

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 in healthcare

Adviser: *Prof. Finale Doshi-Velez (Harvard)* 2016 - present

- Developed semi-supervised models for characterizing and treating depression (with [Dr. Perlis](#) and [Dr. McCoy](#)).
- Applied time-series models to predict ventilator interventions in the ICU for [public dataset](#) of >36,000 patients.
- Created methods for training deep models so they are 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.
- Modeled waveforms and biomass predictions jointly via nonparametric regression using our [BNPy toolbox](#).
- Intended for use in NASA's upcoming [Global Ecosystem Dynamics Investigation \(GEDI\)](#).

Ph.D. thesis: Reliable and scalable variational inference for Bayesian nonparametrics

Adviser: *Prof. Erik Sudderth* 2016

- Thesis Title: Reliable and scalable variational inference for nonparametric mixtures, topics, and sequences
- Developed optimization algorithms for Bayesian nonparametric models that scale to millions of examples.
- Optimized lower bound on marginal likelihood, thus penalizing too simple and too complex explanations.
- Escaped local optima via data-driven proposals that add useful new clusters and remove redundant ones.
- Applied to topic models of 2 million NY Times articles and sequential models of the whole human genome.
- Implemented algorithms in [open-source package: Bayesian Nonparametrics for Python \(BNPy\)](#).

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

NDSEG Graduate Research Fellowship Award 2011
o Three year funding award. Declined to accept NSF fellowship.

Highlighted Publications

1. “[Beyond Sparsity: Tree Regularization of Deep Models for Interpretability.](#)” Mike Wu^u, Michael C. Hughes, Sonali Parbhoo, Maurizio Zazzi, Volker Roth, and Finale Doshi-Velez. To appear in Association for Advancement of Artificial Intelligence (AAAI), 2018.
2. “[Predicting Intervention Onset in the ICU with Switching State Space Models.](#)” Marzyeh Ghassemi, Mike Wu^u, Michael C. Hughes, Peter Szolovits, and Finale Doshi-Velez. AMIA Summit on Clinical Research Informatics, 2017.
3. “[Right for the Right Reasons: Training Differentiable Models by Constraining their Explanations.](#)” Andrew Slavin Ross^m, Michael C. Hughes, and Finale Doshi-Velez. International Joint Conference on Artificial Intelligence (IJCAI), 2017.
4. “[From Patches to Images: A Nonparametric Generative Model.](#)” Geng Ji^d, Michael C. Hughes, and Erik B. Sudderth. International Conference on Machine Learning (ICML), 2017.
5. “[Scalable Adaptation of State Complexity for Nonparametric Hidden Markov Models.](#)” Michael C. Hughes, William Stephenson^u, and Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2015.
6. “[Reliable and Scalable Variational Inference for the Hierarchical Dirichlet Process.](#)” Michael C. Hughes, Dae Il Kim, and Erik B. Sudderth. Artificial Intelligence & Statistics (AISTATS), 2015.
7. “[Joint Modeling of Multiple Time Series via the Beta Process with Application to Motion Capture Segmentation.](#)” Emily Fox, Michael C. Hughes, Erik B. Sudderth, and Michael I. Jordan. Annals of Applied Statistics, Vol. 8 (3), 2014.
8. “[Memoized Online Variational Inference for Dirichlet Process Mixture Models.](#)” Michael C. Hughes and Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2013.

Superscripts indicate mentored student’s role: u = undergraduate, m = masters, d = doctoral.

Highlighted Preprints

1. “[Prediction-Constrained Training for Semi-Supervised Mixture and Topic Models.](#)” Michael C. Hughes, Leah Weiner^d, Gabriel Hope^d, Thomas H. McCoy, Jr., Roy H. Perlis, Erik B. Sudderth, and Finale Doshi-Velez. arXiv e-print, 2017.
2. “[Fast Learning of Clusters and Topics via Sparse Posteriors.](#)” Michael C. Hughes and Erik B. Sudderth. arXiv e-print, 2016.
3. “[BNPy: Reliable and scalable variational inference for Bayesian nonparametric models.](#)” Michael C. Hughes and 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 via custom Android app.

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.

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/u719rBw0nwU>

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 AP computer science (Java).

Olin College Engineering Discovery

Co-Founder and Curriculum Director

Needham, MA

2007-2010

- Managed 15 undergrads in developing hands-on lessons for 4th-8th graders.
- Hosted workshops for 30 children to design, build, and launch bottle rockets.
- Pioneered green energy workshop which earned over \$750 in outside funding.

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. "[Beyond Sparsity: Tree Regularization of Deep Models for Interpretability.](#)" Mike Wu^u, Michael C. Hughes, Sonali Parbhoo, Maurizio Zazzi, Volker Roth, and Finale Doshi-Velez. To appear in Association for Advancement of Artificial Intelligence (AAAI), 2018.
2. "[Prediction-Constrained Topic Models for Antidepressant Prediction.](#)" Michael C. Hughes, Gabriel Hope^d, Leah Weiner^d, Thomas H. McCoy, MD, Roy H. Perlis, MD, Erik B. Sudderth, and Finale Doshi-Velez. NIPS Workshop on Machine Learning for Health (NIPS ML4H), 2017.
3. "[From Patches to Images: A Nonparametric Generative Model.](#)" Geng Ji^d, Michael C. Hughes, and Erik B. Sudderth. International Conference on Machine Learning (ICML), 2017.
4. "[Right for the Right Reasons: Training Differentiable Models by Constraining their Explanations.](#)" Andrew Slavin Ross^m, Michael C. Hughes, and Finale Doshi-Velez. International Joint Conference on Artificial Intelligence (IJCAI), 2017.
5. "[Predicting Intervention Onset in the ICU with Switching State Space Models.](#)" Marzyeh Ghassemi, Mike Wu^u, Michael C. Hughes, Peter Szolovits, and Finale Doshi-Velez. AMIA Summit on Clinical Research Informatics, 2017.
6. "[Refinery: An Open Source Topic Modeling Web Platform.](#)" Daeil Kim, Benjamin F. Swanson,

Michael C. Hughes, and Erik B. Sudderth. JMLR Machine Learning Open Source Software (MLOSS), 2017.

7. [“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^d, and R. Dubayah. American Geophysical Union, Fall General Assembly, 2016.
8. [“Supervised topic models for clinical interpretability.”](#) Michael C. Hughes, Huseyin Melih Elibol, Thomas McCoy, Roy Perlis, and Finale Doshi-Velez. NIPS Workshop on Machine Learning for Health (NIPS ML4H), 2016.
9. [“Scalable Adaptation of State Complexity for Nonparametric Hidden Markov Models.”](#) Michael C. Hughes, William Stephenson^u, and Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2015.
10. [“Reliable and Scalable Variational Inference for the Hierarchical Dirichlet Process.”](#) Michael C. Hughes, Dae Il Kim, and Erik B. Sudderth. Artificial Intelligence & Statistics (AISTATS), 2015.
11. [“BNPy: Reliable and scalable variational inference for Bayesian nonparametric models.”](#) Michael C. Hughes and Erik B. Sudderth. 3rd NIPS Workshop on Probabilistic Programming, 2013.
12. [“Joint Modeling of Multiple Time Series via the Beta Process with Application to Motion Capture Segmentation.”](#) Emily Fox, Michael C. Hughes, Erik B. Sudderth, and Michael I. Jordan. Annals of Applied Statistics, Vol. 8(3), 2014.
13. [“Memoized Online Variational Inference for Dirichlet Process Mixture Models.”](#) Michael C. Hughes and Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2013.
14. [“Effective Split-Merge Monte Carlo Methods for Nonparametric Models of Sequential Data.”](#) Michael C. Hughes, Emily Fox, and Erik B. Sudderth. Neural Information Processing Systems (NIPS), 2012.
15. [“The Nonparametric Metadata Dependent Relational Model.”](#) Dae Il Kim, Michael C. Hughes, and Erik B. Sudderth. International Conference on Machine Learning (ICML), 2012.
16. [“Nonparametric Discovery of Activity Patterns from Video Collections.”](#) Michael C. Hughes and Erik B. Sudderth. CVPR Workshop on Perceptual Organization in Computer Vision (POCV), 2012.