Thomas Hartigan

Queens' College, Cambridge, CB3 9ET

+447597346855 | thomashartigan@sky.com | hartigan.cc | THartigan | TJHartigan

Education

University of Cambridge - Queens' College

MSci and BA (Hons) Natural Sciences (Physics) *September 2021 - Current*

- MSci - Currently undertaking a fourth year of study. Current courses include advanced quantum condensed matter, relativistic astrophysics and cosmology, particle physics, advanced statistical mechanics (stochastic processes), the formation of structure in the universe, and nuclear power engineering.
- BA - Third year studied advanced quantum physics, astrophysical fluid dynamics, optics and electrodynamics, general relativity, particle physics, quantum condensed matter, and statistical mechanics. In previous years I also studied Chemistry, Materials Science and Maths. Attained: 2.1.

King Edward VI School, Stratford-Upon-Avon

Qualifications *September 2019 - June 2021*

- A levels: Maths (A*) Further Maths (A*) Physics (A*) Chemistry (A*)
- 12 GCSEs (or equivalent) of which 8 at the best possible grade

Placements and Experience

Deep Learning Approaches for Tumour Identification and Classification

Masters Project

University of Cambridge - Supervisor: Dr Pietro Lio (hartigan.cc/masters) *October 2024 - Present*

- Developing deep learning approaches for tumour identification and classification using Coherent Raman and mid-IR spectrographs of 90 biopsy samples collected as part of an international collaboration.
- Implementing a novel approach exploiting graph neural networks and vision graph UNET methods for multi-scale whole-image feature learning.
- Processing noisy raw data using spectral analysis and clustering techniques.

Movement Classification by Convolutional Neural Networks

Summer Project

Self-Motivated (hartigan.cc/CNNs) *July 2024 - Present*

- Trained a CNN model in PyTorch capable of using Apple Watch gyroscope data to determine whether the wearer has completed a sit-up in the previous two seconds.
- Generated the training dataset for this by creating a joint Apple Watch and iPhone data logging, video recording and data labelling app.
- Incorporated regularisation, data normalisation and a variable learning rate in the model training process to prevent over-fitting whilst maximising accuracy.
- Developed a proof-of-concept Apple Watch app that terminates an alarm after detecting completion of 10 sit-ups using this model.
- Undertook the Google "Machine Learning Crash Course" and read parts of "An Introduction to Statistical Learning" and "Elements of Statistical Learning" to help with this project.

Hierarchical Methods for N-Body Simulation

Computational Investigaiton

University of Cambridge (hartigan.cc/N-body) *February 2024 - May 2024*

- Researched and implemented the fast multipole and Barnes-Hut algorithms for N-body simulation.
- Compared the computational complexity of these algorithms and found both to scale as $O(N \log N)$, beating direct calculations of $O(N^2)$.
- Found that the Barnes-Hut algorithm achieved much better accuracy in a given time despite both algorithms being of the same computational complexity.

LIDAR in Self-Driving Cars

Literature Review

University of Cambridge - Supervisor: Prof. David Buscher (hartigan.cc/LIDAR) *December 2023 - May 2024*

- Analysed literature and industry statements on the use of LIDAR technology in self-driving cars. This involved the review of more than 50 scientific papers.
- Probed processing techniques such as convolutional neural networks and generative adversarial networks.
- Investigated edge and vertical cavity surface emitting lasers, and single-photon avalanche diode detectors.

Scanning Tunneling Microscopy *Experimental Investigation*

University of Cambridge - Supervisor: Dr David Ward (hartigan.cc/STM) *February 2024 (3 weeks)*

- Produced ten thousand images of graphite surfaces at up to atomic resolution.
- Exploited the isomorphism between rotation and stretching to develop code that mitigates systematic errors in imaging. Measured the carbon-carbon bond length in graphite to an accuracy of 0.003Å accuracy.
- Investigated the rates of oxidative processes by analysing the roughness of the graphite surfaces after heating.

Radar and Electronic Defence Systems *Summer Student*

QinetiQ *June 2023 - August 2023*

- Researched radar systems, antennas, radar scanning techniques and radar signal interpretation techniques.
- Simulated radar return using python, incorporating reflections from terrain and moving aerial targets.
  - Introduced a hybrid ray tracing (100k + rays) and direct calculation method.
  - Mitigated memory and processing limitations using parallel processing and caching.
  - Incorporated version control and automated testing.
- Upgraded an ADS-B system for drone tracking. This was used in the field to help the team perform drone trials.
- Calculated antenna radiation patterns in MATLAB.

Analysis of a Large, Noisy Picoscope Dataset *Experimental Investigation*

University of Cambridge (hartigan.cc/Pico) *November 2022 - December 2022*

- Developed a Python script to analyse quantised, noisy datasets each with more than 10,000 datapoints, representing the characteristic magnetic hysteresis loops for different materials.
- Authored a 3000 word lab report in Latex incorporating results from the computational analysis.

100 Days of SwiftUI *Course*

Hacking With Swift (hartigan.cc/HWS) *July 2022 - September 2022*

- Created more than 20 apps using SwiftUI, incorporating CoreData, Generics, Networking and Machine Learning.
- Learnt best practices for object oriented programming and app development including MVC frameworks.

Extra-Curricular Achievements

Awards	Gold awards in the 2021 UK Physics and Chemistry Olympiads. Sixth Form prize for academic attainment.
Computing	Proficient in Microsoft Office, Python, Swift, MATLAB and LaTeX.
Sports & Societies	Football (College team), Rowing (Men's College VIII). Treasurer of the Queens' College Isaac Milner (Science) Society. Member of the Cambridge University Astronomical and Physics Societies.
Music	ABRSM Grade 8 Saxophone, Grade 5 Trumpet and Grade 5 Music Theory. Music colours (2020).
Other	Full clean UK Driving License, Bronze DofE (2018).