Michael C. Burkhart

burkh4rt.github.io | michael_burkhart@alumni.brown.edu | Plainfield, IN, US

Interests

AI/ML for good • causal inference • time series modeling • feature engineering • computational science

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 (Visiting Researcher in 2024) — 2021–2024

- developed multimodal trajectory models for the early diagnosis of neurodegenerative disease
- cleaned/wrangled/processed dementia-related datasets for training & analysis
- worked with research engineers at the Alan Turing Institute to automate the detection of covariate shift

Adobe, Inc.
San Jose, CA
Machine Learning Scientist — 2018–2021

- built and validated predictive models to personalize user experience (PySpark/LightGBM/Airflow)
- designed and tested personalized pricing interventions within the cancellation flow (causal forests)
- supervised intern projects in representation learning for causal inference and semi-supervised learning (Keras/Tensorflow)

Brown University
Providence, RI
Graduate Research Assistant — 2014–2018

- developed a novel nonlinear filter for online neural decoding (Matlab/Python)
- collaborated with the BrainGate Clinical Trail to test this filter in a brain–computer interface
- experimented with Bayesian solutions to provide robustness against common non-stationarities

Summer research internships at **Spotify, U.S.A.** (Data Research Intern in New York, NY, 2017) & **Argonne National Laboratory** (Graduate Research Aide in Lemont, IL, 2012)

Publications

M. Burkhart, L. Lee, D. Vaghari, A. Toh, E. Chong, C. Chen, P. Tiňo, & Z. Kourtzi, **Unsupervised multimodal modeling of cognitive and brain health trajectories for early dementia prediction**, Scientific Reports 14 (2024)

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)

R. Li, E. Harshfield, S. Bell, M. Burkhart, A. Tuladhar, …, C. Chen, Z. Kourtzi, & H. Markus, **Predicting incident dementia in cerebral small vessel disease: comparison of machine learning and traditional statistical models**, Cerebral Circulation – Cognition and Behavior 5 (2023)

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 diagnostic and prognostic neuroimaging in dementia: a systematic review**, Alzheimer's & Dementia 19 (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 & 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, 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)

M. Burkhart & K. Modarresi, **Determining adaptive loss functions and algorithms for predictive models**, Computational Science – ICCS 2019

M. Burkhart & K. Modarresi, **Adaptive objective functions and distance metrics for recommendation systems**, Computational Science – ICCS 2019

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, …, M. Harrison, J. Simeral, & L. Hochberg, **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)

Dissertation

M. Burkhart, **A Discriminative Approach to Bayesian Filtering with Applications to Human Neural Decoding**, Ph.D. advised by Prof. Matthew Harrison, Division of Applied Mathematics, Brown University, Providence, 2019

Patents & Pending

M. Burkhart & G. Ruiz, Causal inference via neuroevolutionary selection, U.S. Patent Application #17/748,891 filed 2022, published as US 2023/0376776 A1

M. Burkhart & K. Shan, User classification from data via deep segmentation for semi-supervised learning, U.S. Patent Application #16/681,239 filed 2019, granted 2022 as US 11,455,518 B2

M. Burkhart & K. Modarresi, Digital experience enhancement using an ensemble deep learning model, U.S. Patent Application #16/375,627 filed 2019, granted 2023 as US 11,816,562 B2

Preprints & Working Papers

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]

L. Lee, D. Vaghari, M. Burkhart, P. Tiňo, M. Montagnese, Z. Li, K. Zühlsdorff, J. Giorgio, G. Williams, E. Chong, C. Chen, B. Underwood, T. Rittman, & Z. Kourtzi, Robust and interpretable AI-guided marker for early dementia prediction in real-world clinical settings, eClinicalMedicine (in press)

M. Burkhart, Fixed point conditions for non-coprime actions, Proceedings of the Royal Society of Edinburgh Section A: Mathematics (in press)

Recent Talks

M. Burkhart, L. Lee, P. Tiňo, & 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)

Selected Presentations

M. Burkhart, L. Lee, D. Vaghari, J. Venton, S. Thomas, N. Smith, R. Everson, P. Tiňo, & Z. Kourtzi, AI-guided patient stratification for neurodegenerative disorders using unsupervised trajectory modelling, Alzheimer's Association International Conference (AAIC), Amsterdam, Netherlands, 2023

D. Vaghari, L. Lee, M. Burkhart, M. Montagnese, …, T. Rittman, P. Tiňo, & Z. Kourtzi, Validating the clinical utility of AI-guided tools for early dementia prediction, AAIC, 2023

L. Lee, D. Vaghari, M. Burkhart, M. Montagnese, K. Zühlsdorff, …, T. Rittman, P. Tiňo, & Z. Kourtzi, Translating AI-guided tools for early dementia prediction to clinical practice, Dementias Platform UK (DPUK) Translation, London, UK, 2023

F. Marinaro, C. Morvan, R. Au, S. Bond, M. Burkhart, N. Carlebach, …, Z. Walker, R. Everson, C. Hinds, & Z. Kourtzi, The Early Detection of Neurodegenerative diseases initiative: an international and multidisciplinary effort for transforming the early detection of dementia-causing diseases, AAIC, San Diego, CA, 2022

Community Involvement

Cambridge Psych. Dept. Cambridge, UK	**Research Staff Representative**	2022–2023
ICCS Conference	**Program Committee Member** • 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
Rutgers Math Dept. New Brunswick, NJ	**Graduate Liaison Committee Member**	2012–2013
Purdue Student Publishing Foundation West Layfayette, IN	**Member, Corporate Board of Directors** **Chairperson, Finance Committee** • oversaw the *Exponent*, Purdue's Independent Daily (at the time) Student Newspaper	2009–2011

Online

Homepage • LinkedIn • Google Scholar • Github • OrcID