

# Alexander Koziell-Pipe

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## Summary

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- Computer Science PhD student at the University of Oxford, conducting research at the intersection of artificial intelligence, mathematics and quantum computing. 1st Class Physics degree from the University of Oxford.
- Multiple academic scholarships.
- Data science and machine learning experience in industry at both a startup and enterprise level.
- Experience with a breadth of deep learning architectures.
- Leadership and communication skills developed from various roles of responsibility.

## Education and Honors

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**University of Oxford, Wolfson College**

*Oxford, UK*

**PhD in Computer Science**

*Oct 2021 – Present*

- Quantum circuit simulation using reinforcement learning and graph neural networks.
- Category-theoretic semantics for hybrid quantum machine learning.
- Wolfson Harrison Quantum Foundations Scholar (Full Tuition Fees and Stipend)

**University of Oxford, Lincoln College**

*Oxford, UK*

**Master of Physics**

*Oct 2015 – Jun 2019*

- 1<sup>st</sup> Class Honors
- Coursework: numerical simulation design for condensed matter physics.
- Lord Crewe Scholar (£800)
- Sidgwick Exhibition Award (£150)

## Skills

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- **Programming Languages:** Python, JavaScript, Haskell, HTML, CSS, SQL
- **Data Science and Machine Learning:** scikit-learn, NumPy, pandas, matplotlib, seaborn, support vector machines (SVM), decision trees, random forests, data visualisation, data exploration, time series, ETL
- **Deep Learning:** PyTorch, TensorFlow, JAX, convolutional neural networks (CNN), recurrent neural networks (RNN), LSTM, transformers, attention, graph neural networks (GNN), reinforcement learning (RL)
- **Other:** git, version control, Linux, Jupyter, Docker, algorithms, unit testing, SSH, asynchronous programming, React, qiskit, TensorFlow Quantum

## Experience

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**Hitachi Vantara LLC**

*London, UK*

**SE Lumada Data Science Fellow**

*Sep 2020 – Dec 2020*

- Advanced analytics for energy plant anomalies.
- Trained random forests, support vector machines and LSTMs to detect failure modes in a time series dataset.
- Our machine learning models provided a prototype early warning system for energy plant equipment failures.
- Chosen from a pool of more than 500 applicants; selected for academic excellence, intellectual curiosity, and communication skills.

**HELIX RE Inc**

*London, UK*

**Computer Vision Engineer**

*Jul 2019 – Oct 2019*

- Localisation task for generating digital twins of buildings.
- Implemented algorithm for determining relative positioning 360 images with overlapping visual fields.
- The algorithm facilitated automating the creation of an ‘indoor google street view’ and was used in the company’s main data processing pipeline.

**Online Education Partnership Ltd**

*Remote/Worldwide*

**Mathematics and Science Tutor**

*Oct 2019 – Sep 2020*

- Taught Mathematics and Science online to a global demographic (Hong Kong, US, Dubai).
- Subjects: Mathematics, Physics, Chemistry, Biology, Linear Algebra.

## Publications

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- Hybrid Quantum-Classical Machine Learning with String Diagrams**, arXiv:2407.03673 2024
- Presented at the PLDI Workshop on Quantum Software 2024 in Copenhagen, Denmark
- Functorial Language Models**, arXiv:2103.14411 2021
- Presented at the Applied Category Theory Conference 2021 in Cambridge, UK (Remote)

## Volunteering and Leadership

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- Co-organizer** *Remote/Worldwide*
- ZX Seminar** *Sep 2023 – Present*
- Invited speakers and chaired seminars on the ZX-calculus: a graphical language for quantum computing.
- Research Cluster Representative** *Oxford, UK*
- Wolfson Quantum Foundations Research Cluster** *Oct 2021 - Present*
- Invited speakers, organized and chaired events and talks.
  - Topics ranged from ‘The Link between Quantum Mechanics and Music’ to ‘Are Error Correcting Codes built into the laws of the universe?’
- Men’s Captain** *Oxford, UK*
- Oxford University Gymnastics Club** *Oct 2021 – Mar 2022*
- Elected by members of the gymnastics club.
  - Organized and led a team at national competitions and the annual Oxford vs Cambridge Varsity Match.
- IT Officer** *Oxford, UK*
- Oxford University Gymnastics Club** *Mar 2017 – Mar 2018*
- Maintained a WordPress site, produced video content and managed multiple social media accounts to improve the gymnastics club’s online presence.
- Club President** *London, UK*
- Halley Science Society (St Paul’s School)** *Sep 2013 – Jun 2014*
- Invited speakers, organized and chaired events and lectures for the school science society.
  - Notable speakers included Professor John Ellis, who gave a lecture on the Higgs boson shortly after its discovery.

## Grants, Awards and Achievements

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### Academic

- Wolfson Harrison Quantum Foundations Scholarship – University of Oxford (Full tuition fees and stipend)
- Lord Crewe Scholar – University of Oxford (£800)
- Sidwick Exhibition Award – University of Oxford (£150)
- Senior Mathematics Prize – St Paul’s School
- Senior Academic Scholarship – St Paul’s School (£50)

### Sporting Awards

- 4x Full Blue, Oxford University’s highest sporting achievement, in Gymnastics.
- High Profile Sports Grant – Wolfson College, University of Oxford (£200)
- Blues Funding – Lincoln College, Oxford (£150, £270, £125)

### Grants

- Club Development Grant. Won in open competition on behalf of Oxford University Gymnastics Club – Oxford University Sport (£1000)

## Teaching

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- Oxford Study Abroad Programme** *Oxford, UK*
- Special Relativity, Quantum Computation, Machine Learning. PyTorch implementation of arxiv:1512.04150.

## Open Source Contributions

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### Ivy – The Unified AI Framework

- Tested TensorFlow, JAX and PyTorch backends with the hypothesis testing framework.

### Chyp – An Interactive Theorem Prover for String Diagrams

- Implemented a hypergraph data structure, parser and convex optimization visualization code.