Nicole Elyse Mitchell

nicole.elyse.mitchell@gmail.com • SF, CA • LinkedIn: nicole-mitchell • GitHub: nicolemitchell • nicolemitchell.github.io

Education

Rice University, George R. Brown School of Engineering • Houston, TX   BS Dec 2018, MS May 2020
MS, Computer Science; GPA: 3.67/4.00
  Advisor: Dr. Lydia Kavraki
  Research Focus: Machine Learning on Graph-Structured Data
  Relevant Coursework: Statistical Machine Learning, Artificial Intelligence, Research Communications

BS, Computer Science; GPA: 3.79/4.00
  Relevant Coursework: Algorithms, Data Science Tools & Methods, Matrix Analysis, Probability & Statistics

Awards

2019	Adobe Research Women in Technology Scholarship	2018	President's Honor Roll – *all years*
2019	Rice Computer Science Graduate Research Fellowship	2018	CRA-W Grace Hopper Celebration Research Scholar
2019	Conference USA Commissioner's Academic Medal	2017	Elizabeth D. Williams Scholarship for Study Abroad
2019	Rice University Honor Athlete – *all years*	2017	Rice Undergraduate Business Pitch Competition, First

Research Experience

Google AI Residency • Google Research, San Francisco   February 2021 – Present
- Designed a custom compression method for client updates in federated learning to reduce the communication cost from 32 bits per model parameter to 0.1 bits without degrading accuracy on several benchmarks.
- Implemented <u>compression-based aggregation methods</u> for federated learning in TensorFlow Federated. This involved: custom TF ops hosted in <u>TensorFlow Compression</u>, TensorFlow Federated logic, and robust integration tests for system compatibility.
- Presented this work to internal and external audiences. Selected to give an oral presentation at the Google Research Conference. Submitted a paper to ICML 2022, currently under review.
- Integrated custom compression method into Google's federated learning production system [in flight]

Kavraki Computational Robotics, AI and Biomedicine Lab • Rice University Computer Science   January 2018 – October 2020
Graduate Research
- Built a deep graph convolutional network (GCN) using Keras to predict drug metabolism. Proposed the use molecular representations learned through GCNs to identify metabolically labile atoms. Compared to traditional feature extraction methods.

Undergraduate Research
- Improved an incremental docking protocol (DINC) which computationally predicts how peptides bind to protein receptors. Experimented to identify unexpected behavior; strengthened the robustness of DINC by handling these edge cases.
- Evaluated the latest version of DINC by designing re-docking experiments and writing scripts to automate these tests on the XSEDE Comet Supercomputer. Results published in Devaurs et al, 2019.

Internships

Apple • iCloud Storage Analytics, Software Engineering Intern   May 2018 – August 2018
- Built a data pipeline to query server logs and gather time-series metrics on our services
- Wrote a Spark job in Scala to process and aggregate raw data, storing the results in binary large object (BLOB) storage
- Developed and implemented an anomaly detection system in Python using Pandas, SciPy and Matplotlib to automatically detect regressions in quality of service among subsets of our network and generate reports to alert iCloud engineers. Deployed this system, which surfaces one to two critical issues each day that otherwise went unnoticed.
- Presented work to ~30 engineers at iCloud and individually to the Vice President of iCloud

Square • Appointments iOS, Software Engineering Intern   May 2017 – August 2017
- Optimized the calendar in Square Appointments iOS app by identifying performance bottlenecks and improving the search algorithm. Made a 16-fold improvement in CPU time spent rendering events and UI features that restored calendar to 60 fps scrolling.

- Added a feature to notify users when their time zone differs from that of the business they are viewing
- Developed a customized market insights tool for merchants to compare their prices to those of nearby sellers. The tool grouped similar transactions using the "word2vec" ML model. Built a Python Flask app with D3 Visualization to display interactive reports.

Activities & Interests

Baker Institute for Public Policy • Developing Civic Scientist Leaders Program   January 2020 – August 2020
- One of ten graduate students selected to participate in a weekly seminar to learn about the federal policymaking process and develop critical leadership skills to advance science as a public good
- Published an op-ed on a public policy issue; created one-pagers advocating for funding basic scientific research to use in congressional visits in Washington, D.C.

Rice University Women's Track & Field • Varsity Athlete, Tutor for Athletic Academic Advising   August 2015 – May 2020
- Dedicated 20 hours per week training and competing for Rice University's NCAA Division I Track & Field Team
- Tutored female student-athletes in computer science courses to instill confidence in their ability to succeed in STEM fields

Women in Computer Science • Mentor, Club Member   January 2016 – May 2020
- Advised underclassmen interested in computer science on course selection, internships, and study abroad
- Planned and participated on a panel about study abroad for computer science majors

Publications

Pre-prints
2021   **N. Mitchell**, J. Ballé, Z. Charles, and J. Konečný, "Optimizing the Communication–Accuracy Trade-off in Federated Learning with Rate–Distortion Theory," *arXiv*, Jan. 2022. abs/2201.02664 [under review at ICML]

Thesis
2020   **N. Mitchell**, "Machine Learning-Based Prediction of Sites of Metabolism in Drugs: Exploring Feature Extraction Methods on Molecular Graphs," Master's Thesis, Rice University, April 2020. https://hdl.handle.net/1911/108430

Journal Articles
2019   D. Devaurs, D. A. Antunes, S. Hall-Swan, **N. Mitchell**, M. Moll, G. Lizée, and L. E. Kavraki, "Using parallelized incremental meta-docking can solve the conformational sampling issue when docking large ligands to proteins," *BMC Molecular and Cell Biology*, vol. 20, no. 1, p. 42, Sep. 2019. doi:10.1186/s12860-019-0218-z

Posters
2021   **N. Mitchell**, J. Ballé, Z. Charles, and J. Konečný, "Reducing Communication Costs in Federated Learning with Rate— Distortion Optimized Compression." Presented at: *Urban Mobility Simulation and Optimization Workshop*, Nov. 2021.
2019   E. Litsa, **N. Mitchell**, and L. E. Kavraki, "Applying Graph Convolutional Neural Networks for Drug Metabolism Prediction." Presented at: *Rice Data Science Conference*, Oct. 2019; *29ᵗʰ Annual Keck Research Conference*, Oct. 2019.
2019   **N. Mitchell** and L. Fox, "Road Identification in Satellite Images Using Image Segmentation Approaches." Presented at: *Rice University Statistical Machine Learning Poster Session*, April 2019.
2018   **N. Mitchell**, D. Devaurs, and L. E. Kavraki, "DINC 2.0: An Improved Version of an Incremental Docking Protocol for Large Ligands." Presented at: *Rice University Undergraduate Research Symposium*, April 2018.

Other
2020   **N. Mitchell**, "Sears: Once your Ordinary Department Store, Now a Vehicle for Tech Sector Gentrification," *Baker Institute Blog*, Rice University's Baker Institute for Public Policy, April 2020.
2017   **N. Mitchell**, J. Wang, "Using Word2Vec to Power a Recommendation Engine," *Square Corner Blog*, Square Inc., Aug. 2017.