Andrew M. Webb

MACHINE LEARNING RESEARCH SCIENTIST

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Produced 31/07/2024 — up-to-date CV at www.awebb.info/cv

Experience

Lead Machine Learning Research and Development Engineer
2019–Present

vTIME LIMITED, LIVERPOOL

Led a team of four engineers developing novel deep learning solutions for problems with vision, audio, text, and 3D scene data. Developed processes for reducing development time and improving reproducibility. Exported models for deployment on mobile devices, and deployed models at scale in the cloud with AWS Lambda and AWS EC2/ECS. Example projects include text-to-speech, automatic avatar and room customization, emotion/animation prediction. Produced tools used in the development of products, e.g., the virtual reality game Border Bots VR.

Postdoctoral Research Associate, LAMBDA/PAMELA Projects
2017–2019

SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF MANCHESTER

On the LAMBDA project, I studied 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 also studied bias and variance in ensemble methods. Presented work at the Arm Research Summit 2018. On the PAMELA project, I integrated 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 for flight trajectory prediction. Proposed a method that reduced time taken to join flight and weather data (a common operation) 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. (github.com/SpiNNakerManchester/spinnaker_tools/tree/master/apps/pt_demo).

Publications

- D. Wood, T. Mu et al.: *A Unified Theory of Diversity in Ensemble Learning*, JMLR 2023
- 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 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, ordered by proficiency: Python, Scala, C++, C
- Python libraries: PyTorch, NumPy, Matplotlib, SciPy, Scikit-learn

Machine Learning/Inference/Probability

- Training deep neural network models in PyTorch and exporting to portable formats, e.g., TorchScript, ONNX
- Experience with LLMs including open source/local LLMs
- Model architectures/methods: transformers, normalizing flows, diffusion models, GANs
- 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
- SLAM (simultaneous localization and mapping) algorithms
- Spiking neural networks and neuromorphic hardware

Cloud Computing / AWS

- Deployed models at scale on AWS with Lambda, EC2 auto-scaling spot fleets, and ECS
- Experience with other AWS services: S3, ECR, SQS, API Gateway

Other Computing Skills

- Docker, Docker Compose
- CI/CD; GitHub Actions, GitLab CI/CD
- Bash
- Git
- Mathematica
- Graphics with OpenGL
- Wrote QCircuits, a Python library for simulating quantum computers (awebb.info/qcircuits/index.html)

Communication/Management/Other Skills

- Managing a team
- Strong mathematical background
- Presented at international conferences, e.g., ALIFE, ECAL, the Arm Research Summit, Develop
- 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 indoor climbing, football, science fiction, and board games. I use my Twitter account as a platform for sharing animations and visualizations about maths and science.