Dr. Scott Vinay

Data Scientist | Quantum Physicist

Derby, UK

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Employment and Other Experience

Machine Learning Researcher — *United Kingdom*

Transformative AI — *July 2020 – Present*

- Working on the development of deep classification models for the prediction of arrhythmias from electrocardiogram data. The current algorithm represents the worldwide state-of-the-art for this task.
- Took responsibility for the data pre-processing system, consolidating it to a single data standard and refactoring the codebase to a single unified pipeline.
- Designed and constructed novel deep-learning algorithms in mixed supervised/unsupervised learning and convolutional networks for the extraction of morphological characteristics of time-series data.
- Adapted cutting-edge results from research in bias-reduction in AI to improve generalisability to new databases, including experimenting with multi-headed multi-loss neural networks.
- Produced high-quality reports both internally and for external funding agencies.

Data Scientist — *Melbourne, Australia*

isgood.ai — *Aug. 2019 – April 2020*

- Co-designed, developed, and tested a novel machine learning pipeline for rapid understanding of a client's text, and semantically matched it to a database of existing text.
- Developed a highly modular code structure to allow for ease of delegation of tasks across a team and deployed iteratively via Gitlab.
- Set up and used Google Cloud Platform for storage and training of large models.
- Took on a leadership role during the absence of the team leader, which involved tutoring new members on complex methods and assigning and reviewing progress on subtasks.

Data Technician — *Melbourne, Australia*

Black.ai — *Jan. 2020 – April 2020*

- Helped create and verify the dataset for a massive-scale image recognition system.
- Worked closely with development and machine-learning teams to help optimise efficiency of classification models.

Contract Consultant — *Melbourne, Australia*

RMIT University — *Dec. 2019*

- Subject matter expert. Designed assignments for the Introduction to Analysis module for the Master of Data Science course. This involved the automatic generation of unique problems and answers for each student, mainly using R.

Postgraduate Teaching Assistant — *Sheffield, United Kingdom*

University of Sheffield — *Sep. 2016 – April 2019*

- Demonstrator for the courses of Advanced Quantum Mechanics, Programming in Python (for 3 years), and Advanced Programming in Python (for 2 years).
- Assisted students working on problem sets, marked homework, graded formal assessments, and designed assignments.
- Advanced Programming in Python involved the teaching of object-oriented programming and neural network construction.

Undergraduate Research Internship - Fluid Dynamics — *Coventry, United Kingdom*

University of Warwick — *Summer 2014*

- Modelled swimmers in the Stokes regime as sets of singularities, and used a method of images similar to that used in electromagnetism to calculate the resultant flow and behaviour when brought near to a wall. Used to investigate the behaviour of so-called "squirmer"-type creatures.

Undergraduate Research Internship - Computer Vision — *Coventry, United Kingdom*

University of Warwick — *Summer 2013*

- Designed and constructed a computer vision system, that used OpenCV to capture an image of a set of counters at a skewed angle, load the positions into an atomic energy simulator, and find the local-minimum energy. This allowed for researchers to easily test hypothesised atomic configurations in a tactile way, which I demonstrated at a university open day.

Education

PhD in Quantum Cryptography
Sheffield, United Kingdom

The University of Sheffield
Sept. 2015 - March 2019

- Thesis on *The Statistics and Security of Quantum Key Distribution.*
- Research included development of both practical proposals for technological protocols and novel mathematical frameworks for efficient statistical analysis of arbitrary networks.
- Supervised by Pieter Kok and Stephano Pirandola.

MPhys in Physics
Coventry, United Kingdom

The University of Warwick
Oct. 2011 - Jun. 2015

- 1st class honours with an 84% average grade.
- Dissertation on *Energetics of Knotted Defects in Nematic Liquid Crystals.*
- Supervised by Gareth Alexander.

Machine Learning MOOC
Via Coursera

Stanford University
2018

Publications

Total citations: 49

Statistical analysis of quantum entangled network generation
Physical Review A

Scott E. Vinay and Pieter Kok
April 2019

- We developed novel numerical and analytic techniques for the analysis of probabilistic network generation, which we apply to the specific case of quantum communication to prove new security bounds.
- Improved secure communication rates by three orders of magnitude over more simplistic methods.
- Techniques used: Markov chains, Cauchy's residue theorem, Fourier transforms, complex analysis.

Extended analysis of the Trojan-horse attack in quantum key distribution
Physical Review A

Scott E. Vinay and Pieter Kok
April 2018

- We analysed the effect of a side-channel attack on quantum communication, proving an increased bound on security while relaxing the assumptions previously used.
- Techniques used: Covariance matrices, Krauss-decomposition of channels.

Practical repeaters for ultralong-distance quantum communication
Physical Review A

Scott E. Vinay and Pieter Kok
May 2017

- We presented a complete protocol for a quantum repeater, and an analysis of its efficiency that takes probabilistic effects into careful consideration. We show that it produces high secret key rates relative to comparable protocols.
- Techniques used: Order statistics, entanglement distillation.

Skills and Personal

Software

- Highly proficient in the use of Python for research applications, including object-oriented and parallel performance-focused approaches. Highly proficient with Pandas, Numpy, Matplotlib, Git, and machine learning packages including Sklearn and Keras.
- Significant experience using Mathematica, Unix, LaTeX, R, and SQL.
- Comfortable and confident in the Google Cloud Platform (GCP) architecture, including the Cloud Compute, Storage, and Cloud Functions systems.
- Some experience with C and MATLAB.

Presentational

- Confident at public speaking on complex topics.
- Delivered talks at multiple department symposia, as well as at meetings of the multi-university White Rose group.
- Research presented at conferences at the University of Cambridge (UK), Technische Universität Wien (Vienna), and the University of Nottingham (UK).

Personal

- In my personal time I like to keep active through rock climbing and snowboarding.
- I am a keen chess and go player.