

# Freddie Bullard

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## PERSONAL PROFILE

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Current Part III Mathematics student at the University of Cambridge with a first-class bachelor's degree in physics from Durham University interested in applying machine learning, computing and mathematics to solve problems across scientific disciplines. Strong programmer with software engineering and research computing experience.

## EDUCATION

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**University of Cambridge**, Cambridge, UK

Oct. 2024 – July 2025

*MASt Applied Mathematics and Statistics*

- **Courses:** Inverse Problems, Information Theory, Approximation Theory, Statistical Learning in Practice, Infinite Dimensional Spectral Computations, Astrostatistics

**Durham University**, Durham, UK

Oct. 2021 – July 2024

*BSc Physics*

- **Grade:** First-class honours - ranked 4th in cohort
- **Relevant Topics:** Linear Algebra, Calculus, Electromagnetism, Quantum Mechanics, Thermodynamics, Condensed Matter Physics, Stars and Galaxies, Classical Mechanics, ODEs, PDEs, Nuclear Physics, Statistical Physics, Complex Analysis, Computational Physics
- **Awards:** Durham Physics Award for Outstanding Achievement, Stars and Galaxies Module Prize, Computing Project Poster Prize

## RESEARCH EXPERIENCE

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**Research Intern**, Dresden, Germany

July – Sept. 2024

*Machine Learning for Infection and Disease Group, HZDR*

- Trained a Fourier Neural Operator neural network to extract high-fidelity 3-dimensional maps of cellular refractive index from diffracted through-focus microscopy images.
- Generated the training dataset by solving the Helmholtz PDE with the Finite Element Method in Python to simulate the physical diffraction process.

**Classical and Quantum Monte Carlo Optimisation** 

Oct. 2023 – Mar. 2024

*Department of Physics, Durham University*

- Conducted a comparative study of simulated and quantum annealing as heuristics, using the Travelling Salesman Problem as a test example
- Employed Monte Carlo techniques to implement simulated and quantum annealing in Python

**Complex Structure Stress Analysis with Machine Learning** 

Autumn 2023

*Department of Physics, Durham University*

- Investigated the use of stress-induced birefringence in studying the stresses and strains in complex structures under load
- Implemented a CNN based on UNet to extract stress information from photoelasticity images
- Added a physical constraint layer to allow training over fewer epochs and improve generalisation on experimentally obtained data

**Investigating the Dark Matter Content of Spiral Galaxy M82** 

Spring 2023

*Department of Physics, Durham University*

- Investigated the dark matter content of the spiral galaxy M82 through analysis of its rotation curve from HI and CO emission lines, and its luminosity as a function of distance from the galactic centre
- Applied image processing techniques, including dark and bias subtraction and flat-field corrections, to reduce uncertainty in our data

## PROFESSIONAL EXPERIENCE

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### Software Development Engineer Intern

Summer 2023

*Expedia Group, London*

- Worked in a team of 10, developing and maintaining the ad delivery and tracking services
- Enhanced and extended a RESTful API service to track events related to ad impressions, utilised Kotlin and Spring to implement new tracking functionalities

### Research Software Engineer Intern

Summer 2022

*Spectrum Logic, London*

- Designed and implemented an image segmentation algorithm in Python to automate region-of-interest detection in low contrast, 16-bit greyscale images for their Western Blot CMOS 1:1 image scanner

## PERSONAL PROJECTS

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### Noise Reduction Web App 🗣️ | Python (Flask, NumPy)

Summer 2022

- Implemented Gaussian, Median and Bilateral filters from scratch in Python with NumPy
- Improved code efficiency through vectorisation, concurrency and filter-separation
- Developed a full-stack web application using Python with Flask, hosted on Google Cloud Platform

## ONLINE COURSES

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### Finding Hidden Messages in DNA (Bioinformatics I)

Summer 2023

*UC San Diego via Coursera*

### Neural Networks and Deep Learning

Summer 2023

*DeepLearning.AI via Coursera*

### 6.006 Introduction to Algorithms

Summer 2022

*MIT OCW*

### 6.0001 Introduction to Computer Science and Programming in Python

Summer 2022

*MIT OCW*

## TECHNICAL SKILLS

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**Languages:** Python, Kotlin, HTML/CSS, L<sup>A</sup>T<sub>E</sub>X, SQL

**Libraries and Frameworks:** NumPy, SciPy, Matplotlib, Flask, FEniCSx

**Other:** VS Code, IntelliJ, Git, Linux, MacOS, Windows, ImageJ

## REFERENCES

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Available upon request