

Emma Allen

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I am a technically skilled and intellectually curious student, with the ultimate goal to build a career developing and applying AI techniques and ML in the physical sciences, from high energy physics to climate modelling. I am currently studying for an MPhil in Data Intensive Science at the University of Cambridge, supported by the Murray Edwards Scholarship.

Education

University of Cambridge 2025 to 2026

Data Intensive Science, MPhil

- Taking courses across machine learning, statistical analysis and high performance computing
- Awarded Murray Edwards Scholarship for Women in Data Intensive Science worth £30,000.

University of Edinburgh 2021 to 2025

Computational Physics, BSc Hons

- Upper Second Class Division, 2:1
- Awarded pre-honours certificate of achievement for excellent grades in first and second year
- Awarded Margaret Campbell Scott scholarship for achieving excellent entrance qualifications (achieved A*A*A), worth £1000
- Senior Honours Project: The Physics of Morphologically Diverse Bacteria in Moving Fluids

University of California, Los Angeles (UCLA) 2023 to 2024

Academic Exchange

- 10% acceptance rate
- Completed courses in quantum mechanics (A), machine learning (A) and differential equations (A)
- Attended Conference for Undergraduate Women and Non-Binary Physicists (CUWiP) in San Diego

Research Experience

Summer Research Student June - August 2025

University of Edinburgh, Edinburgh

- Project focused on reconstructing Parton Distribution Functions (PDFs), which are essential for predicting outcomes in hadron collider experiments but must be inferred from experimental data. The work involved assessing the Gaussianity of NNPDF4.0 replicas by computing excess kurtosis across all one-dimensional marginals and reconstructing one and two dimensional PDFs using Kernel Density Estimation (KDE).
- I built global 450-dimensional correlation matrix was built by averaging overlapping entries from pairwise 2D KDE correlation matrices. The reconstructed correlation matrix showed strong agreement with empirical data, validating KDE as a reliable method for PDF reconstruction.
- Awarded School of Physics summer research scholarship worth £2580.
- Supervisor: Professor Luigi Del Debbio.
- Tools utilised: Python, LaTeX

Senior Honours Project September - December 2024

University of Edinburgh, Edinburgh

- Project aimed to understand the rotational dynamics of a single bacterium suspended in a constant shear rate flow. The bacterium was modelled as a banana-shaped polymer suspended in a fluid with a constant shear flow, confined within a two-dimensional box with periodic boundary conditions applied to the vertical walls. Molecular Dynamics in Multi-Particle Collision Dynamics were employed to study the rotational dynamics as its curvature angle is varied from 0 to 2π .
- It was found that noise effects have a significantly greater influence on the rotational dynamics than the

curvature angle. These noise effects cause noticeable deviations from theoretical predictions.

- Supervisors: Dr. Tyler N. Shendruk and Dr. Gavin Melaugh.
- *Tools utilised: Python, bash terminal, LaTeX*

Research Intern

June - August 2024

Applied Science and Technology Research Institute, Hong Kong

- Project based on compressing weights and KV cache data that will be used to develop a large language model. Using C++, I implemented several algorithms with limited success due to the large dataset size and lack of element-wise repetition.
- Overcame these problems by looking at entropy-based methods and applying my knowledge of entropy from thermodynamics to information theory. Ultimately, achieved a compression ratio of 92.4% compared to the theoretical limit of 92.1% for this dataset.
- Detailed my findings and methodology in a report and presented to my colleagues
- *Tools utilised: C++, Python, Latex*

Undergraduate Researcher

Jan 2024 - August 2024

UCLA, Los Angeles

- Looked at surface temperature variability from 1980 to 2020. Began by detrending the data and plotting contour plots of variance, mean temperature and skewness to gain a baseline for what results to expect.
- Conducted an EOF analysis to identify the dominant modes of variability using singular value decomposition. The Results demonstrated that the first two EOFs captured distinct temperature variability patterns primarily in North America and Eurasia, which aligns with existing literature.
- Supervisor: Professor Gang Chen.
- *Tools utilised: Python (NumPy, scikit-learn, PyTorch), Latex*

Industry Experience

Safety Case Engineer

Nov 2020 - Sept 2021

EDF, Gloucestershire

- Collaborated with members of the defueling team to author essential safety case documentation that provides comprehensive visibility of the defueling safety case for two nuclear stations
- Completed an independent research project consolidating over 30 years of research detailing the impact climate change will have on the entire nuclear fleet.
- Reviewed chemistry standards across the nuclear fleet, made a series of recommendations, which I recorded in a report and internally published and I presented my findings to colleagues and members of the UK Office for Nuclear Regulation
- Maintained the internal Wikipedia to showcase organisation changes and share operational experience. I designed the website to ensure easy access to consolidated key information
- Achieved the Industrial Cadets Platinum Leaders Award by the Engineering Development Trust (EDT) for completing a comprehensive 14000-word logbook that detailed my volunteering, mentoring and project accomplishments
- *Tools utilised: HTML / CSS, Microsoft Office*

Optiver Spring Intern

April 2023 (1 week)

Optiver, Amsterdam

- Learnt about trading and market making from interactive lectures on fundamentals of profitable trading, trading systems introduction, and panel discussions
- Applied newly acquired knowledge to complete Optibook challenge. Collaboratively we engineered a dual-listing algorithm and competed against other teams, finishing fourth out of ten teams
- *Tools utilised: Python*

Mathematics and Physics Tutor

Jan 2018 - Sept 2023

Various Locations

- Crafted innovative lesson plans and delivered them with an empathetic approach that enabled student to

progress, such that three of my students achieved As in National 5 mathematics

- Adapted instructional strategies to effectively address individual challenges and improve their range of problem-solving techniques.

Projects

Astronomy Project, 2023

- I led the Python sub-team to design and implement code object orientated code that reconstructed the analytical analysis supporting Hubble's universe expansion conclusion. Poster available *here*

Students As Change Agents, 2022

- Our team produced a concise 5-minute video and report that outlined short-, medium- and long-term solutions to address the problem "How can Scotland save vacant buildings to save the planet?". Presented these to our client, a start-up company called Grand Bequest
- Completed the Edinburgh award, exemplifying personal development and adaptability in a professional setting, public speaking and multifaceted communication

Additional Experience and Awards

Scuba Diving, 2025: PADI Divemaster

Edinburgh University Society Positions, 2021 to 2023: Head of socials for Hoppers (gender minorities in CS). Head of media and marketing for hot chocolate society

Grade Eight Piano, 2023: Achieved grade 8 piano after playing piano for five years

Engineering Development Trust (EDT) Ambassador, 2021 to 2024: Deliver panel sessions to provide insights to my industry placement at EDF

First Place - Cambridge, Newnham College Essay Competition, 2019: Thoroughly researched the future of autonomous vehicles and reported my findings in a 2500 word essay

Technologies

Programming Languages: Python, C++ / C, Java, Haskell, HTML / CSS, LaTeX