- Responsible for recruiting mentors and mentees, designing training program for 20+ mentors, organizing off-campus retreat and year-long series of workshops and cultural events
- Mentor incoming students who identify as API to help them adapt to college life and explore identity
- Help organize events to raise awareness about social justice and diversity

Harvey Mudd College

Claremont, CA, USA

TUTOR, GRADER

Spring 2017-May 2020

- Served as grader for *Discrete Math, Intro to Biology*
- Served as both grader and tutor for *Intro to Computational Biology, Principles of Computer Science, Intro to Computer Science, Databases, Machine Learning*

Harvey Mudd College

Claremont, CA, USA

ACADEMIC EXCELLENCE PROGRAM FACILITATOR

Fall 2019-Spring 2020

- Recommended by the biology department to facilitate weekly workshops that helps students to improve their understanding of the biology core curriculum
- Stay in close touch with class instructors and provide feedback to instructors on student progress
- Develop a repertoire of pedagogical and collaborative learning strategies
- Plan staff development presentations at a staff meeting

Texas Children's Hospital

Houston, TX, USA

VOLUNTEER

Summer 2018

- Volunteered at the urgent care unit of Texas Children's Hospital in the Texas Medical Center