# E. Kelly Buchanan


**Contact Information**

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Code: github.com/ekellbuch


**Interests**

Making efficient and reliable artificial intelligent systems to augment humans.

**Education**

**Columbia University** — New York, NY
Ph.D. Candidate in Computational Neuroscience — 2018 – 2024
Advisors: Liam Paninski and John Cunningham
Dissertation: Building reliable and efficient systems for neuroscience.

**University of Kansas** — Lawrence, KS
M.S. Electrical Engineering with *honors* — 2017
Advisors: Randolph Nudo and Yang Yi
Thesis: Methods to study temporal coding in biological and artificial networks.

B.S., Electrical Engineering with minor in Mathematics
Advisor: Shannon Blunt
Project: Miniaturization of sense-and-avoid radars for Unmanned Aerial Vehicles.

**National University of San Marcos** — Lima, Peru
Physics Olympiads Training Program for high-school students — 2008-2009
Top 1 percent in National Physics Olympiads

**Research & Professional Experience**

**Stanford University** — Palo Alto, CA
Postdoctoral Fellow — 07/24 –
Advisors: Scott Linderman and Christopher Ré

**Google AI** — New York, NY
Student Researcher — 02/22 – 10/22
Supervisors: Dustin Tran and Kevin P. Murphy

**Google X** — New York, NY
Ph.D. resident in AI — 05/21 – 09/21
Team: Rapid Evaluation

**Center for Theoretical Neuroscience, Columbia University** — New York, NY
Research Associate — 08/17 – 07/18
Supervisor: Liam Paninski

**Cortical Plasticity Lab, KU Medical Center** — Kansas City, KS
Graduate Research Assistant — 2014 – 2017
Advisor: Randolph Nudo

**Brain-Inspired Computing and Communication Lab, ITTC** — Rome, NY
Visiting Research Assistant — Summer 2016
Advisor: Yang Yi

**Neural Interfaces and Neurorehabilitation Lab, IIT** — Genoa, Italy
Visiting Research Assistant — 2016
Supervisor: Michaela Chiappalone

**NSF Center for Remote Sensing of Ice Sheets** — Lawrence, KS
Undergraduate Research Assistant — 2014

Supervisor: John Paden

**IBM** Rochester, MN
Software Engineering Intern 2012 – 2013
Team: Power Systems Qualification

PUBLICATIONS * **indicates equal contribution**

[1] **Terminal-Bench: Benchmarking Agents on Hard, Realistic Tasks in Command Line Interfaces**
Mike Merrill, Alexander Glenn Shaw, Nicholas Carlini, Boxuan Li, Harsh Raj, Ivan Bercovich, Lin Shi, Jeong Yeon Shin, Thomas Walshe, **E. Kelly Buchanan**, et al.
*Under Review, 2025.*

[2] **Shrinking the Generation-Verification Gap with Weak Verifiers**
Jon Saad-Falcon*, **E. Kelly Buchanan***, Mayee Chen*, Tzu-Heng Huang, Brendan McLaughlin, Tanvir Bhathal, Shang Zhu, Ben Athiwaratkun, Frederic Sala, Scott Linderman, Azalia Mirhoseini, Christopher Ré.
*Neural Information Processing Systems (NeurIPS), 2025.*

[3] **Extracting task-relevant preserved dynamics from contrastive aligned neural recordings**
Yiqi Jiang, Kaiwen Sheng, Yujia Gao, **E. Kelly Buchanan**, Yu Shikano, Seung Je Woo, Yixiu Zhao, Tony Hyun Kim, Fatih Dinc, Scott Linderman, Mark Schnitzer.
*Neural Information Processing Systems (NeurIPS), 2025.*

[4] **A Unifying Framework for Parallelizing Sequential Models with Linear Dynamical Systems**
Xavier Gonzalez*, **E. Kelly Buchanan***, Hyun Dong Lee, Jerry Weihong Liu, Ke Alexander Wang, David M. Zoltowski, Christopher Ré, Scott Linderman.
*Under review, Arxiv Preprint: 2412.17227, 2025.*

[5] **Brain-wide representations of prior information in mouse decision-making**
International Brain Laboratory. *Nature, 2025.*

[6] **Reproducibility of in vivo electrophysiological measurements in mice**
International Brain Laboratory. *eLife, 2025.*

[7] **Archon: An architecture search framework for inference-time techniques**
Jon Saad-Falcon, Adrian Gamarra, Shlok Natarajan, Nahum Maru, Hristo Todorov, Etash Guha, **E. Kelly Buchanan**, Mayee Chen, Neel Guha, Christopher Ré, Azalia Mirhoseini.
*International Conference on Machine Learning (ICML), 2025.*

[8] **Batik: behavior discovery, interpretation and annotation directly from raw video using large vision-language models**
Aditya Nair, Rohan Kolhe, Nestor Coria, Jadon Hale, Jineun Kim, Angel Wang, Amit Vinograd, Dan Biderman, **Kelly Buchanan**, Pietro Perona, Scott Linderman.
*Under Review, 2024.*

[9] **Brain-to-Text Benchmark '24: Lessons Learned**
Francis R. Willett, Jingyuan Li, Trung Le, Chaofei Fan, Mingfei Chen, Eli Shlizerman, Yue Chen, Xin Zheng, Tatsuo S. Okubo, Tyler Benster, Hyun Dong Lee,

Maxwell Kounga, **E. Kelly Buchanan**, David Zoltowski, Scott W. Linderman, Jaimie M. Henderson.
*ArXiv Preprint: 2412.17227, 2024.*

[10] **Pathologies of Predictive Diversity in Deep Ensembles**
Taiga Abe, **E. Kelly Buchanan**, Geoff Pleiss, John P. Cunningham.
*Transactions on Machine Learning Research, 2024.* **Featured Certification.**

[11] **The Effects of Ensembling on Long-Tailed Data**
**E. Kelly Buchanan**, Geoff Pleiss, Yixin Wang, John P. Cunningham.
*Neural Information Processing Systems (NeurIPS), 2023, Heavy Tails in Machine Learning Workshop.*

[12] **Reliability Benchmarks for Semantic Segmentation**
**E. Kelly Buchanan**, Michael W. Dusenberry, Jie Ren, Kevin P. Murphy, Balaji Lakshminarayanan, Dustin Tran.
*Neural Information Processing Systems (NeurIPS), 2022, Workshop on Distribution Shifts.*

[13] **The Best Deep Ensembles Sacrifice Predictive Diversity**
Taiga Abe*, **E. Kelly Buchanan***, Geoff Pleiss, John Cunningham.
*Neural Information Processing Systems (NeurIPS), 2022, I Can't Believe It's Not Better Workshop.*
**Entropic Award for Most Surprising Negative Result**.

[14] **Deep ensembles work, but are they necessary?**
Taiga Abe*, **E. Kelly Buchanan***, Geoff Pleiss, Richard Zemel, John Cunningham.
*Neural Information Processing Systems (NeurIPS), 2022.*

[15] **Plex: Towards Reliability using Pretrained Large Model Extensions**
Dustin Tran, Jeremiah Liu, Mike Dusenberry, Du Phan, Mark Collier, Jie Ren, Kehang Han, Zi Wang, Zelda Mariet, Huiyi Hu, Neil Band, Tim GJ Rudner, Karan Singhal, Zachary Nado, Joost van Amersfoort, Andreas Kirsch, Rodolphe Jenatton, Nithum Thain, Honglin Yuan, **E. Kelly Buchanan**, Kevin P. Murphy, D Sculley, Yarin Gal, Zoubin Ghahramani, Jasper Snoek, Balaji Lakshminarayanan.
*Internal Conference on Machine Learning (ICML), 2022, Pre-training Workshop.*

[16] **Neuroscience cloud analysis as a service**
Taiga Abe, Ian Kinsella, Shreya Saxena, **E. Kelly Buchanan**, Joao Couto, John Briggs, Sian Kitt, Ryan Glassman, John Zhou, Liam Paninski, John P. Cunningham.
*Neuron, 2022.*

[17] **Semi-supervised sequence modeling for improved behavioral segmentation**
Matthew R. Whiteway, Evan S Schaffer, Anqi Wu, **E. Kelly Buchanan**, Omer F. Onder, Neeli Mishra, Liam Paninski. *Conference on Computer Vision and Pattern Recognition (CVPR) Computer Vision for Animal Behavior, Tracking and Modeling Workshop, 2021.*

[18] **Partitioning variability in behavioral videos using semi-supervised deep generative models**
Matthew Whiteway, Daniel Biderman, **E. Kelly Buchanan**, Anqi Wu, Mario Dipoppa,

Yoni Friedman, International Brain Laboratory, John Cunningham, Liam Paninski. *PLoS Computational Biology, 2021.*

[19] **DeepGraphPose: a semi-supervised deep graphical model for improved animal pose tracking**.
Anqi Wu*, **E. Kelly Buchanan***, Matthew Whiteway, Michael Schartner, Guido Meijer, Jean-Paul Noel, Erica Rodriguez, Claire Everett, Amy Norovich, Evan Schaffer, Neeli Mishra, C. Daniel Salzman, Dora Angelaki, Andres Bendesky, John P. Cunningham, Liam Paninski.
*Neural Information Processing Systems (NeurIPS), 2020.*

[20] **Voltage imaging and optogenetics reveal behaviour-dependent changes in hippocampal dynamics** Yoav Adam, Jeong J. Kim, Shan Lou, Yongxin Zhao, Michael E. Xie, Daan Brinks, Hao Wu, Mohammed A. Mostajo-Radji, Simon Kheifets, Vicente Parot, Selmaan Chettih, Katherine J. Williams, Benjamin Gmeiner, Samouil L Farhi, Linda Madisen, **E. Kelly Buchanan**, Ian Kinsella, Ding Zhou, Liam Paninski, Christopher D. Harvey, Hongkui Zeng, Paola Arlotta, Robert E. Campbell, Adam E. Cohen.
*Nature 569, 413417 (2019).*

[21] **Penalized matrix decomposition for denoising, compression, and improved demixing of functional imaging data**
**E. Kelly Buchanan**, Ian Kinsella, Ding Zhou, Rong Zhu, Pengcheng Zhou, Felipe Gerhard, John Ferrante, Ying Ma, Sharon Kim, Mohammed Shaik, Yajie Liang, Rongwen Lu, Jacob Reimer, Paul Fahey, Taliah Muhammad, Graham Dempsey, Elizabeth Hillman, Na Ji, Andreas Tolias, Liam Paninski.
*BioRxiv Preprint:334706, 2018.*

[22] **Quantifying the behavioral dynamics of C. elegans with autoregressive hidden Markov models**.
**E. Kelly Buchanan**, Akiva Lipshitz, Scott Linderman, Liam Paninski.
*Workshop on Worm's Neural Information Processing at Neural Information Processing Systems (NIPS), Long Beach, CA, 2017.*
**Selected for a spotlight presentation**.

## Abstracts

[1] **Constrained matrix factorization methods for denoising and demixing voltage imaging data**.
**E. Kelly Buchanan**, Johannes Friedrich, Ian Kinsella, Patrick Stinson, Pengcheng Zhou, Felipe Gerhard, John Ferrante, Graham Dempsey, Liam Paninski.
*Computational and Systems Neuroscience (Cosyne). Denver, CA. 2018.*

[2] **Assessing the validity of extracellular recordings and the variability of spike-triggered stimulation experiments**.
**E. Kelly Buchanan**, David J. Guggenmos, Gustaf M. Van Acker, Randolph Nudo.
*Society for Neuroscience (SfN) Annual Meeting. San Diego, CA. November 2016.*

[3] **Efficacy of an automated spike detection algorithm for processing in vivo multichannel recordings**.
**E. Kelly Buchanan**, David J. Guggenmos, Alverto Averna, Caleb Dunham, Gustaf Van Acker, Randolph J. Nudo, Michaela Chiappalone.

*Society for Neuroscience (SfN) Annual Meeting. Chicago, IL. October 2015.*

## Invited Talks

**Developing Reliable Frameworks for Longitudinal Evaluation of AI Agents**

- Together AI. San Francisco, California, USA. October 2025.

**Pathologies of Predictive Diversity in Deep Ensembles**

- Center for Neural Data Science at NYU. New York, USA. October 2023.

**Building reliable tools for neuroscience research**

- Scott Linderman Group Meeting in Stanford University. CA, USA. September 2023.
- Gatsby Tri-Center Meeting. Wales, UK. June 2023.
- Pietro Perona Group Meeting in Caltech. Online. March 2023.
- Machine Learning Seminar in the Mohamed bin Zayed University of AI. Abu Dhabi, UAE. January 2023.

**Deep Ensembles work but are they necessary?**

- Amazon Science Machine Learning Seminar. Online. March 2023.
- ETH Zurich Uncertainty Reading Group. Online, February 2023.
- Machine Learning Seminar in New York University Abu Dhabi. Abu Dhabi, UAE. January 2023.

**Plex: last-layer changes in CLIP models for semantic segmentation**

- Paninski Group Meeting at Columbia University. New York, USA. October 2022.
- Reliable Deep Learning Team Meeting at Google. New York, USA. September 2022.

**Algoritmos para acelerar el descrubimiento cientfico en la neurociencia**

- TECHSUYO 2021. San Diego, CA, USA. October 2021.

**Encoding expert knowledge for improved behavioral video analysis**

- Araya Research Team Meeting. Online. January 2021.
- Brain Initiative Team-Research Circuit Program (U19) Motor Control Meeting at Columbia University. Online. November 2020.
- Neuromatch 3.0 Virtual Conference. November 2020.

**Denoising and demixing neural activity in functional imaging data**

- Cortex Lab Group Meeting in the University College London. London, UK. July 2019.
- IARPA Machine Intelligence from Cortical Networks Meeting. Texas, USA. March 2018.

**Challenges in online spike detection and clustering during electrical microstimulation**

- Rehabilitation Technologies Seminar in the Italian Institute of Technology. Genoa, Italy. January 2016.
- Cortical Plasticity Seminar in the University of Kansas Medical Center. Kansas, USA. December 2015.

## Selected Honors and Awards

Entropic Award for Most Surprising Negative Result — 2022
I Can't Believe It's Not Better Workshop at NeuRIPS

Innovation Award for solving X — 2022
Google X

Ph.D. Engineering and Science Fellowship (awarded) — 2019
Graduate Degrees for Minorities in Engineering and Science Consortium

Machine Learning Summer School Scholarship — 2019
Imperial College London

Deep Learning and Reinforcement Learning Summer School Scholarship
Alberta Machine Intelligence Institute — 2019
Vector Institute for Artificial Intelligence — 2018

Wallace S. Strobel Fellowship — 2014 – 2016
University of Kansas

David D. and Mildred H. Robb Award — 2015
University of Kansas School of Engineering

Full Tuition Award for Academic Excellence — 2009 – 2014
University of Kansas and Fulbright Peru

## Teaching Experience

**Columbia University**
Guest Seminar:

- Foundations of Graphical Models Lab — Fall 2020

**University of Kansas**
Supplemental Instructor:

- Physics I — Fall 2013
- Introduction to Digital Logic Design — Fall 2010

## Professional Activities

Co-organizer of I can't believe it is not better Workshop (ICBINB) at the Neural Information Processing Systems Conference — 2023

Co-organizer of The Symbiosis of Deep Learning and Differential Equations at the Neural Information Processing Systems Conference — 2021-2022

Reviewer for Journal of Machine Learning Research — 2023-
International Conference in Machine Learning — 2021-
Neural Information Processing Systems Conference — 2020-

## Service

Senior Program Chair at Women in Machine Learning (WiML) — 2023

Mentor for Black Undergraduate Mentorship Program (BUMP) — 2022-2023

Co-founder DEI Committee at Columbia University Theory Center — 2019 – 2022

Facilitator for Girls Who Code at Zuckerman Institute — 2019 – 2020

Coding tutor for middle school children at CoderDojo KC — 2015 – 2016