# Rui Shu


CONTACT INFORMATION

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OVERVIEW

I am a CS Ph.D. student at Stanford University. My research focus has primarily been on representation learning, semi-supervised learning, and density estimation. I enjoy thinking about learning algorithms through the lens of posterior regularization and seek to better understand the inductive bias of deep learning models.

EDUCATION

**Stanford Unversity, Ph.D.** (2017 – Present)
- Computer Science: Machine Learning/Artificial Intelligence
- Rotation Advisor: Stefano Ermon

**Stanford University, M.Sc.** (2015 – 2017)
- Biomedical Informatics. GPA: 3.92.
- Selected coursework: Representation learning in computation vision · probabilistic graphical models · sequential decision making · convex optimization

**Dartmouth College, B.A.** (2011 – 2014)
- Chemistry, with Minor in Statistics. GPA: 3.95
- Selected coursework: Theoretical machine learning · communication protocols and complexity · probability and statistical inference

WORK EXPERIENCE

**Adobe Research**, San Jose, California USA
**Research Intern**, (2017 – Present)
Developed a novel approach to unsupervised domain adaptation by leveraging the cluster assumption. Demonstrated that the model achieves state-of-the-art on several visual domain adaptation benchmarks. Conference submission currently under review.

**Adobe Research**, San Jose, California USA
**Research Intern**, (2016 – 2017)
Developed a novel framework for semi-supervised high-dimensional conditional density estimation by hybridizing joint and conditional variational autoencoders. Work presented at the International Conference on Machine Learning (ICML).

**Fliptop**, San Francisco, California USA (acquired by LinkedIn)
**Data Scientist Intern**, (2015)
Created a Python pipeline for large-scale feature extraction and model evaluation. Demonstrated that simpler, well-regularized models were able to achieve 5% predictive accuracy improvement in comparison to Fliptop's existing algorithms.

PUBLICATIONS

Shu, R., Bui, H., Ermon, S., (2017). AC-GAN Learns a Biased Distribution. In *Neural Information Processing Systems (NIPS) Workshop on Bayesian Deep Learning.*

Shu, R., Bui, H., Ermon, S., (2017). A DIRT-T Approach to Unsupervised Domain Adaptation. In *Neural Information Processing Systems (NIPS) Workshop on Learning with Limited Labeled Data.*

Shu, R., Bui, H., Ghavamzadeh, M., (2017). Bottleneck Conditional Density Estimation. In *International Conference on Machine Learning (ICML).*

Banijamali, E., Shu, R., Ghavamzadeh, M., Bui, H., and Ghodsi, A., (2017). Robust Locally-Linear Controllable Embedding. In *International Conference on Machine Learning (ICML) Workshop on Implicit Models*

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

Brofos, J., Shu, R., and Zhang, F., (2016). The Optimistic Method for Model Estimation. In *International Symposium on Intelligent Data Analysis*.

Brofos, J., Shu, R., Jin, M., and Downs, M., (2015). Leveraging Deep Neural Networks as Kernels for Survival Analysis. In *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. In *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. In *Journal of Biological Chemistry*.

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

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

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

## Open-Source Projects

Available on github

**ACGAN-Biased**. Showed that the AC-GAN objective is a Lagrangian to an objective that constrains the generator from placing density near the decision boundary of the auxiliary classifier. Empirically verified that AC-GAN learns a biased distribution.

**VAE-Clustering**. Showed that M2 model can be reparameterized as a Gaussian Mixture Variational Autoencoder. Showed that, by constraining the generator and/or changing the variational inference procedure, the model can learn better clusters.

**Tensorbayes**. A light-weight extension of TensorFlow designed to a TensorFlow analog to Lasagne's Parmesan. Applied to several downstream deep generative model projects.

**Fast-Style-Transfer**. Yet another amortized style transfer implementation in TensorFlow. Improved upon Logan Engstrom's awesome repository by replacing transpose convolutions and adding TensorBoard visualizations.

**Variational-Autoencoder** Provided a design paradigm for the training of variational autoencoders in Torch. Applied framework to experiments on video prediction and multi-modal density estimation.

**Automated-Statistician**. Leveraged Gaussian Processes and reinforcement learning to build an automated system that performed predictive model and hyperparameter

selection in a multiple-model setting.

**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.

**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).

## Masters and Undergraduate Research Experience

**Stanford Intelligent Systems Laboratory**
**Independent researcher**, (2016)
Applied conditional variational autoencoders to video prediction. Improved performance by using mixture of Gaussians as the latent variable distribution. Presented as a workshop contribution at ECCV Action and Anticipation for Visual Learning.

**Stanford University**
**Research Assistant**, (2015 - 2017)
Applied variational autoencoders and generative adversarial networks to semi-supervised anomaly detection of bone microfractures in radiology images. Demonstrated that semi-supervised deep generative models can be successfully applied to radiology image classification.

**Dartmouth College**
**Research Assistant**, (2013 - 2014)
Discovered unique response of the protein INF2 to the energy-storage molecule ATP. Demonstrated that the actin protein can either be assembled or disassembled using INF2 by changing the concentration of ATP. Work presented in Cell.

**Stanford University**, Stanford, California USA
**Research Assistant**, (2012)
Correlated gene expression with cellular and electrophysiological features in neurons from Phelan-McDermid syndrome patients. Work presented in Nature.

## Teaching Experience

**Dartmouth College**
**Teaching Science Fellow**, $(2014 - 2015)$
Applied machine learning techniques to predict student performance in science classes based on prior academic indices. Provided 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.

## Programming Skills

Deep learning software: TensorFlow, Keras, Torch, Theano
Languages: Python, Java, C
Scientific computing: R, MATLAB

## 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)

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| Grants | Stanford Biomedical Informatics Travel Grant | (2015) |
| | Neukom Institute Travel Grant | (2014) |
| | Dartmouth Presidential Scholarship Award | (2013) |
| | Dartmouth Undergraduate Leave Term Research | (2013) |
| | Dartmouth Research Fellowship | (2012) |