

# Michael C. Burkhardt

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## INTERESTS

sequential inference • user understanding/personalization • semi-supervised learning • causality

## EDUCATION



**BROWN UNIVERSITY**  
Providence RI

Ph.D. Applied Mathematics

2013–2019



**RUTGERS UNIVERSITY**  
New Brunswick NJ

M.Sc. Mathematics

2011–2013



**PURDUE UNIVERSITY**  
West Lafayette IN

B.Sc.'s Mathematics, Statistics, & Economics

2007–2011

## EXPERIENCE



**UNIVERSITY OF  
CAMBRIDGE**  
Cambridge UK

Research Associate

2021–

- developed machine learning-based approaches for the early diagnosis of neurodegenerative disease
- prototyped graph neural networks to predict brain age (PyTorch geometric)



**ADOBE, INC.**  
San Jose CA

Machine Learning Scientist (Senior in 2021)

2018–2021

- built and validated predictive models to personalize user experience (PySpark/LightGBM)
- liaised with creatives to design custom content specialized to the needs of different user segments
- supervised intern projects in semi-supervised learning and causal inference (Keras/Tensorflow)



**BRAIN GATE CLINICAL  
TRIAL**  
Providence RI

Doctoral Researcher

2014–2018

- developed and implemented a novel nonlinear filter for online neural decoding (Matlab/Python)
- this framework enabled participants with quadriplegia to communicate and interact with their environments in real time using mental imagery alone
- experimented with Bayesian solutions to provide robustness against common non-stationarities



**SPOTIFY USA, INC.**  
New York NY

Data Research Intern

2017

- implemented online stochastic variational inference for topic models on playlist data to group songs by genre (cloudML)



**ARGONNE NATIONAL  
LABORATORY**  
Lemont IL

Graduate Research Aide

2012

- propagated variance in a multi-step prediction model to better estimate prediction error (Matlab/R)

### JOURNAL ARTICLES

- M. Burkhart & G. Ruiz. Neuroevolutionary representations for learning heterogeneous treatment effects. *Journal of Computational Science* 71 (2023)
- M. Burkhart. Discriminative Bayesian filtering lends momentum to the stochastic Newton method for minimizing log-convex functions. *Optimization Letters* 17 (2023)
- M. Burkhart. Conjugacy conditions for supersoluble complements of an abelian base and a fixed point result for non-coprime actions. *Proceedings of the Edinburgh Mathematical Society* 65 (2022)
- M. Burkhart, D. Brandman, B. Franco, L. Hochberg, & M. Harrison. The Discriminative Kalman Filter for Bayesian Filtering with Nonlinear and Nongaussian Observation Models. *Neural Computation* 32 (2020)
- D. Brandman, M. Burkhart, J. Kelemen, B. Franco, M. Harrison, & L. Hochberg. Robust Closed-Loop Control of a Cursor in a Person with Tetraplegia using Gaussian Process Regression. *Neural Computation* 30 (2018)
- D. Brandman, T. Hosman, J. Saab, M. Burkhart, B. Shanahan, J. Ciancibello, et al. Rapid calibration of an intracortical brain computer interface for people with tetraplegia. *Journal of Neural Engineering* 15 (2018)
- M. Burkhart, Y. Heo, & V. Zavala. Measurement and verification of building systems under uncertain data: A Gaussian process modeling approach. *Energy and Buildings* 75 (2014)

### CONFERENCE PROCEEDINGS

- M. Burkhart & G. Ruiz. Neuroevolutionary Feature Representations for Causal Inference. *Computational Science – ICCS* 2022
- M. Burkhart. Discriminative Bayesian Filtering for the Semi-supervised Augmentation of Sequential Observation Data. *Computational Science – ICCS* 2021
- M. Burkhart & K. Shan. Deep Low-Density Separation for Semi-supervised Classification. *Computational Science – ICCS* 2020
- M. Burkhart & K. Modarresi. Adaptive Objective Functions and Distance Metrics for Recommendation Systems. *Computational Science – ICCS* 2019

### PREPRINTS

- M. Burkhart. Fixed point conditions for non-coprime actions. arXiv:2308.12286 [math.GR] (accepted, *Proceedings of the Royal Society of Edinburgh Section A: Mathematics*)
- M. Abroshan, M. Burkhart, O. Giles, S. Greenbury, Z. Kourtzi, J. Roberts, M. van der Schaar, J. Steyn, A. Wilson, & M. Yong. Safe AI for health and beyond – Monitoring to transform a health service. arXiv:2303.01513 [cs.LG]
- R. Li, E. Harshfield, S. Bell, M. Burkhart, A. Tuladhar, S. Hilal, D. J. Tozer, F. Chappell, S. Makin, J. Lo, J. Wardlaw, F.-E. de Leeuw, C. Chen, Z. Kourtzi, & H. Markus. Predicting Incident Dementia in Cerebral Small Vessel Disease: Comparison of Machine Learning and Traditional Statistical Models. SSRN:4432297 (accepted, *Cerebral Circulation - Cognition and Behavior*)
- R. Borchert, T. Azevedo, A. Badhwar, J. Bernal, M. Betts, R. Bruffaerts, M. Burkhart, I. Dewachter, ..., D. Llewellyn, M. Veldsman, & T. Rittman. Artificial intelligence for diagnosis and prognosis in neuroimaging for dementia; a systematic review. medRxiv:2021.12.12.21267677 (accepted, *Alzheimer's & Dementia*)

### DISSERTATION

- M. Burkhart. "A Discriminative Approach to Bayesian Filtering with Applications to Human Neural Decoding." Ph.D. Dissertation, Brown University, Division of Applied Mathematics (2019)

## PATENTS PENDING

- M. Burkhart & G. Ruiz. **Causal Inference via Neuroevolutionary Selection**. Filed 2022
- M. Burkhart & K. Shan. **User Classification from Data via Deep Segmentation for Semi-supervised Learning**. U.S. Patent Application #16/681,239. Filed 2019. Published as US2021/0142152A1. Granted 2022 as US11,455,518B2
- M. Burkhart & K. Modarresi. **Digital Experience Enhancement using an Ensemble Deep Learning Model**. U.S. Patent Application #16/375,627. Filed 2019. Published as US2020/0320382A1. Allowed 2023

## TEACHING EXPERIENCE

- Graduate Teaching Assistant (Brown):** Recent Applications of Probability & Statistics (Spr. '16, Spr. '18)
- Statistical Inference (Spr. '17)
  - Computational Probability & Statistics (Fall '15)
  - Essential Statistics (Spr. '15)
  - Information Theory (Fall '14)
- Team Leader, High Performance Computing (Brown-Kobe Summer School):** designed and supervised a project to create a parallelized particle filter for neural decoding with graduate students from Brown and Kobe Universities (Summer '16)

## SELECTED TALKS

- M. Burkhart, L. Lee, P. Tino, & Z. Kourtzi. **Clustering Trajectories of Neurodegenerative Disease**. Trustworthy AI for Medical & Health Research Workshop, Cavendish Laboratory, Cambridge, UK, 2022
- M. Burkhart & G. Ruiz. **Neuroevolutionary Feature Representations for Causal Inference**. International Conference on Computational Science (ICCS), London, UK, 2022
- M. Burkhart. **Discriminative Bayesian Filtering for the Semi-supervised Augmentation of Sequential Observation Data**. ICCS, Kraków, Poland, 2021 (virtual)
- M. Burkhart & K. Modarresi. **Adaptive Objective Functions and Distance Metrics for Recommendation Systems**. ICCS, Faro, Portugal, 2019
- M. Burkhart, D. Brandman, C. Vargas-Irwin, & M. Harrison. **Nonparametric discriminative filtering for neural decoding**. ICSA Applied Statistics Symposium, Atlanta, GA, 2016

## COMMUNITY INVOLVEMENT

<b>DEPARTMENTAL INFORMATION COMMITTEE</b>	<b>Research Staff Representative</b>	<b>2022–</b>
<b>ICCS CONFERENCE</b>	<b>Program Committee Member</b> <ul style="list-style-type: none"><li>• for the thematic track on Applications of Computational Methods in Artificial Intelligence and Machine Learning</li></ul>	<b>2019–2021</b>
<b>BROWN SIAM STUDENT CHAPTER</b> <small>Providence RI</small>	<b>Vice President, Chapter Records Interdepartmental Liaison Officer</b> <ul style="list-style-type: none"><li>• organized events within the applied math community</li></ul>	<b>2015–2017</b>
<b>PURDUE STUDENT PUBLISHING FOUNDATION</b> <small>West Lafayette IN</small>	<b>Member, Corporate Board of Directors</b> <b>Chairperson, Finance Committee</b> <ul style="list-style-type: none"><li>• oversaw the Exponent, Purdue's Independent Daily Student Newspaper</li></ul>	<b>2009–2011</b>

## WEBSITE

<https://burkh4rt.github.io>