

Beren Millidge

Email: beren@millidge.name

LinkedIn:

www.linkedin.com/in/beren-millidge-377065142/

GitHub: github.com/BerenMillidge

EDUCATION

University of Edinburgh Ph.D. in Machine Learning and Computational Neuroscience, supervised by Richard Shillcock	Edinburgh 2017–2021
University of Edinburgh MSc. in Artificial Intelligence, Distinction	Edinburgh 2016–2017
University of Oxford BSc. in Psychology, Philosophy, and Linguistics, First Class Honours	Oxford 2013–2016

EXPERIENCE

University of Oxford Postdoctoral Researcher <i>Working with Rafal Bogacz on Predictive Coding and Reinforcement Learning in the Basal Ganglia</i>	Oxford April 2021 –Present
University of Sussex Visiting Fellow <i>Worked closely with Christopher Buckley and Anil Seth on a wide range of Machine Learning and Computational Neuroscience projects. See publications list.</i>	Brighton January 2020 –Current
Payara Services Limited Software Development Intern <i>Java middleware and application server development.</i>	Malvern June –September 2016
Oxford Centre for Theoretical Neuroscience and Artificial Intelligence Student Researcher <i>Ran simulated psychophysics experiments on deep spiking neural networks and performed statistical analyses.</i>	Oxford May –August 2015

AREAS OF EXPERTISE

- **Machine Learning** Model-Based and Model-Free Reinforcement Learning, Active Inference, Predictive Coding
- **Machine Learning Libraries** Pytorch, Tensorflow, Keras, Flux.jl
- **Bayesian Inference** Variational Inference, Graphical Models, MCMC, (Stan, Edward, Turing.jl)
- **Statistical Analysis** ANOVA, LMER
- **Web Development** Django, Flask, Nodejs, Express.js, React, Vue.js, Shiny (R)

LANGUAGES

- **Highly Experienced** Python, Javascript, Julia
- **Proficient** C++, C, Java, Rust, HTML, CSS, R
- **Conversant** CUDA, Ruby, Haskell, Elm, Bash, PHP, Typescript, MATLAB

PUBLICATIONS

- [1] M. Aguilera, **B. Millidge**, A. Tschantz, and C. L. Buckley, “How particular is the physics of the free energy principle?”, *arXiv preprint arXiv:2105.11203*, 2021.

- [2] **B. Millidge**, “Applications of the free energy principle to machine learning and neuroscience”, *arXiv preprint arXiv:2107.00140*, 2021.
- [3] **B. Millidge**, “Towards a mathematical theory of abstraction”, *arXiv preprint arXiv:2106.01826*, 2021.
- [4] **B. Millidge**, A. Tschantz, A. Seth, and C. Buckley, “Neural kalman filtering”, *arXiv preprint arXiv:2102.10021*, 2021.
- [5] **B. Millidge**, A. Tschantz, A. Seth, and C. Buckley, “Understanding the origin of information-seeking exploration in probabilistic objectives for control”, *arXiv preprint arXiv:2103.06859*, 2021.
- [6] A. D. Noel, C. van Hoof, and **B. Millidge**, “Online reinforcement learning with sparse rewards through an active inference capsule”, *arXiv preprint arXiv:2106.02390*, 2021.
- [7] **B. Millidge**, A. Tschantz, and C. L. Buckley, “Predictive coding approximates backprop along arbitrary computation graphs”, *arXiv preprint arXiv:2006.04182*; *Submitted to ICLR 2021*, 2020.
- [8] **B. Millidge**, A. Tschantz, and C. L. Buckley, “Whence the expected free energy?”, *Neural Computation*, 2020.
- [9] **B. Millidge**, A. Tschantz, C. L. Buckley, and A. Seth, “Activation relaxation: A local dynamical approximation to backpropagation in the brain”, *arXiv preprint arXiv:2009.05359*; *submitted to ICLR 2021*, 2020.
- [10] **B. Millidge**, A. Tschantz, C. L. Buckley, and A. Seth, “Investigating the scalability and biological plausibility of the activation relaxation algorithm”, *arXiv preprint arXiv:2009.05359*; *submitted to NeurIPS 2020 workshop, Beyond Backpropagation in the Brain*, 2020.
- [11] **B. Millidge**, A. Tschantz, A. Seth, and C. L. Buckley, “Relaxing the constraints on predictive coding models”, *arXiv preprint arXiv:2010.01047*; *submitted to Neural Networks*, 2020.
- [12] **B. Millidge**, A. Tschantz, A. K. Seth, and C. L. Buckley, “On the relationship between active inference and control as inference”, *IEEE IWAI Workshop on Active Inference*, 2020.
- [13] **B. Millidge**, A. Tschantz, A. K. Seth, and C. L. Buckley, “Reinforcement learning as iterative and amortised inference”, *arXiv preprint arXiv:2006.10524*, 2020.
- [14] A. Seth, **B. Millidge**, C. L. Buckley, and A. Tschantz, “Curious inferences: Reply to sun & firestone on the dark room problem”, *Trends in Cognitive Science*, 2020.
- [15] A. Tschantz, **B. Millidge**, A. K. Seth, and C. L. Buckley, “Control as hybrid inference”, *ICML 2020 Workshop on Theoretical Foundations of RL*, 2020.
- [16] A. Tschantz*, **B. Millidge***, A. K. Seth, and C. L. Buckley, “Reinforcement learning through active inference”, *ICML 2020 Workshop Bridging AI and Cognitive Science*, 2020.
- [17] **B. Millidge**, “Combining active inference and hierarchical predictive coding: A tutorial introduction and case study”, *PsyArxiv*; *Submitted to Cognition*, 2019.
- [18] **B. Millidge**, “Deep active inference as variational policy gradients”, *Journal of Mathematical Psychology*, vol. 96, p. 102 348, 2019.
- [19] **B. Millidge**, “Fixational eye movements: Data augmentation for the brain?”, *PsyArxiv*, 2019.
- [20] **B. Millidge**, “Implementing predictive processing and active inference: Preliminary steps and results”, *PsyArxiv*, 2019.
- [21] R. Shillcock, **B. Millidge**, and A. Ravignani, “Exploring infant vocal imitation in tadarida brasiliensis mexicana”, in *Neurobiology of Speech and Language*, 2019, pp. 36–37.
- [22] **B. Millidge** and R. Shillcock, “A predictive processing account of bottom-up visual saliency using cross-predicting autoencoders”, *PsyArxiv*, 2018.

AWARDS

- Best Dissertation in Artificial Intelligence Award, University of Edinburgh 2017
- Highest Performance in Prelims Linguistics, University of Oxford 2014

SELECTED INVITED TALKS

- Sackler Centre Seminar Series, University of Sussex 2020
- Institute for Adaptive Neural Computation, University of Edinburgh 2020
- Adaptive and Evolutionary Systems Group, University of Sussex 2019
- Nature Inspired Machine Learning Group, Oak Ridge National Laboratory, USA 2019
- Chancellor's Presentation, University of Edinburgh 2019
- Neurons and Systems Seminar, University of Edinburgh 2019
- Institute for Adaptive Neural Computation, University of Edinburgh 2018