Behrooz Ghorbani

Address: 37 Angell Court, Apt 215, Stanford, CA
E-mail: ghorbani@stanford.edu *Webpage:* web.stanford.edu/~ghorbani/

Education

Stanford University, Stanford, California USA
- PhD in Electrical Engineering, Advisor: David L. Donoho 2014-2020
- MS in Electrical Engineering, GPA: 3.88 2014-2017
- Coursework: Machine Learning, Random Matrix Theory, Advanced Topics in Statistics, Artificial Intelligence, Natural Language Processing, Convex Optimization, Statistical Signal Processing

University of British Columbia, British Columbia, Canada 2010-2014
- BA Double Major in Mathematics and Economics, GPA: 93%

Professional Experience

Software Engineering Intern, Google Inc. June - December, 2018
Examination of the loss landscape of large neural networks:
- Designed and implemented a scalable algorithm for estimating the full spectrum of the Hessian in large neural networks. Our TensorFlow implementation computes the full Hessian spectrum of a ResNet with 0.46 million parameters in under 30 minutes.
- Studied the effects of Batch Normalization and skip connections on the optimization trajectory.

Software Engineering Intern, Google Inc. June - September, 2017
Scalable and interpretable dimensionality reduction algorithms for time-series data:
- Built interpretable factor models for real-time dimension reduction in large time-series datasets.
- Demonstrated that our algorithm was able to reliably identify anomalies and isolate their sources in a dataset of more than 1400 time-series in a matter of seconds.

Academic Projects

Large Scale Study of the Behavior of Wide Neural Networks 2019-present
- Developed TensorFlow code to effectively optimize extremely large (up to 2×10^5 features) random feature regression models via second-order optimization.
- Designed and conducted thousands of GPU hours of experiments examining the function approximation capabilities of neural network, random feature regression, and kernel predictors.
- Derived precise mathematical characterization of the approximation error of the predictors under consideration in high-dimensional setting.

Analysis of Variational Inference in Topic Modeling 2017-2018
- Designed and ran tens of thousands of CPU hours of experiments to empirically examine the behavior of variational inference in low signal to noise ratio regime.
- Provided theory that characterizes the regions in the parameter space where the results of the variational approximation are misleading.

Optimal Estimation of Large Covariance Matrices for Preconditioning 2015-2017
- Derived optimal non-linear shrinkage estimators for estimating a high-dimensional covariance matrix when the estimated covariance matrix is to be used for preconditioning unseen data.

Selected Publications

Ghorbani, B., Mei, S., Misiakiewicz, T., Montanari, A. "Linearized Two-Layers Neural Networks in High Dimension" Submitted to Annals of Statistics (2019).

Ghorbani, B., Mei, S., Misiakiewicz, T., Montanari, A. "Limitations of Lazy Training of Two-layers Neural Networks" NeurIPS (2019) (**Selected for Spotlight**, Representing Top 3% of Submissions).

Ghorbani, B., Xiao, Y., Krishnan, S. "An Investigation into Neural Net Optimization Via Hessian Eigenvalue Density" ICML (2019).

Ghorbani, B., Xiao, Y., Krishnan, S. "The Effect of Network Depth on the Optimization Landscape" ICML Workshop on Deep Phenomena (2019).

Ghorbani, B., Javadi, H., Montanari, A. "An Instability in Variational Inference for Topic Models" ICML (2019).

Donoho, D., **Ghorbani, B.** "Optimal Covariance Estimation for Condition Number Loss in the Spiked Model" submitted to the Annals of Statistics (2018).

Fellowships and Awards

Stanford Graduate Fellowship 2014
Three years of funding awarded to the top entering graduate students.

Governor General Silver Medal in Arts 2014
Medal from Governor General of Canada awarded to the top graduating student of the UBC Faculty of Arts.

Reginald Palliser-Wilson Scholarship in Mathematics 2014
Awarded by the UBC Mathematics Department to the top students majoring or honoring in mathematics.

Wesbrook Scholar 2013
The University of British Columbia's most prestigious designation awarded to 20 senior students university-wide for outstanding achievements in research, leadership, academic performance, and community activity.

Trek Excellence Scholarship 2012 & 2013
Awarded for ranking in the top 5% of the Faculty of Arts at UBC.

Languages and Technologies

Python, TensorFlow, C++, R, LaTeX