Alexander **Koziell-Pipe**

Quantum Computing · Artificial Intelligence · Category Theory

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Education

Wolfson College, University of Oxford — *Oxford, UK*

DPhil Computer Science - Supervisors: Prof. Aleks Kissinger, Prof. Bob Coecke — *Oct. 2021 - present*

- Research focus: Category Theory, Quantum Computing, Artificial Intelligence and the intersection thereof.
- Software Project: HypNN - Neural Network String Diagrams.
- Wolfson Harrison UK Research Council Quantum Foundation Scholar (Full Tuition Fees & Stipend).
- Member of the Oxford Quantum Group.

Lincoln College, University of Oxford — *Oxford, UK*

MPhys Master of Physics - 1st Class Honours — *Oct. 2015 - Jun. 2019*

- Thesis Title: Interaction of Chiral Magnetic Skyrmions
- Lord Crewe Scholar (£700).

St Paul's School — *London, UK*

A Levels & GCSE — *Sept. 2009 - Jun. 2014*

- *(A2 Level)* Mathematics: A*, Physics: A*, Further Mathematics: A*, Chemistry: A*
- *(AS Level)* all of the above: As, Biology: A (A highest awarded grade at AS Level)
- *(GCSE)* 9 A*s and 3 As including A*s Maths, Physics, Chemistry, Biology, Electronics

Preprints

2021 **Functorial Language Models (Extended Abstract)**, arXiv:2103.14411 — *Alexis Toumi, Alex Koziell-Pipe*

Presented at Semspace (Workshop on Semantic Spaces at the Intersection of NLP, Physics, and Cognitive Science) and ACT (Applied Category Theory Conference), 2021. Implemented in JAX.

Experience

Hitachi Vantara LLC — *London, UK*

SE Lumada Fellow — *Sep. 2020 - Dec. 2020*

- Applied machine learning algorithms and statistical modelling techniques to solve real-world problems for clients. Data science.
- Python, Seaborn, Time Series Analysis, Anomaly Detection, Data Mining, Graphical Models, Random Forests, SQL.

Helix RE Inc. — *London, UK*

Computer Vision Engineer — *Jul. 2019 - Oct. 2019*

- Designed Computer Vision algorithms and applied Deep Learning as part of a mission to create 'digital twins' of buildings.
- Contributed production-level code used in the company's main data processing pipeline.
- Python, C++, Matplotlib, Computational Geometry, Linear Algebra.

Online Education Partnership Ltd. — *Remote/Worldwide*

Mathematics and Science Tutor — *Jun. 2016 - Sept. 2020*

- Taught Maths and Science to students around the world (Hong Kong, US, Dubai) via an online interface.
- Communication of abstract ideas to students through innovative use of video and online whiteboard software.
- Subjects: Mathematics, Further Mathematics Physics, Chemistry and Biology, up to and including A Level. University-level Linear Algebra.

National Tsing Hua University — *Hsinchu, Taiwan*

Condensed Matter Physics Intern — *Mar. 2015 - Apr. 2015*

- Introduction to research on Weyl Semimetals: solid state crystals in a topologically non-trivial phase of matter.

University of Texas at Dallas — *Dallas, Texas, USA*

Atmospheric Physics Intern — *Feb. 2015 - Mar. 2015*

- Ran computer simulations in FORTRAN to study the effect of airborne particles on cloud formation.

Source Lifestyle Inc. — *London, UK*

Competitor Analyst — *Jan. 2015 - Feb. 2015*

- Research of 100+ potential competitors for a former startup company.

Teaching

Oxford Study Abroad Programme — *Oxford, UK*

Advanced Machine Learning — *Oct. - Dec. 2023*

- Machine Learning with a computer vision focus. PyTorch implementation of arxiv:1512.04150.

Oxford Study Abroad Programme — *Oxford, UK*

Quantum Computation — *Oct. - Dec. 2023*

- Introduction to the theory behind Quantum Computing and practical implementations in Qiskit.

Oxford Study Abroad Programme — *Oxford, UK*

Special Relativity — *June. 2023*

- Introduction to special relativity.

Extracurricular Activity

ZX Calculus Seminar — *Worldwide*

Co-organizer — *Sep. 2023 - present*

- The ZX Seminar is a virtual venue for researchers to share their work related to the ZX calculus - a formal graphical language for Quantum Computing.
- Responsibilities include inviting speakers, scheduling seminars, and co-chairing events.

Wolfson Quantum Foundations Research Cluster — *Wolfson College, Oxford*

Research Cluster Representative — *Oct. 2021 - present*

- Responsibilities include inviting speakers, organizing and chairing talks and discussions.
- Previous topics include 'The Connection between Quantum Mechanics and Contemporary Music' and 'Supersymmetry as an Evolutionary Adaptation'.

Oxford University Gymnastics — *Oxford University Sport*

Men's Captain — *Oct. 2021 - Mar. 2022*, *Mar. 2018 - Mar. 2019*

- Contributed, as part of a committee, to managing Oxford University Gymnastics Club.
- Attended meetings, organized and led a team, and supported and taught other club members.
- Elected by teammates and members of the gymnastics club.

Oxford University Gymnastics — *Oxford University Sport*

IT Officer — *Mar. 2017 - Mar. 2018*

- Maintained a website, produced video content, managed publicity and multiple social media accounts.
- HTML, CSS, Image and Video Editing (GIMP, DaVinci Resolve), Social Media Management.

Halley Science Society — *St Paul's School*

Club President — *Sep. 2013 - Jun. 2014*

- Invited speakers and hosted lectures for the St Paul's School Science Society.
- Notable speakers include Professor John Ellis, who talked about the Higgs Boson shortly after its experimental confirmation.

Grants, Awards & Achievements

Academic

2018-19	**Lord Crewe Scholarship (£700),** awarded to 11 out of 304 students to mark outstanding work.	*University of Oxford*
2017	**Sidgwick Exhibition 2017-18 (£150),** awarded for exceptional academic achievement and promise.	*University of Oxford*
2014	**Senior Mathematics Prize,** chosen for outstanding work out of approximately 20 students.	*St Paul's School*
2013-14	**Senior Academic Scholarship (£50),** for top results in AS-level and excellent work throughout the year.	*St Paul's School*

Sporting

2023, 19,18	**Full Blue (Gymnastics) x3,** Oxford University's highest sporting achievement.	*University of Oxford*
2022 17,16	**Half Blue (Gymnastics) x3,** Oxford University's second highest sporting achievement.	*University of Oxford*

Grants

2023	**Wolfson College High Profile Sports Grant (£200),** Awarded to support individual graduate students who are striving towards the peak of sporting success.	*Wolfson College, University of Oxford*
2018	**Club Development Grant (£1000),** won in open competition to support further development of Oxford University Gymnastics Club.	*Oxford University Sport*
2016, 17,19	**Lincoln College Blues Fund (£150, £270, £125),** to support achievement in gymnastics.	*Lincoln College, University of Oxford*

Open Source Contributions

2023	**Ivy - The Unified AI Framework,** Function implementation and tests using the hypothesis framework.
2023	**Chyp - An interactive theorem prover for string diagrams,** Contributions to hypergraph backend, parser, and drawing code.

Skills

Research	Mathematics (Category Theory), Quantum Computing, Machine Learning
Programming Lanugages	Up to date: Python, Haskell. Previously learned: Rust, C++, HTML, CSS, javascript, Swift
Natural Languages	Fluent English, Français Niveau Intermédiaire, 初級日本語

Extra Information

Technical Interests Algorithms, Programming Languages, Web Development, IOS App Development, Deep Learning, Pytorch, Tensorflow, Data Science, Blockchain Technology, Cryptocurrency, Cryptoeconomics, Game Development, Command Line, Linux, Version Control, Git, Github Pro Account, Neuroscience

Sport Artistic Gymnastics, Skiing, Snowboarding, Tennis, Windsurfing, Horsemanship, Martial Arts

Music Trumpet Grade 4, Piano Grade 2

Self Teaching and Online Courses

(An accumulation of self-motivated self-teaching out of curiosity, fascination and a passion for learning. Please note that I may need a refresher on some of the skills in these courses.)

Andrej Karpathy	**Neural Networks: Zero to Hero (https://karpathy.ai/zero-to-hero.html),** Reverse-mode automatic differentiation from scratch. PyTorch. Self attention and Transformers. GPTs.	*Andrej Karpathy*
Coursera	**Machine Learning,** Linear and Polynomial Regression, PCA, SVMs, Neural Networks, MATLAB and Octave.	*Stanford University, Andrew Ng*
Coursera	**TensorFlow in Practice Specialization,** Dense Neural Networks, CNNs, RNNs, LSTMs and Time Series Analysis with TensorFlow.	*deeplearning.ai*
Coursera	**Algorithms Part I,** Algorithmic design and analysis, A* Search, k-d Trees, Java.	*Princeton University*
Udemy	**Complete Web Development Bootcamp,** HTML, CSS, javascript, Nodejs, React, Databases (SQL, mongoDB), Authentication and Security.	*LondonAppBrewery*
Udemy	**iOS 12 & Swift - The Complete iOS App Development Bootcamp,** Swift, Databases (Core Data, Realm), CoreML, ARKit, SwiftUI.	*LondonAppBrewery*
Udemy	**Deep Learning A-Z,** Theory behind different deep learning models, Tensorflow, Keras and Pandas.	*SuperDataScience*
Udemy	**Blockchain A-Z,** Theory behind blockchain technology, coding a simple cryptocurrency in Python, the Solidity programming language.	*SuperDataScience*
Udemy	**How to Program Games: Tile Classics in JS for HTML5 Canvas,** Creating browser-based games from scratch using javascript and HTML.	*ChrisDeLeon*
Kaggle	**Kaggle Courses,** Basics of the Seaborn plotting library, Pandas, and Machine Learning.	*Various*
fast.ai	**fast.ai Course,** PyTorch, Computer Vision, NLP, implementing academic papers, data mining.	*Jeremy Howard*