

Dr Guangyu Xu

ENTHUSIASTIC, ADAPTIVE, FAST LEARNING

THEORETICAL PHYSICIST

QUANTITATIVE RESEARCHER

London, United Kingdom

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I am a quantitative researcher working in the sports trading industry, with an education background in mathematical and theoretical physics.

- I have deep knowledge in data science and machine learning, familiar with the entire pipeline from data pre-processing to deployment.
- I have been using Python as my main programming language for almost a decade. I respect and follow closely to the engineering standards, from coding styles to testing procedures.
- I am also experienced in managing projects, interpreting machine learning models, and communicating on progresses and expectations.

With my problem solving and abstract thinking skills, I can quickly adapt to any mathematical or data-driven projects.

Experience

PMT Analytics, Ltd.

London, United Kingdom

QUANTITATIVE RESEARCHER

Dec 2022 -

- Analysed multiple horse racing markets of both parimutuel and bookmaking types.
- Developed a profitable horse racing staking system with estimated Sharpe ratio at **1.9**.
 - Developed fundamental handicapping XGBoost classification models starting from data preparation and feature engineering.
 - Developed short-term odds regression models using XGBoost.
 - Developed several profitable horse racing staking strategies by effectively reducing risks in the Kelly criterion.
 - Monitored and maintained the staking system during trading.
 - Interpreted and reported on model performances and expected returns to the team.

PMT Analytics, Ltd.

London, United Kingdom

QUANTITATIVE DEVELOPER

Sep 2022 - Nov 2022

- Developed and maintained production code of sports trading strategies in Python.
- Developed web scraping tools with Selenium and BeautifulSoup to collect scoring data for tennis into MongoDB.
- Deployed data retrieval API for traders using FastAPI.
- Deployed production Docker containers for data collection and sports trading to AWS.

Department of Mathematical Sciences, Durham University

Durham, United Kingdom

UNDERGRADUATE TUTOR

2019 - 2022

- Taught tutorial classes on Complex Analysis II, delivered in both in-person and on-line formats.

Pennon Education Technology Co., Ltd.

Qingdao, China

PHYSICS TEACHER

2018

- Wrote a series of comprehensive A-level course notes on Physics.
- Taught university level courses on classical mechanics, vector calculus, and Python to school leavers.
- Held a public talk on matrix quantum mechanics and the Einstein-Podolsky-Rosen paradox for high school students and teachers.

Skills

Programming Python, Pandas, XGBoost, SciPy, SciKit-Learn, MagicMock, JavaScript, LaTeX, RegEx

Computing Git, AWS, Linux, Mathematica

Mathematics Linear Algebra, Probability, Statistics, Calculus, Differential Geometry, Topology, Group Theory

Languages Chinese (Native), English (Fluent), Japanese (Intermediate)

Education

University of Durham

Durham, United Kingdom

DOCTOR OF PHILOSOPHY IN MATHEMATICAL SCIENCES

2018 - 2022

Thesis An Algebro-Geometric Approach to Twisted Indices of Supersymmetric Gauge Theories

Research My research is at the interface of physics and mathematics. My focus is on the geometric structures arising from supersymmetric quantum field theories, and their connections to quantum K-theory.

Keywords Quantum Field Theory, Supersymmetry, Mirror Symmetry, Algebraic Geometry, Quantum K-Theory

- Proposed a natural interpretation in terms of supersymmetric gauge theory for the window phenomenon in quantum K-theory, identifying the Chern-Simons level with the quantum K-theory level structure via determinant line bundles.
- Developed a computational technique for multivariate Jeffrey-Kirwan contour integrations using Gröbner basis.
- Proposed a novel scheme of supersymmetric localisation to consistently interpret twisted indices of three-dimensional gauge theories as integrals over characteristic classes on the moduli spaces of saddles in each topological sectors.
- Gave a concise presentation in the London Geometry and Machine Learning Summer School (LOGML), on the application of symbolic regressions on generating functions of line bundle cohomologies in Calabi-Yau threefolds.

University of Cambridge

Cambridge, United Kingdom

MASTER OF ADVANCED STUDY IN APPLIED MATHEMATICS

2016 - 2017

Courses Quantum Field Theory, Supersymmetry, General Relativity, Lie Groups and Lie Algebras, Standard Model, String Theory

Imperial College London

London, United Kingdom

BACHELOR OF SCIENCE IN PHYSICS

2013 - 2016

Thesis Geometry Optimisation of Muon Production Target for High Energy Physics

Modules Linear Algebra, Calculus, Statistics, Classical Mechanics, Quantum Mechanics, Electromagnetism, Relativity, Thermodynamics

- Graduated in the top 10 of my cohort in the physics department.
- Simulated and analysed pair productions in particle accelerators with regression using SciPy. Innovative error analysis closely reproduced the results from the ALICE experiment. The report was awarded full mark.
- Developed an optical ray tracing system in Python to investigate and optimise simple lenses.
- Wrote an essay, *A Scientific Theory of Music*, applying harmonic series and human brain signal processing to music theory.
- Developed a game in Java to demonstrate the thought experiment of Maxwell's Demon, and presented it on university open days.
- Performed a wide range of laboratory experiments in optics, electromagnetism, radioactivity, interferometry, and spectrometry.

Jinan Foreign Language School

Jinan, China

A-LEVEL

2010 - 2013

Subjects Mathematics, Physics, Economics, Chemistry

- Awarded distinction in the Euclid Mathematics Contest.
- Lectured on essay analysis and writing in economics to junior schoolmates.
- Organised lunchtime Q&A sessions in physics and economics for junior schoolmates.
- Developed communication and leadership skills in my role as student representative in physics class.
- Organised additional mock exams and problem classes in physics for classmates.
- Made a mini space shooter computer game using C# and Unity.

Personal Development

Machine Learning

Andrew Ng (2018) *Machine Learning*

- Learned the concepts and implementations of classical machine learning models, including regression, support vector machine, and principal component analysis.
- Learned the theories and practices of model selection and regularisation.

Michael Nielsen (2015) *Neural Networks and Deep Learning*

- Learned the concepts of deep neural networks, including the backpropagation algorithm and regularisations.

Patrick Loeber (2021) *Deep Learning with PyTorch*

- Learned the basics of PyTorch to implement deep learning models.

Jake Vanderplas (2016) *Python Data Science Handbook*

- Learned the practices of data manipulation with Pandas, including imputation, indexing, re-sampling, and one-hot encoding
- Learned the practical implementations of classical machine learning algorithms in SciKit-Learn.

Quantitative Finance

Jean-Philippe Bouchaud and Marc Potters (2003) *Financial Risk and Derivative Pricing*

- Consolidated knowledge of statistics required in finance.
- Learned stochastic calculus and its connection to path integral in quantum physics.

Personal Projects

OmniOutliner JavaScript Plug-Ins

GitHub

- Wrote a reference manager interfacing with the standard BibTeX format.
- Wrote a collection of scripts to extend the capability of the outlining software OmniOutliner, including RegEx replacement, and interactions with third-party apps such as Things, DEVONthink, and Anki.

Imaginary Mass

Blog, YouTube

- Produced a tutorial on the open source password manager, KeePass.
- Produced a tutorial on building a system-wide firewall on iOS and iPadOS.
- Produced a comprehensive tutorial on writing and typesetting LaTeX documents on iPadOS.

Publications

The Twisted Index and Topological Saddles

Journal of High Energy Physics

MATHEW BULLIMORE, ANDREA E. V. FERRARI, HEEYEON KIM, GUANGYU XU

2022

Expositions

- Multivariate Jeffrey-Kirwan Residue and 3D Mirror Symmetry
- Supersymmetric Quantum Field Theory in Zero Dimension
- Arithmetic Construction of Number Systems
- Residue Theorem
- Singlet Lens Optimisation and Rainbow Simulation
- Geometry Optimisation of the Muon Production Target
- The Game of Entropy: Maxwell's Demon
- Investigation of Asymmetry in Particle Collisions
- A Scientific Theory of Music