Rui Shu

Contact Information

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Research Interests

I am a Master's student at Stanford University with a strong interest in variational inference, generative modeling, and deep learning. I have worked with scalable Bayesian optimization, scalable graphical models, and variational autoencoders. I am particularly interested in using information-theoretic approaches to improve upon existing deep generative models, and in its application to semi-supervised learning.

Education

Stanford University. M.Sc., Biomedical Informatics. Expected graduation June 2017. GPA: 3.92
Selected and current† coursework:

- Computer Science:
  Representation learning in computation vision† · convolutional neural networks for visual recognition · decision making under uncertainty · advanced topics in sequential decision making · natural language processing

Dartmouth College. B.A., Chemistry, Minor in Statistics. Graduated June 2014. GPA: 3.95
Selected coursework:

- Computer Science:
  Theoretical machine learning · communication protocols and complexity
- Mathematics:
  Mathematical statistics · differential equations · probability and statistical inference

Honors and Awards

John G. Kemeny Computing Prize—honorable mention	2015
Phi Beta Kappa Honor Society—associate member. Membership based on GPA	2014
Duke Data Science Competition—honorable mention	2014
Rofus Choate Scholar Award. Membership based on GPA	2012, 2013
Dartmouth Presidential Scholarship Award	2013

Conference and Workshop Contributions

Shu, R., Bui, H., Ghavamzadeh, M. (2016) "Bottleneck Conditional Density Estimation." Neural Information Processing Systems (NIPS) Workshop on Bayesian Deep Learning.

Shu, R., Brofos, J., Zhang, F., Ghavamzadeh, M., Bui, H., and Kochenderfer, M. (2016) "Stochastic Video Prediction with Conditional Density Estimation." European Conference on Computer Vision (ECCV) Workshop on Action and Anticipation for Visual Learning.

Brofos, J., Shu, R., Jin, M., and Downs, M. (2015) "Leveraging Deep Neural Networks as Kernels for Survival Analysis." Neural Information Processing Systems (*NIPS*) Workshop on Machine Learning in Healthcare.

Brofos, J., Shu, R. (2015) "Parallelization of Minimum Probability Flow on Binary Markov Random Fields." IEEE International Conference on Machine Learning and Applications (*ICMLA*). **Best poster award**.

Gurel, P., et al. (2015) "Assembly and Turnover of Short Actin Filaments by the Formin INF2 and Profilin." Journal of Biological Chemistry.

Gurel, P., et al. (2014) "Monitoring ATP hydrolysis and ATPase inhibitor screening using 1H NMR." Chemical Communications.

Gurel, P., et al. (2014) "INF2-Mediated Severing through Actin Filament Encirclement and Disruption." Cell.

Shcheglovitov, A., et al. (2013) "SHANK3 and IGF1 restore synaptic deficits in neurons from 22q13 deletion syndrome patients". Nature.

Technical Reports

Brofos, J. and Shu, R. (2015) "Optimistic and Parallel Ising Model Estimation" Dartmouth Computer Science Technical Report TR2015-766.

Brofos, J., Kannan, A., and Shu, R. (2014) "Automated Attribution and Intertextual Analysis" *ArXiv preprint.*

Research Experience

Adobe Research, San Jose, California USA
Research Intern *June 2016 - Present*
Investigating the application of conditional variational autoencoders density to semi-supervised high-dimensional conditional density estimation. Demonstrated extensions of ladder variational architecture to the conditional setting and proposed a novel framework that improves conditional variational autoencoder performance on benchmark conditional density estimation tasks. Work presented as workshop contribution at NIPS Bayesian Deep Learning.

Stanford Intelligent Systems Laboratory, Stanford, California USA
Independent researcher *March 2016 - June 2016*
Independent research project for CS399. Studied the application of conditional variational autoencoders to video prediction. Demonstrated that multi-modality in the data distribution can be successfully handled by using a mixture of Gaussians as the latent variable generative distribution. Work presented as a workshop contribution at ECCV Action and Anticipation for Visual Learning. Research advisor: Mykel Kochenderfer.

Stanford University, Stanford, California USA
Research Assistant *November 2015 - Present*
Investigating the use of variational autoencoders for data imputation and anomaly detection of bone microfractures in radiology images. Research advisor: Curtis Langlotz.

Fliptop, San Francisco, California USA (acquired by LinkedIn)
Data Scientist Intern *June 2015 - September 2015*
Analyzed Fliptop's internal machine learning pipeline and provided consultation to improve its predictive analytics platform. Created a Python pipeline that performed large-scale feature extraction and multi-model evaluation. Demonstrated that proper feature engineering techniques, when applied to simpler models, were able to achieve 5% predictive accuracy improvement in comparison to Fliptop's existing algorithms.

Dartmouth College, Hanover, New Hampshire USA
Research Assistant *April 2013 - March 2014*
Discovered unique behavior of the protein INF2 when subjected to varying levels of the energy-storage molecule ATP. Demonstrated that actin, the protein in charge of maintaining cellular structure, can either be assembled or disassembled using INF2 by modulating the concentration of ATP in the system. Research advisor: Henry Higgs.

Stanford University, Stanford, California USA
Summer Research Assistant *July 2012 - September 2012*
Correlated gene expression with cellular and electrophysiological features in neurons from Phelan-McDermid syndrome patients. Research advisor: Alex Shcheglovitov.

Open-Source Projects

Available on github

Variational-Autoencoder Provided a highly modular design paradigm for the training of variational autoencoders in Torch. Wrote GPU-optimized versions of various loss functions frequently used in variational inference. Applied framework to various variational autoencoder experiments on

video prediction and multi-modal density estimation. Completed as part of my work for Stanford CS399: Independent research project.

Automated-Statistician Leveraged reinforcement learning algorithms to build an automated system that performed predictive model and hyperparameter selection in a multiple-model setting. Demonstrated that the automated system achieved faster model tuning than existing model selection baselines. Completed as final project for Stanford AA228: Decision Making under Uncertainty.

Minimum-Probability-Flow-Learning Extended Sohl-Dickstein's work on minimum probability flow by incorporating the use of graph factorization/auxiliary Markov random fields for parameter-estimation in binary pair-wise Markov random fields. The resulting factorized minimum porbability flow is embarrassingly parallelizable and out-competes factorized maximum likelihood estimation in the parameter estimation of large Ising graphs.

Neural-Net-Bayesian-Optimization Implemented a distributed version of a Bayesian optimization framework that used a deep neural network as the surrogate model (based on Ryan Adams' work on scalable Bayesian optimization). This implementation was developed as part of the John Kemeny Computing Competition.

Grants

Stanford Biomedical Informatics Travel Grant, award amount $2,000 — 2015
Neukom Institute Travel Grant, Duke Data Science Competition, award amount $1,000 — 2014
Dartmouth Presidential Scholarship Award, award amount $1,500 — 2013
Dartmouth Undergraduate Leave Term Research, award amount $4,500 — 2013
Dartmouth Research Fellowship, award amount $1,500 — 2012

Teaching Experience

Dartmouth College, Hanover, New Hampshire USA
Teaching Science Fellow *June 2014 - June 2015*
Applied machine learning techniques to predict student performance in science classes based on prior academic indices. Provided additional resources for general chemistry education in the Dartmouth Chemistry Department. Managed a site devoted to correspondence between the Academic Skills Center, Deans Office, and Teaching Science Fellows.

Skills

- Deep learning software: Keras, Theano, TensorFlow, Torch
- Scientific computing: Python, R, MATLAB
- Languages: C, Java
- Parallel processing: MPI, Hadoop