Henry Aldridge

henry.aldridge.23@ucl.ac.uk | linkedin.com/in/henry-aldridge | henry-ald.github.io | London, UK

Education

University College London · *PhD, Statistical Machine Learning* Sep 2023 – Sep 2027 (expected)

- Centre for Doctoral Training in Data Intensive Science, Dept. of Physics & Astronomy. Supervisor: Prof. Jason McEwen (Interim Chief Scientist, The Alan Turing Institute).

University of Leeds · *MPhys Physics, First Class Honours (82%; First $\geq$ 68.5%)* 2019 – 2023

- Master's project (87%): trained CNNs to classify cancer cells by disease stage from images of cells deforming in a microfluidic device, using transfer learning and data augmentation to mitigate overfitting.
- 2023 Beaumont Award for excellent undergraduate research (one of 10 recipients university-wide).

Research Experience

Adaptive Langevin nested sampling for Bayesian model comparison of data-driven priors

- Developing an algorithm to compare competing models in high-dimensional problems by their Bayesian evidence, e.g. identifying which neural-network prior is best supported by the data in inverse imaging problems.
- Proposed an adaptive Langevin Markov chain Monte Carlo (MCMC) scheme for the likelihood-constrained sampling step of nested sampling.
- Built a vectorised, JIT-compiled GPU sampler that runs many chains in parallel, scaling nested sampling to thousands of dimensions.

Self-supervised conformal prediction with equivariant bootstrapping

- Developed self-supervised uncertainty quantification for inverse imaging problems: conformal prediction calibrates heuristic error estimates from equivariant bootstrapping, which exploits symmetries in the data.
- Implemented self-supervised calibration via Stein's unbiased risk estimate (SURE), using automatic differentiation for Hutchinson trace estimates and adjoint operators.
- Applied to dark matter mass-mapping from weak gravitational lensing, where avoiding expensive, cosmology-dependent simulated calibration data removes a potential source of bias in cosmological inference.

Industry Experience

RevEng.AI (Series A cybersecurity start-up) · *Machine Learning Research Intern* Apr 2026 – Oct 2026

- Led uncertainty quantification research for LLM-based binary decompilers to estimate when a decompilation can be trusted.
- Built a conformal prediction pipeline giving calibrated token-level prediction sets and sequence-level confidence scores, and visually flagging uncertain tokens at a controlled false-alarm rate.
- Conditioned calibration on a compressed latent representation of the input binary, improving robustness to distribution shift between calibration and deployment data.
- Developed the pipeline into a tool for uncertainty quantification in the company's LLM decompiler.

MediaTek Research UK · *Group Industry Project* Jan 2024 – Apr 2024

- Co-developed a second-order neural-network compression method that uses an online-learned approximation of the inverse Fisher information to choose which weights to prune.
- Reached 84% CIFAR-10 accuracy for ResNet-18 at 95% sparsity, against 60% for the classical method it builds on.

Publications

- **H. J. Aldridge**, T. I. Liaudat, M. Pereyra, J. D. McEwen. *Adaptive Langevin nested sampling for Bayesian model comparison of data-driven priors.* In preparation for ICML 2027.
- **H. J. Aldridge**, T. I. Liaudat, M. Pereyra, J. D. McEwen. *Self-supervised conformal prediction with equivariant bootstrapping for image uncertainty quantification.* International Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering 2026. arXiv:2605.18655.
- J. McGowan, W. S. Lai, W. Chen, **H. Aldridge**, et al. *Efficient model compression techniques with FishLeg.* NeurIPS 2024 Workshop on Machine Learning and Compression. arXiv:2412.02328.

Skills

Statistics & ML: Bayesian inference and model comparison, MCMC, conformal prediction, uncertainty quantification, deep learning, LLMs, optimisation, automatic differentiation, linear algebra, probability.

Software: Python (PyTorch, NumPy, scikit-learn, vLLM); Git, Linux/Bash, Slurm/HPC.

Teaching

UCL · *Postgraduate Teaching Assistant, MSc module* Machine Learning with Big Data Jan 2025 – Sep 2025