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# Nicholas Daultry Ball

[LinkedIn](#)

## EDUCATION

### DPhil, CDT in Mathematics of Random Systems

Sep 2022 - Oct 2026 (expected)

*Oxford University*

Supervisor: Prof. Justin Sirignano

Project: Deep Learning for Kinetic Equations

Taught courses: Stochastic Analysis, Theories of Deep Learning, Stochastic Simulation Techniques, Optimal Transport, Finite Elements

### Master of Mathematical and Theoretical Physics

Oct 2015 - Jul 2019

*Dual classification: Distinction (4th Year, MSc equivalent), 1st Class (BA equivalent)*

*Oxford University*

Dissertation: Langmuir Turbulence & the Zakharov Equations (Distinction)

Main courses: General Relativity, Plasma Physics, Algebraic Geometry

Average mark 80 in years 2 & 3, 78 in year 4.

Commendation for lab work in 2nd year

## PROFESSIONAL EXPERIENCE

### Desk Strat, Associate

October 2021 - September 2022

*Synthetic Products Group, Goldman Sachs*

*London*

- Developed pricing models for equity swaps and other delta one derivatives, working with sales and trading to respond to client demands on tight time scales.
- Automated middle office processes for spot and dividend overrides, reducing volume of overrides by 90% and client impacting incidents by 50%. I liaised with engineering and operations teams to analyse the problem, and with clients to investigate incidents, before designing and implementing a fully automated solution.
- Supported pricing and trading infrastructure, working as required to assist traders, investigate and resolve issues under pressure.

### Model Validation Quant, Associate Director

Jun 2020 - Oct 2021

*UBS*

*London*

- Validated algorithmic trading models for cash equities and structured products, analysing performance data and algo implementations to critically investigate the algo risks.
- Automated validation workflow, maintaining Flask web interface and Postgres backend for front office interaction, and creating parsers to ingest documentation and algo performance data.
- Product manager for development of Transaction Cost Analysis library, incorporating database integration, data processing and statistical tests to analyse performance of algorithms.

### Quantitative Analyst

July 2019 - Jun 2020

*Deutsche Bank*

*London*

- Built and maintained data processing infrastructure in Python and kdb+, handling the data requirements of desks across flow fixed income e-trading.
- Implemented and automated data pipeline and quality checks to aggregate market data, reference sources and internal trade data for use by quant researchers.
- Took part in an extensive training programme, passing the CISI securities, derivatives and regulations exams.

## RESEARCH PROJECTS

**Adjoint Optimization of Embedded Deep Learning Models for the BGK Equation**      **Nov 2022-**  
*Accepted at AIAA Scitech Forum 2024*

- Derived and implemented a novel adjoint optimization method for the Bhatnagar-Gross-Krook equation of gas dynamics.
- Used the method to train an embedded neural network for the solution of the 1D shock problem with reference to trusted DSMC data, achieving accuracy comparable to physically motivated parameter values.
- Current and future work aims to evaluate the effectiveness of models trained out of sample, and generalise the method to higher dimensional geometries directly relevant to engineers.

**Hybrid Direct Simulation Monte-Carlo Methods for the Boltzmann Equation**      **June 2023 -**  
*In Progress*

- Implemented and validated 1D DSMC Boltzmann solver.
- Project aims to develop a deep learning assisted hybrid DSMC method, using a high fidelity solver in regions of physical interest to train the parameters of a cheaper solution method in the rest of the domain.
- Currently developing online method to train DSMC model based on trusted data points.

**Inducing Activation Sparsity in Deep Neural Networks**      **Jan - October 2023**  
*Submitted to ICLR 2024*

- Investigated the role of novel non-linear activation functions in inducing sparsity of hidden layer outputs during training of Deep Neural Networks.

## OTHER EXPERIENCE AND ACHIEVEMENTS

- Treasurer, Oxford University SIAM Student Chapter, September 2023 -
- Physics Tutor (Mathematical Methods, Classical and Quantum Mechanics), St Edmund Hall, Oxford University, October 2022 - present
- TA (Probability, Measure and Martingale), Mathematical Institute, Oxford University, October 2022 - Jan 2023
- Winner of Oxford-Lingnan-Yale Global Leadership Symposium speaking competition, 2019
- Extra-curricular classes coordinator, Oxford University Physics Society, 2017-2018
- Treasurer, Oxford University Finance Society, 2017 - 2019

## SKILLS

<b>Programming</b>	Python (Proficient), Rust, Java, Haskell, Bash, SQL , q/kdb+ (Intermediate), Git, L <sup>A</sup> T <sub>E</sub> X
<b>Languages</b>	English (Native), French (Intermediate)