Alex Johnson

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Education

- **University of Washington** — *Seattle, WA*
  PhD Student, Applied Mathematics — *Sep 2022 - Jun 2027 (Anticipated)*
- **Brigham Young University (BYU)** — *Provo, UT*
  B.S. Mathematics; B.S. Economics; GPA: 4.00, Summa Cum Laude — *Sept 2014 - Apr 2022*

Research Focus: Machine learning, computer vision, generative modelling, optimization, and optimal transport.

Skills Summary

- **Languages:** Python, Julia, Matlab, Mathematica, C++, LaTeX
- **Tools:** Git, Docker, Pyspark, Numpy, Pandas, Pytorch, Jax, Conda, Juptyer, Visual Studio

Experience

- **Intermountain Healthcare** — *Salt Lake City, UT*
  Data Science Intern (Python) — *Summer 2022*

  Implemented a FB Prophet model and an RNN in developing time series, predictive models for various research projects related to enterprise analytics. Integrated products for use in various departments through data pipelines using interfacing tools such as Databricks.

Major Projects & Research

- **Optimal Transport of 2D Empirical Measures** — *University of Washington*
  Research (Python) — *Fall 2023 - Ongoing*

  Constructing Optimal Transport (OT) maps between 2D discrete, empirical measures while observing the sparsity of the Kantorovich solutions through distributional statistics. We also consider OT maps constructed using concave cost and observe similar statistics.

- **Burden of Proof–Relative Risk Assessment** — *University of Washington*
  Project/Research (Python) — *Summer 2023-Ongoing*

  Developing spline based methods to construct a meta-analysis in assessing log relative risk scores of dose-response relationships, e.g., the increase in risk of lung cancer associated with different levels of tobacco smoking. In conjunction with IHME. We update spline coefficients by decorrelating coefficient estimates.

- **Relaxed Optimization Approaches to Computer Vision** — *University of Washington*
  Research (Pytorch) — *Spring 2023 - Ongoing*

  Working with Sasha Aravkin in applying "Relax and Split" optimization methods like Sparse, Relaxed, Regularized Regression (SR3) to computer vision problems such as image deblurring and denoising. Exploring directions in constructing catered regularizing functionals using neural networks.

- **Graphical Semi-Supervised Learning** — *University of Washington*
  Project (Python) — *Winter 2023*

  Leveraged graphical construction techniques to approximate lower-dimensional manifolds of image data, while also introducing a Matérn kernel regularization functional whose eigenvalues reveal geometric clustering of sparsely labelled points. Even in a semi-supersvised regime, the results were comparable to several fully supervised methods.

- **Effects of DUI Convictions on Future Outcomes** — *BYU*
  Research (Python) — *Winter 2021 - Spring 2022*

  Developed web-scraping code using various Python packages to obtain 300+ files of evictions records. Wrote code to prepare raw data for further econometric analysis in a regression discontinuity design.

- **Graph Persistent Homology** — *BYU*
  Research (Python) — *Spring 2020 - Spring 2021*

  Developed graph-based persistent homology methods applied to data analytic questions, such as seismic sensing, with an undergraduate group. Wrote code in Python to implement said methods.

Honors and Awards

- **Joseph Hammack Award for Academic Perfomance** Jun, 2023
- **Valedictorian of the Department of Economics** Apr, 2022
- **Outstanding Performance in Mathematics** Apr, 2021
- **Edwin S. Hinckley Full Tuition Scholarship** Sep, 2017 - Apr, 2021

Presentations

- **Student Research Conference** BYU
  - **Persistent Homology:** Presented on our research on graph persistent homology. Included introductory information on persistent homology and gradually introduced our methods.

Teaching and Mentoring

- **Graduate Teaching Assistant:** University of Washington
  - **Calculus II and II:** Graduate teaching assistant for Math 125 and Math 126 for Fall 22, Win 23, and Spring 23. Taught weekly quiz sections, graded assignments and exams, and held office hours semiweekly.
  - **Mathematical Methods for Quantitative Finance:** Graduate teaching assistant in Fall 23 for a class introducing more advanced topics in mathematics (such as probability, calculus, and differential equations) applied to financial topics. Responsibilities similar to those described above.
- **Undergraduate Teaching Assistant:** BYU
  - **Mathematical Statistics** Undergraduate teaching assistant assisting in the instruction of fundamental mathematical statistics and probability. Held 5 office hours per week, graded homework assignments and exams, and provided extra assistance to several students.

Extra Curriculars

- **Reading Groups:** Discussion of current research being done at University of Washington.
  - **NeuroAI:** Readings in self-supervised learning methods in deep learning applied to computer vision. Discussing topics such as auto-encoding methods, VAEs, GANs, and NeRF. *(Fall 23 - Ongoing)*
  - **Methods of Machine Learning:** Study of mathematical and scientific methods applied to machine learning, presenting on topics related to transport-based generative modelling, kernel methods, and operator learning, as examples. *(Fall 22 - Ongoing)*