# Dominic Williamson

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## Education

**University College London**

**CDT (MRes + PhD) AI-Enabled Healthcare Systems** 2021 – 2025

**Modules taken:** *Principles of Health Data Science*, *Graphical Models*, *Data Methods for Health Research*, *Advanced Statistical Analysis*.

**Imperial College London**

**MSc Artificial Intelligence – Distinction** 2020 – 2021

**Dissertation title:** *Transfer Learning and Canonical Kernels for GANs* – analysed the training convergence benefits of applying naïve transfer learning to 3D GANs, and compared these results to those when initialising the network with empirically-identified 'general' kernels. This research was performed with GANs developed for multi-phase material generation.

**Modules taken:** *Python Programming*, *Mathematics for Machine Learning*, *Introduction to Machine Learning*, *Introduction to Symbolic AI*, *Reinforcement Learning*, *Deep Learning*, *Probabilistic Inference*, *Machine Learning for Imaging*, *Ethics, Privacy, and AI in Society*, *Software Engineering Group Project*.

**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*, *Several Computing Projects and Laboratory Sessions*.

## 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 **PyTorch** to both develop and analyse the performance of each network to determine which performed 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.
- Self-taught the statistical theory behind machine learning and the state of current research on computer vision and transfer learning specifically.

**Quantum Chemistry Simulation Internship (Full time)** June – Aug 2018

Manchester Institute of Biotechnology, Quantum Chemical Topology Group

- Researched 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, in collaboration with two other students.
- Developed job submission scripts using **Python** and ran in Gaussian, a chemistry software package. Several **bash** scripts were developed to run Gaussian and analyse data on a high-performance cluster.
- Utilised LaTeX to write sections of the final. 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*

- **TensorFlow** was used to train a GAN to produce Monte Carlo simulations of neutrino detections in liquid argon, as part of a final year physics project.
- Researched and implemented candidate GAN architectures for Monte Carlo simulations, using **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.
- Utilised **Python** to create the simulation and data analysis programs, including 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.
- Attended 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 an online course concerning the use of Generative Adversarial Networks (GANs) for data augmentation and segmentation of medical images.
- Implemented aspects of the associated research paper (DOI: 10.1007/978-3-030-00536-8_1) 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.
- Advertised and ran the workshops alongside other students, as well as providing help to attendees by troubleshooting problems and discussing programming concepts.

## Scholarships and Awards

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| 2019 | Competitive funding awarded for an 8-week 'Learning Through Research' internship. |
| 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

- Taekwondo – in which I have achieved a black belt – which required significant commitment and training over eight years.
- 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.

*References available on request.*