Dominic Williamson

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Education

Imperial College London
MSc Artificial Intelligence Oct 2020 – Oct 2021

Optional modules: *Reinforcement Learning, Mathematics for Machine Learning, Machine Learning for Imaging, Deep Learning, Probabilistic Inference, Computer Vision (audited)*

The University of Manchester
BSc (Hons) Physics with Theoretical Physics – 1st class 2016 – 2019

Relevant modules: *Random Processes in Physics, Thermal and Statistical Physics, Courses in Quantum Mechanics, Courses in Mathematics.* These modules were important to understanding the theory behind machine learning – in particular probability, statistical methods, multivariable calculus, and linear algebra.

Oakbank School (now Beckfoot Oakbank School), Keighley, West Yorkshire 2009 – 2016

A level: **3A*** – Physics, Maths, Chemistry
AS level: **3A** – Biology, History, Extended Project Qualification
GCSE: **5A***, **Dist***, **3A**, **Dist**, **3B**

Research Experience

Machine Learning Internship (Full time) June – Aug 2019
The University of Manchester, School of Electrical and Electronic Engineering

- Applied machine learning and transfer learning techniques to the detection of tumours in 3D magnetic resonance images of the brain – supervised by Dr Fumie Costen.
- Designed and implemented a series of convolutional neural networks for image classification. One of these networks included a stacked convolutional autoencoder pre-trained entirely on a larger Alzheimer's patient MRI dataset.
- Used **Python** with **PyTorch** to both develop and analyse the performance of each network to determine which worked best. The **tcsh** Unix shell was used throughout the project for the pre-processing of large amounts of data and the training of the networks on an external high-performance computer cluster.
- Prior to and throughout the internship, I was required to research the statistical theory behind machine learning and the state of current research on transfer learning specifically.

Quantum Simulation Internship (Full time) June – Aug 2018
Manchester Institute of Biotechnology, Quantum Chemical Topology Group

- Studied the repulsive behaviour of topological atoms (due to steric interactions) as they are brought together and compressed – supervised by Prof Paul Popelier.
- Designed and ran a set of computational experiments to investigate the hypothesis. These were developed into submission scripts using **Python** and ran in Gaussian, a chemistry software package. **Bash** scripts were used to both run Gaussian and analyse data on a high-performance computer cluster.
- Unexpected observations prompted a more comprehensive range of experiments to be designed. This not only required the application of programming skills but also problem solving to help determine the most appropriate set of experiments to perform at each stage of the project.
- Used **LaTeX** to write sections of the paper detailing the final theory, further developing my scientific writing skills. Conducted extensive research into the surrounding literature and performed thorough data analysis in presenting the results.

Publications

Symons, B. C. B., Williamson, D. J., Brooks, C. M., Wilson, A.L., Popelier, P. L. A., *Does the Intra-atomic Deformation Energy of IQA Represent Steric Energy?,* ChemistryOpen 2019, **8**, 560.

Notable Projects – *see dominicwllmsn.github.io*

Project 1 – *Simulating Neutrino Detection Experiments using GANs*

- As a final year physics project, **TensorFlow** and **Keras** were used to train a GAN to produce Monte Carlo simulations of neutrino detections in liquid argon.
- Involved the research and implementation of possible GAN architectures for Monte Carlo simulations, the use of **C++** and ROOT (the proprietary C++ library used at CERN) to create the artificial training data, as well as developing **Python** scripts to clearly and succinctly present the results.

Project 2 – *Simulated Markov Chain Monte Carlo Spin Models*

- Developed Monte Carlo simulations to study the properties of variations on the Ising model, including the 2D XY and 3D Heisenberg models. Produced an accompanying ten-page final report.
- The finished simulation and data analysis programs, written in **Python**, involved implementations of a fast Fourier transform to calculate correlation and the bootstrap binning method for error determination.

Extracurricular Development

Machine Learning School in Seville March 2020
BigML

- Participated in a two-day training event involving lectures on machine learning and its applications to real-world problems, delivered via live webinars.
- Took part in networking and discussion sessions with lecturers and fellow attendees, covering progress in areas such as generalization and anomaly detection. This was alongside practical talks on optimizing machine learning workflows in our individual projects.

Data Augmentation for Medical Imaging Aug 2019
NVIDIA Deep Learning Institute

- Completed a course concerning the use of Generative Adversarial Networks (GANs) for data augmentation and segmentation of medical images.
- Implemented the associated research paper using **PyTorch** and applied it in my transfer learning internship, where I analysed the impact of an augmented target dataset on the learning model.

Volunteer Experience

Python Teaching Assistant Oct 2018 – Apr 2019
UniCS Society

- Created and delivered lecture materials covering beginner and intermediate Python concepts. These were taught to non-CS students in weekly coding workshops.
- Worked alongside other students to advertise and run the workshops, as well as providing help to attendees by troubleshooting problems and discussing programming concepts.

Scholarships and Awards

2016	The University of Manchester Physics Entrance Scholarship for 3A* grades at A level.
2016	Oakbank School E.D. McDonald Prize for best all-round academic progress.
2015	Oakbank School S. Dunhill Prize for best all-round academic progress.

Interests

- Computer programming challenges, especially those which are mathematically based such as Project Euler. This has developed my lateral thinking skills and my awareness of algorithmic complexity.
- Taekwondo – in which I have achieved a black belt – which required significant commitment and training over eight years.

References available on request.