Andrew M. **Webb**

Machine Learning Research Scientist

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Produced 17/09/2019 — up-to-date CV at www.awebb.info/cv

Experience

Postdoctoral Research Associate, LAMBDA/PAMELA Projects *2017–Present*

School of Computer Science, University of Manchester

On the LAMBDA project, I am studying methods for explicitly encouraging diversity in ensembles in deep learning (arxiv.org/abs/1902.04422 and github.com/grey-area/modular-loss-experiments), while minimizing communication overheads when training in a distributed setting. We are also studying bias and variance in ensemble methods. Presented work at the Arm Research Summit 2018. On the PAMELA project, I am integrating object detection into SLAM (simultaneous localization and mapping) systems, and specifically looking at energy/accuracy trade-offs in real-time applications.

Participant, One Week Data Study Group *2018*

Alan Turing Institute, London

Worked with NATS—the UK's main air navigation service provider—and a team to predict aircraft trajectories. Developed a proof-of-concept nearest neighbour-based approach, where the future trajectory of a flight is assumed to lie within the range of the nearest N neighbours of previously seen (suitably normalized) flights. Also reduced time taken to join flight and weather data (done regularly at NATS) from hours to minutes.

Research Software Engineer, SpiNNaker Project *2016*

School of Computer Science, University of Manchester

Wrote code for generating neural data structures for SpiNNaker—a many-core neuromorphic (spiking neural network) computing platform—in parallel on the machine itself, decreasing load times and energy use by an order of magnitude. (github.com/project-rig/pynn_spinnaker).

Research Software Engineer, SpiNNaker Project *2012*

School of Computer Science, University of Manchester

Developed graphics rendering software for the SpiNNaker many-core neuromorphic computing platform, which did not support floating point arithmetic. Software was demonstrated to visitors from Samsung, and is still in use for demonstrations. (github.com/SpiNNakerManchester/spinnaker_tools/tree/master/apps/pt_demo).

Publications

- C. Shand, R. Allmendinger et al.: *Evolving Controllably Difficult Datasets for Clustering*, **best paper nomination** GECCO 2019
- A. M. Webb, G. Brown, and M. Luján: *ORB-SLAM-CNN: Lessons in Adding Semantic Map Construction …* TAROS 2019
- A. M. Webb, C. Reynolds et al.: *Joint Training of Neural Network Ensembles*, preprint arXiv:1902.04422 2019
- S. Saeedi, B. Bodin et al.: *Navigating the Landscape for Real-Time Localization and Mapping…*, Proc. IEEE Vol. 2018
- A. M. Webb: *On Selection for Evolvability*, PhD thesis 2016
- A. M. Webb, J. Handl, and J. Knowles: *How Much Should You Select for Evolvability?*, ECAL 2015
- A. M. Webb and J. Knowles: *Studying the Evolvability of Self-Encoding Genotype-Phenotype Maps*, ALIFE 2014
- A. M. Webb, S. Davies, D. Lester: *Spiking Neural PID Controllers*, ICONIP 2011

Education

PhD in Computer Science, Machine Learning and Optimization Group *2012–2016*

School of Computer Science, University of Manchester

Research synopsis: Evolutionary algorithms are a family of heuristics for solving optimization problems. Solutions can differ in their 'evolvability'—their propensity to give rise to good descendant solutions. I model the evolvability of each solution as a hidden variable about which we can learn something by making noisy observations. I use sequential Bayesian filtering algorithms to estimate the evolvability of each solution in the population, in order to select evolvable solutions. Theoretical and experimental results show that periodically selecting solutions based on evolvability estimates can lead to increased expected performance on some optimization problems. (Thesis: awebb.info/misc/thesis.pdf). During the PhD I attended master's degree level course units on machine learning and data dimensionality reduction, and also undergraduate course units in the mathematics department.

BSc in Artificial Intelligence, First Class Honours (80%) *2006–2010*

University of Manchester

- Studied course units such as *Computer Vision*, *Symbolic AI*, and *Machine Learning and Optimization*.
- As a final year project, produced software that translates descriptions of programs into sets of 2D tile shapes, where tiling the plane with those shapes is analogous to running the program. (Report: awebb.info/misc/ug_report.pdf).

Skills

Programming Languages (ranked by proficiency)

- Python (with NumPy, SciPy)
- C++
- C
- Julia

Machine Learning/Inference/Probability

- Training deep neural network models in PyTorch and TensorFlow
- Bayesian statistics, experience with probabilistic programming languages Stan and PyMC
- Bayesian filtering algorithms, e.g., Kalman filter, particle filter
- Metaheuristic optimization algorithms such as evolutionary algorithms
- Scikit-learn machine learning library
- Spiking neural networks and neuromorphic hardware

Quantum Computing

- Wrote and maintain QCircuits, a Python library for simulating quantum computers (awebb.info/qcircuits/index.html)

Other Computing Skills

- Experience writing software for distributed architectures
- Mathematica
- Git version control
- Graphics with OpenGL

Communication/Other Skills

- Presented at international conferences, e.g., ALIFE, ECAL, the Arm Research Summit
- Co-chaired a regular research seminar
- One-to-one teaching and marking on *Mathematical Techniques for CS*, *Computer Graphics*, and *Symbolic AI* course units
- Ran a successful martial arts club for adults and children

Interests

Hobbies and interests include guitar, fishkeeping (tropical fish and invertebrates), science fiction, board games, and fitness, and I'm a keen fan/follower of the space industry. I maintain a blog at awebb.info/blog that I use to write about topics as I learn or to explore problems that are too small to lead to publication.