Ira Shokar

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Profile

Theoretical Physics finalist, on track to graduate with First Class Honours, with interests and experience in mathematical problem solving, fluid and non-linear dynamics, computational modelling and deep learning. I am applying to the CDT in AI for the study of Environmental Risks, with research interests in using machine learning to improve the performance of physical models in predicting extreme weather events.

Education

University College London   **Bloomsbury, London**
BSc. Theoretical Physics   *Sept 2017 – Present*

- **Predicted Grade – 1st Class Honours**. 2nd Year Result –77. 1st Year Result – 72.
- **Projects:**
  - **3rd Year:** Deep-learning Classifier Robustness in Neutrino Experiments.
  - **2nd Year:**
    - Cellular Automata to Investigate Traffic Flow's Similarities to Fluids.
    - **Research Presentation**- Particle Identification in Ground-Based Gamma-Ray Astronomy Using Convolutional Neural Networks by the TAIGA-IACT telescope.
  - **1st Year:** 'Angry Birds'-like collision-based game.
- **Relevant Modules and Topics:**
  - **Further Practical Mathematics and Computing (Python):**
    - Numerical methods (explicit and implicit Euler method, Runge-Kutta, errors and stability, discrete calculus).
    - Using discretisation and matrix methods for ODEs and PDEs (Wave equation, Laplace and Poisson equations, Parabolic equations in transport processes, time-dependent and independent Schrödinger equations).
    - Modelling (coarse-graining, Verlet methods, interactions between particles in a box, three-body orbits).
    - Stochastics and Monte Carlo simulations (Ising spin, annealing), function fitting, Fourier transforms.
  - **Mathematical Methods for Theoretical Physics:**
    - Linear algebra and Cartesian tensors.
    - Analysis of ODEs (variation of parameters, Green's functions, Sturm-Liouville, self-adjoint linear differential operators).
    - PDEs (Solutions of Non-Separable PDEs, nonhomogeneous equations and boundary conditions).
    - Transforms (Laplace and Fourier).
    - Fluid Mechanics (Euler's Identity, irrotational flow, potential flow, Bernouilli's theorem, Poiseuille flow, vorticity, viscous stress tensor, incompressible Navier-Stokes equations, Reynolds's number).
  - **Theory of Dynamical Systems:**
    - Hamiltonian and Lagrangian systems.
    - Analysis of nonlinear systems (linearisation, phase portraits, stability, conservative systems, bifurcation).
    - Chaos (dynamics, discrete maps and fractals).
  - **Mathematical For Physics and Astronomy:**
    - Calculus of variations, integral constraints, complex analysis (continuity and differentiability, analytic functions, Cauchy-Riemann equations, residue theorem, Cauchy's integral theorem).
  - **Statistical Physics:**
    - Classical thermodynamics, microstates and macrostates, a priori probabilities, entropies, canonical and grand canonical ensembles, partition functions,
    - Quantum gases (Bose-Einstein condensation and degenerate Fermi gases),
    - Photons and phonons (black-body radiation, energy density and flux, Debye model, zero-dimensional radiation model - greenhouse effect).
  - **Atoms, Stars and the Universe:**
    - Radiation (Planck, Stefan-Boltzmann, and Wien Laws, effective temperature).
  - **Mathematical Methods (I, II, III):**
    - Vectors and linear algebra, real analysis, complex variables, calculus, ODEs (exact solutions, eigenvalue methods, matrix methods, power series), PDEs (separation of variables), Legendre polynomials, Fourier analysis, special relativity.

Tiffin School   **Kingston-Upon-Thames, Surrey**
- **4 A-Levels** - **A*** in Mathematics and Further Mathematics; **A** in Economics and Physics.
- **6 AS-Levels** - **A** in Mathematics, Further Mathematics, Economics, Physics, History and Physical Education.
- **11 GCSEs** - **A*** in English Language, Further Mathematics, Latin, Mathematics, Physics and Religion & Philosophy; **A** in Biology, Chemistry, English Literature and History; **B** in French.

Research Experience

- **Deep-learning Classifier Robustness in Neutrino Experiments.** *Supervisor - Dr. Chris Backhouse.*
  - This project is being undertaken alongside the fourth year MSci students, over two terms.
  - I was approved by the department to take a project in place of two optional modules as I was on a first-class and able justify approval from the department that they could cope with the increased demands of an MSci level project. I then had to compete with the master's students for the projects that supervisors were offering.
  - In wanting to bring together my interests in machine learning together with physics I am looking at applying a Domain-Adversarial Neural Network (DANN) to improve the performance of a Convolutional Neural Network (CNN) to classify neutrino interactions, for the analysis of neutrino oscillations.
  - The approach is looking to produce a model that is invariant to the differences in statistics between the input data (the labeled Monte Carlo simulations used to train the classifier) and the detector data.
  - **Technologies Used:** Python- Keras, Tensorflow. C++, Scientific Linux, LaTeX.
- **Cellular Automata to Investigate Traffic Flow's Similarities to Fluids.** *Supervisor - Prof. David Bowler.*
  - In wanting to build upon the introduction to fluids we were given, I chose to complete the mini-project in the 'Further Practical Mathematics & Computing' module looking at a building a Cellular Automata to simulate motorway traffic flows, in order to compare the similarities to the Venturi effect, turbulence and choked flow when traffic shockwaves arise.
  - The model consisted of a few rules with the system was able to evolve over time with a stochastic element put in place to represent human decision making and irrationality, and was extended to contain different vehicles with different maximal speeds, blockages such as accidents or road closures to try and model a driverless car system and optimise this model to reduce fuel consumption.
  - **Technologies Used:** Python.
- **Research Presentation- Particle Identification in Ground-Based Gamma-Ray Astronomy Using Convolutional Neural Networks by the TAIGA-IACT telescope.**
  - I gave a presentation on a research paper that I found particularly fascinating, looking at the use of computer vision in physics.
  - This involved summarising the methodology and key take aways from the papers and explaining the place that machine learning is having on research science.
  - From this I gained a better understanding and furthered my interests in computer vision, and the applications of AI in the physical sciences.

Technical Skills

- **Python**
  - I am adept at using Python, from both undergraduate modules, as well as external experience such as employment and hackathons.
  - 'Practical Physics and Computing I' gave me an introduction to Python, through its uses in analysing experimental data, as well as simulation- leading to building an 'Angry-Birds'-like collision game.
  - In 'Further Practical Mathematics and Computing' we built upon this to use Python for scientific computation, using numerical methods to solve problems and understand time complexity, as well as simulating physical problems. This was all computed using the NumPy libraries.
  - In my research project the neural network is being implemented using the Keras API with Tensorflow in Python.
  - During my internship with FTI Consulting Python was used for various types of analysis, from cleaning text inputs to building models, to network analysis.
- **C++**
  - In my research project, all the data analysis functions, as well as cosmic-preselection cuts have been written in C++ in the NovaSoft package, and CafAna framework.
- **Linux**
  - I have had to learn my away around the Linux command line as the High Energy Physics group Linux cluster runs on Scientific Linux 7.
- **Mathematica**
  - In 'Computing for Mathematical Physics' we used Mathematica's inbuilt solvers to solve problems in Linear Algebra, Differential Equations and Calculus, and plot solutions.
- **SQL**
  - Used during my internship to query and build large datasets.

Relevant Work Experience

FTI Consulting   **Aldersgate St, City of London**
Data Science & Analytics Summer Intern (kyle.johnson@fticonsulting.com)   *July 2019 – August 2019*
- An 8-week summer internship in the Forensic Litigations department, aiding teams working on compliance investigations.
- I looked at applying data science pipelines in the form of: data wrangling and data cleaning (dynamic and static web-scraping, parsing structured data and regular expressions), storing large data sets, data mining and querying using **SQL**, building models using various algorithms such as regressors, trees and random forests in **Scikit-Learn** and neural networks using the **Keras API** with **Tensorflow**, and applying analysis to search for anomalous activity, fraud and money-laundering.
- My main project involved creating a relationship and transaction graph network using **Python** and **Neo4j**, applying various network analysis metrics to determine key players and clusters that may require extra investigation. These were then queried and visualised using **Python** and **Cypher**. This was used in conjunction with bank records in implementing fuzzy token matching as well as with anomaly detection models.

Machine Learning Hackathons

Developer Circles from Facebook   **Rathbone Square, Fitzrovia, London**
UCL Hackathon Team (president@ucltechsoc.com)   *December 2019*
- I was selected to represent UCL at the AI for Messenger Hackathon where we created a chatbot that returned the translated text from an image containing text in a different language.
- Used **Node.js** for the messenger front end, with **Flask** connecting to the **Pytorch** models, which comprised of a CNN to determine the locations of the words, an OCR CNN to recognise the text, and a translation neural network.

UCL Data Science Society Hackathon   **Microsoft Reactor, City of London**
Winning Hackathon Team (su-datascience@ucl.ac.uk)   *November 2019*
- Hackathon hosted by Microsoft and American Express to look at providing insight from their credit card customer datasets.
- I was part of the winning team, where we produced a solution concluding that that product personalisation for customer subsets could increase credit card growth while assessing potential credit default and delinquency risk.
- We conducted exploratory analysis through k-means clustering and build decision tree and random forest models using **Scikit-Learn** and the **Azure API**.

Microsoft AI Mini Hack   **Microsoft Reactor, City of London**
Hackathon Participant (president@ucltechsoc.com)   *November 2018*
- Made calls to **Microsoft's Cognitive Azure API** to identify landmarks and animals and run a bot, by altering pre-build code, that played an image matching game against other participants.

Industry Insight Days

Arm Holdings   **Peterhouse Technology Park, Cambridge**
Applied Machine Learning Insight (shoko.ueda@arm.com)   *November 2019*
- I was part of the winning team that completed a **Python** debugging challenge applying an adaptive image filter to a webcam image using a CNN during an insight into the research being conducted by ARM in the fields of computer vision and natural language processing for mobile devices.

Bloomberg LP   **Queen Victoria St, City of London**
Global Data Insight (cmeyer57@bloomberg.net)   *March 2019*
- Worked on a project to forecast company stock market behaviour by writing a parser in **Python** used the data to make predictions on a firm's future trading using time series forecasting.
- We presented these findings along with our methodology.

Weights and Biases   **Queen Victoria St, City of London**
Deep Learning Insight Workshop (vanpelt@gmail.com)   *November 2018*
- Built a CNN to classify MNIST digit and fashion datasets in **Python** with the **Keras API, Tensorflow**. These are skills I am using in my final year project.

Undergraduate Societies

- UCL Men's Rugby Union 1st XV, UCL Physics Society, UCL Data Science Society, UCL Technology Society.

Undergraduate Roles of Responsibility

University of London Halls   **Lillian-Penson Hall, Tyburnia**
Resident Advisor (*Voluntary Role*) (*derrick.chong@london.ac.uk*)   *August 2019 – Present*
- My role as part of the Warden's team involves assisting the Warden in encouraging a supportive and harmonious living environment.
- This involves promoting and monitoring residents' personal, mental and social welfare, other pastoral care, dealing with disciplinary issues & conflict resolution, and being in charge of organising the social life of the Hall.
  - We organise events for residents of hall as well as the wider University of London halls and manage the Lillian-Penson JCR.
- While on duty, when the hall manager is not present, we are responsible for managing, and being the point of contact for, any emergencies that arise.
  - Mental Health First Aid certified (MHFA).
  - Eating disorder and suicide prevention awareness trained (BEAT, Papyrus).
  - Equality, Diversity and Inclusion trained (Definitely Able, All Sorts).
  - Physical First Aid certified (British Red Cross).
  - Fire Safety Awareness & Fire Marshall trained (Health & Safety, University of London).
- We work closely with Reduce the Juice- a University of London sustainability project looking at reducing power consumption and waste though behavioural change of residents.
  - This has been through various forms such as sustainable clothes recycling, presentations to residents, social media campaigns and inter-hall competitions to drive down energy consumption and reduce waste.

Department of Physics and Astronomy   **University College London, Bloomsbury**
Transition Mentor (*a.owusu@ucl.ac.uk*)   *Sept 2018 – Dec 2018*
- I provided support and guidance to a group of first year students, by meeting weekly and preparing sessions to aid in their adaptation to university life and the physics course.

University of London Halls   **Nutford House, Marylebone**
JCR Committee (*paul.phibbs@london.ac.uk*)   *Sept 2017 – June 2018*
- Given responsibility as part of a team of four to organise events for fellow members in halls using a budget of £6,000.
  - Events ranged from small events such as Tea & Cakes, to large events such a Boat Ball.

Volunteering

Bubbles Turtle and Reef Conservation   **Perhentian Islands, Malaysia**
Conservation Volunteer (*duncan.maguire@live.co.uk*)   *April 2017 – May 2017*
- Volunteered on the Perhentian Islands, patrolling beaches at night to protect turtles that were laying eggs from poachers, as well as educating local school children and tourists on the importance of turtles and marine wildlife and the detrimental effects of plastic waste.

Fuze Ecoteer   **Taman Negara, Malaysia**
Conservation Volunteer (*daniel@ecoteer.com*)   *April 2017*
- Volunteered in the Taman Negara Jungle, looking for animal pugmarks and traps to collect data on the numbers of endangered animals attempt to ensure their safety from poachers, as well as teaching local school children English as well as the importance of preserving their local wildlife.

Swan Lifeline Eton   **Cuckoo Weir Island, Eton**
Volunteer (*Wendy Hermon: @Cygnet_2009*)   *September 2014 – April 2015*
- Volunteered once a week to help clean the pens and feed swans for a small charity that looked at the nursing of injured swans.