# Jake McAllister Dorman

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## EDUCATION

**PhD Machine Learning** Oct 2024 - Present
Department of Physics, University of Nottingham.

**MSc Machine Learning in Science** - Distinction (86%) Sep 2023 - Sep 2024
Department of Physics, University of Nottingham.

**BSc Mathematics with Economics** - Upper Second Class (68%) Sep 2020 - May 2023
Department of Mathematics, University College London.

**A Levels** - Maths: A*, Further Maths: A*, Physics: A*, Philosophy: A, Sep 2018 - Jun 2020
Extended Project Qualification: A
Fakenham Sixth Form.

## RESEARCH PROJECTS & EXPERIENCE

**Rare Event Analysis of Large Language Models** Oct 2024 - Present
*PhD Project - University of Nottingham.*
[**ICML 2026 Spotlight & Oral Presentation**] Adapting Large Deviation Theory techniques from Statistical Physics and Computational Chemistry (including Importance Sampling, Markov-Chain Monte Carlo (MCMC) and MBAR) to sample and estimate the likelihood of Rare Events in Large Language Models. This allows for probability estimates of an LLM producing unwanted or dangerous behaviour, that may go unobserved during testing but have non-negligible frequency when models are used by the general public. This methodology has allowed for probability estimates to be made with $10^8$ times fewer samples than would be needed using Direct Sampling. Current research directions include applications of this methodology to AI safety contexts and further MCMC efficiency improvements via infilling, as well as rigorous error analysis.

Supervised by Dr. Edward Gillman & Prof. Juan Garrahan.

**Agentic LLM Pipeline Development for R&D Tax Claims** Oct 2025 - Present
*Subcontractor - KPMG.*
Building agentic LLM pipelines to assist with research and writing for R&D tax credit claims. This includes the development and rigorous testing of LLM personas in multi-agent system, guided by relevant tax knowledge and law.

**Fine Grained Control of Text Generation Using Large Language Models** Mar 2024 - Sep 2024
*Internship & Master's Project - University of Nottingham.*
Investigated how the choice of decoding strategy influences the distribution of text produced by a Large Language Model over a variety of observables, including linguistic and model based metrics. This included standard decoding strategies as well as a custom-made Markov-Chain Monte-Carlo (MCMC) based decoding strategy utilizing Transition Path Sampling (TPS) to gradually generate completions with desired characteristics. Demonstrated how Reinforcement Learning (RL) Techniques such as Proximal Policy Optimization (PPO) can be used to target the TPS (exponentially biased) dynamics, allowing for the generation of uncorrelated samples from these dynamics.

Supervised by Dr. Edward Gillman & Dr. Jamie Mair.

**Numerical Navier Stokes Simulations for Bayesian Decision Making** Jun 2023 - Jan 2024
*Research Internship - University College London & Stockholm University.*
Developed a Python library to produce complex hydrodynamical simulations efficiently, which was then used for the evaluation of a simulation-based Bayesian decision-making framework.

Supervised by Dr. Niall Jeffrey (UCL) and Dr. Justin Alsing (Stockholm University).

**Learning Physics from Simulated Systems with NeuralODEs** Jun 2023 - Sep 2023
*Research Internship - University College London.*
Trained Neural Ordinary Differential Equations on data generated from various numerically simulated physical models. From here, Symbolic Regression was used on the predicted differential values from the NeuralODE to derive the differential equations governing the physical system, testing the possibility of using this technique on real data to recover unknown dynamics. Investigated the possibility of using conservation of energy and action minimization as loss functions for Neural ODEs.

Supervised by Dr. Niall Jeffrey.

**Mammal Inspired Grid Cells for Navigation of Reinforcement Learning Agents** Aug 2021 - Sep 2021
*Research Internship - University College London.*
Evaluating the performance of RL Agents trained with state observations processed through Mammalian-inspired grid cells and compared performance against models with fully-observable states.

Supervised by Dr. Augustine Mavor-Parker.

## PUBLICATIONS

- **J. McAllister Dorman**, E. Gillman, D. C. Rose, J. F. Mair, J. P. Garrahan, *Rare Event Analysis of Large Language Models* - **ICML 2026 Spotlight & Oral Presentation**. arXiv:2602.06791.

## CONFERENCES AND PRESENTATIONS

**International Conference of Machine Learning (ICML) 2026** Jul 2026
*Seoul, South Korea* - Spotlight Oral & Poster Presentations.

**'10 Minute Talks' PhD Conference** Sep 2025
*University of Nottingham* - Organiser & Oral Presentation.

**Workshop: Fluctuations in self-interacting and learning processes** Jul 2025
*NORDITA, Stockholm* - Poster Presentation.

## TEACHING

**Workshop Lead - MSc Machine Learning in Science** Oct 2025 - Present
*Department of Physics, University of Nottingham.*
Independently running problem classes on Supervised Learning, as well as assisting with teaching of Unsupervised and Reinforcement Learning.

**Teaching Assistant - BSc Physics** Oct 2024 - Present
*Department of Physics, University of Nottingham.*
Assisting in problem classes for first year modules 'Basic Mathematical Methods' and 'Quantitative Physics', and third year module 'Scientific Computing in Python'.

**Teaching Assistant - MSc Machine Learning in Science** Oct 2024 - Sep 2025
*Department of Physics, University of Nottingham.*
Assisting in problem classes for Supervised, Unsupervised and Reinforcement Learning modules.

**Mathematics Revision Content Creator** Jul 2022 - Oct 2022
*StudySmarter.*
Creating written and visual content including revision articles and flashcards for a leading EdTech Startup, for students studying A level Further Mathematics and AP Calculus.

**GCSE Mathematics Tutoring** Jan 2019 - Mar 2020
*Fakenham Academy Norfolk.*
GCSE Mathematics and Further Mathematics tutoring for disadvantaged but promising students at a local high school.

## OTHER ROLES AND ACTIVITIES

**President** Jun 2022 - Jun 2023

*UCL Artificial Intelligence Society.*

Managing a team of over 30 people to deliver an average of 3 events per week, ensuring all events were of a high quality and created an informative, inclusive space for members. Planning and hosting Machine Learning tutorials, journal clubs, keynote speakers and large scale social events, to give members an opportunity to learn and network. Leading project teams of students interested in producing their own research, as well as helping build student-led startups through the startup incubator AI Foundry.

**Head of Operations** Jun 2021 - Jun 2022

*Climate Hack.AI.*

Key organizer of an international machine learning datathon between 25 world class universities across the UK, USA and Canada. The competition aimed to use Machine Learning to accurately replicate future satellite imagery of weather data, given an input of previous satellite imagery. This allowed for a reduction in carbon emissions of up to 100 kilotonnes per year in the UK alone, according to data partner Open Climate Fix. Created industry partnerships to secure both a dataset and over £100,000 in sponsorship. Managed an international team to plan and execute joint finals at UCL and Harvard.

## OTHER SKILLS

**Programming Languages:** Python, Julia.

**Machine Learning Frameworks:** Pytorch, HuggingFace, JAX, TensorFlow.