Michael C. Burkhart

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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)

BrainGate 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. arχiv: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. arχiv: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. medRχiv: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

Departmental Information Committee	Research Staff Representative	2022–
ICCS Conference	Program Committee Member • for the thematic track on Applications of Computational Methods in Artificial Intelligence and Machine Learning	2019–2021
Brown SIAM Student Chapter Providence RI	Vice President, Chapter Records Interdepartmental Liaison Officer • organized events within the applied math community	2015–2017
Purdue Student Publishing Foundation West Lafayette IN	Member, Corporate Board of Directors Chairperson, Finance Committee • oversaw the Exponent, Purdue's Independent Daily Student Newspaper	2009–2011

Website

https://burkh4rt.github.io