Michael C. Hughes

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Education

Brown University
Ph.D. and M.S., Computer Science. *2016*

Olin College of Engineering
B.S. Electrical & Computer Engineering *2010*

Research Experience

Postdoctoral fellow: Machine learning to improve clinical decisions
Adviser: Prof. Finale Doshi-Velez (Harvard) *2016 -*

- Developed semi-supervised topic models for characterizing depression (with Dr. Perlis and Dr. McCoy)
- Applied time-series models to predict ventilator interventions in the ICU using MIMIC-III dataset
- Advanced methods for training deep models to be more interpretable to clinicians or other users

Postdoc project: Estimating carbon biomass from LiDAR waveforms
Adviser: Prof. Erik Sudderth & Prof. Jim Kellner (Brown U., Ecology & Evolutionary Biology) *2016*

- Predicted forest biomass from LiDAR waveforms to better understand land use and climate change
- Developed Bayesian nonparametric regression to jointly model waveforms and biomass values
- Intended for use in upcoming NASA mission GEDI

Ph.D. Thesis: Reliable and scalable inference for Bayesian nonparametric clustering
Adviser: Prof. Erik Sudderth *2016*

- Developed variational inference algorithm that adapts to data by adding or removing clusters during training.
- Optimizes marginal likelihood objective function capable of Ockham's razor model selection.
- Applicable to mixture models, topic models, and hidden Markov models.
- Implemented algorithms in open-source Python package: BNPy.

Master's Project: Sequential Models for Video and Motion Capture
Adviser: Prof. Erik Sudderth *2012*

- Developed methods to discover common actions from many videos of humans performing household exercises.
- Improved existing MCMC inference algorithms with data-driven Metropolis-Hastings proposals.

Honors and Awards

Nominee for AMIA Clinical Informatics Research Award *2017*

- 1 of 7 papers nominated at AMIA's 2017 Joint Summits on Translational Science, out of >50 papers.

NSF Graduate Research Fellowship Award *2011*

- Three year award to fund Ph.D. studies. Covers tuition and provides research stipend.

NDSEG Graduate Research Fellowship Award *2011*

- Three year funding award. Declined to accept NSF fellowship.

Highlighted Publications

1. "Predicting Intervention Onset in the ICU with Switching State Space Models." Marzyeh Ghassemi, Mike Wu, Michael C. Hughes, Peter Szolovits, and Finale Doshi-Velez. AMIA Summit on Clinical Research Informatics, 2017.
2. "Right for the Right Reasons: Training Differentiable Models by Constraining their Explanations." Andrew Slavin Ross, Michael C. Hughes, and Finale Doshi-Velez. ICJAI, 2017.
3. "From Patches to Images: A Nonparametric Generative Model." Geng Ji, Michael C. Hughes, and Erik B. Sudderth. ICML, 2017.
4. "Reliable and Scalable Variational Inference for the Hierarchical Dirichlet Process." Michael C. Hughes, Dae Il Kim, & Erik B. Sudderth. Artificial Intelligence & Statistics (AISTATS), 2015.
5. "Joint Modeling of Multiple Time Series via the Beta Process with Application to Motion Capture Segmentation." Emily Fox, Michael C. Hughes, Erik B. Sudderth, & Michael I. Jordan. Annals of Applied Statistics, Vol. 8(3), 2014.
6. "Memoized Online Variational Inference for Dirichlet Process Mixture Models." Michael C. Hughes & Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2013.

Highlighted Preprints

1. "Prediction-Constrained Training for Semi-Supervised Mixture and Topic Models." Michael C. Hughes, Leah Weiner, Gabriel Hope, Thomas H. McCoy, Jr., Roy H. Perlis, Erik B. Sudderth, & Finale Doshi-Velez. arXiv e-print, 2017.
2. "Fast Learning of Clusters and Topics via Sparse Posteriors." Michael C. Hughes & Erik B. Sudderth. arXiv e-print, 2016.
3. "BNPy: Reliable and scalable variational inference for Bayesian nonparametric models." Michael C. Hughes, & Erik B. Sudderth. 3rd NIPS Workshop on Probabilistic Programming, 2014.

Industry Experience

Google **Mountain View, CA**

Software Engineering Intern *Summer 2013*

- Improved walking/biking/running classifier using smartphone accelerometer data.
- Led collection of dataset from dozens of individuals for classifier evaluation.

Outreach Experience

Harvard Humanitarian Initiative **Cambridge, MA**

Signal Program Fellow *2014*

- Developed prototype detector for common housing structures in sub-Saharan Africa from satellite images.
- Intended for humanitarian oversight of conflict areas where burning structures is common attack pattern.
- Featured in TEDx talk: `http://youtu.be/u7l9rBwOnwU`

TEALS and Boston Latin Academy **Roxbury, MA**

Volunteer AP Computer Science Instructor *2014-2016*

- Taught 1-2 classes / week for 2 years via TEALS "CS in every high school" initiative sponsored by Microsoft.
- Developed hands-on lessons to excite students from diverse backgrounds about computational thinking.
- Mentored full-time teacher Ingrid Roche as she transitioned from media arts to computer science.

Teaching and Mentorship

Harvard University SEAS

Research Mentor *2016-2017*

- Mentored undergraduate senior thesis projects on Bayesian nonparametric inference.
- Frederick Widjaja. 2017 honors thesis: Streaming Variational Inference for the Indian Buffet Process.
- Madhu Vijay. 2017 honors thesis: Characterizing Posterior Uncertainty for the Indian Buffet Process.

Brown University

Research Mentor *2014-2016*

- Mentored students on projects related to Bayesian nonparametric clustering and the BNPy Python package.
- William Stephenson. 2015 undergraduate honors thesis: Variational Inference for Hierarchical Dirichlet Process based Nonparametric Models.
- Sonia Phene. 2015 undergraduate honors thesis: Multiprocessor Parallelization of Variational Inference for Bayesian Nonparametric Topic Models.
- Mengrui Ni. 2015 masters project: Variational Inference for Beta-Bernoulli Dirichlet Process Mixture Models.
- Mert Terzihan. 2015 masters project.

Lead Graduate TA for CS 142: Intro to Machine Learning *Fall 2013*

- Led weekly 1 hour recitation session to review key concepts for 50+ students.
- Designed homework assignments and exam questions.

Professional Service

Workshop Organizer *2017*

- Machine Learning for Health workshop at NIPS '17 (NIPS ML4H 2017)
- Full-day workshop with invited keynotes and panels involving clinicians, statisticians, and computer scientists
- Organized peer-review process for 118 submitted papers

Workshop Organizer *2016*

- Practical Bayesian Nonparametrics workshop at NIPS '16
- Full-day workshop with invited speakers, contributed talks, two panel discussions, and lively poster session
- Led decisions on >25 submitted papers based on peer review

Invited Panelist *2016*

- Software panel at Advances in Approximate Bayesian Inference workshop at NIPS '16

Program Committee / Reviewer

- 2018 - ICLR, AAAI, AMIA CRI
- 2017 - NIPS, ICML, AAAI
- 2016 - NIPS
- 2015 - NIPS, ICML
- 2014 - NIPS, ICML
- 2013 - NIPS (reviewer award)

All Publications (in chronological order)

1. "From Patches to Images: A Nonparametric Generative Model." Geng Ji, Michael C. Hughes, and Erik B. Sudderth. ICML, 2017.
2. "Right for the Right Reasons: Training Differentiable Models by Constraining their Explanations." Andrew Slavin Ross, Michael C. Hughes, and Finale Doshi-Velez. ICJAI, 2017.
3. "Predicting intervention onset in the ICU with switching state space models." Marzyeh Ghassemi, Mike Wu, Michael C. Hughes, Peter Szolovits, and Finale Doshi-Velez. AMIA CRI, 2017.
4. "Refinery: An Open Source Topic Modeling Web Platform." Daeil Kim, Benjamin F. Swanson, Michael C. Hughes, and Erik B. Sudderth. JMLR MLOSS, 2017.
5. "Associations between aboveground forest biomass and waveform LiDAR metrics: implications for modeling footprint-level biomass using Global Ecosystem Dynamics Investigation data." J. Kellner, J. B. Blair, L. Duncanson, L., S. Hancock, M. A. Hofton, M. C. Hughes, S. Marselis, S., J. Armston, E. B. Sudderth, H. Tang, L. Weiner, and R. Dubayah. American Geophysical Union, Fall General Assembly, 2016.
6. "Supervised topic models for clinical interpretability." Michael C. Hughes, Huseyin Melih Elibol, Thomas McCoy, Roy Perlis, and Finale Doshi-Velez. ML for Health workshop at NIPS, 2016.
7. "Scalable Adaptation of State Complexity for Nonparametric Hidden Markov Models." Michael C. Hughes, William Stephenson, & Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2015.
8. "Reliable and Scalable Variational Inference for the Hierarchical Dirichlet Process." Michael C. Hughes, Dae Il Kim, & Erik B. Sudderth. Artificial Intelligence & Statistics (AISTATS), 2015.
9. "BNPy: Reliable and scalable variational inference for Bayesian nonparametric models." Michael C. Hughes, & Erik B. Sudderth. 3rd NIPS Workshop on Probabilistic Programming, 2013.
10. "Joint Modeling of Multiple Time Series via the Beta Process with Application to Motion Capture Segmentation." Emily Fox, Michael C. Hughes, Erik B. Sudderth, & Michael I. Jordan. Annals of Applied Statistics, Vol. 8(3), 2014.
11. "Memoized Online Variational Inference for Dirichlet Process Mixture Models." Michael C. Hughes & Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2013.
12. "Effective Split-Merge Monte Carlo Methods for Nonparametric Models of Sequential Data." Michael C. Hughes, Emily Fox, & Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2012.
13. "The Nonparametric Metadata Dependent Relational Model." Dae Il Kim, Michael C. Hughes, & Erik B. Sudderth. International Conference on Machine Learning (ICML), 2012.
14. "Nonparametric Discovery of Activity Patterns from Video Collections." Michael C. Hughes & Erik B. Sudderth. CVPR Workshop on Perceptual Organization in Computer Vision (POCV), 2012.