

Charlie Tan

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Education

University of Oxford

Oct. 2023 - Present

DPhil Computer Science

Research Interests: Geometric Deep Learning, Theories of Generalisation in Deep Learning, Optimisation Methods and Biases, AI for Science

Supervised by Prof. Michael Bronstein

University of Cambridge

Oct 2022 - Jun 2023

MPhil Advanced Computer Science

Pass with Distinction - 78%

Dissertation: Rethinking Proximal Optimisation for Deep Learning

Supervised by Dr Ferenc Huszár

University of Bristol

Sep 2019 - Jun 2022

BEng Electrical and Electronic Engineering

First Class Honours - 82%

Awards: Final Result Rank #1 in Department, Year-Two Result Rank #1 in Faculty of Engineering

Dissertation: Learned Image Compression with Transformers

Publications

ICLR 2023 TinyPapers - Geodesic Mode Connectivity

May 2023

Notable Accept (**Top 6%**) arXiv GitHub Presentation Video

- Recast linear mode connectivity using **information geometry**, in which statistical models are considered as manifolds of distributions, and geodesics generalise straight lines as the shortest path between points
- Proposed novel algorithm for the **approximation of geodesics** between trained neural networks, finding the identified paths to be regions of low-loss
- Demonstrated **zero-barrier mode connectivity** between ResNet20 models trained on CIFAR10, with architectures **4 times less wide** than achieved with previous methods

Research Projects

Rethinking Proximal Optimisation for Deep Learning

Nov 2022 - June 2023

MPhil Dissertation

- **Developed novel optimisation algorithm** for supervised deep learning, derived to achieve exact natural gradient descent without explicit construction of Hessian
- Demonstrated algorithm to follow **natural gradient trajectory** on toy optimisation problem
- **Evaluated proposed algorithm** on a variety of deep learning tasks and architectures, indicating algorithm to be inferior in convergence rate and stability to stochastic gradient descent

Persistent Homology Dimension Does Not Measure Generalisation

Apr 2023 - May 2023

MPhil Module Project

- **Conducted extended empirical evaluation** of persistent homology dimension, a proposed measure of generalisation based on topological data analysis
- **Demonstrated two failure modes** in which the measure failed to correlate with generalisation; large learning rates and adversarial initialisations
- **Discussed potential hypotheses** for the failure of persistent homology dimension as a measure of generalisation

Control-Approach to Graph Neural Networks

Mar - May 2023

MPhil Module Project

- Proposed inclusion of **control terms in graph neural networks**, extending work casting them as dynamic systems
- Developed novel framework for graph representation learning, in which a simple backbone network is **augmented with control terms**
- Evaluated proposed method on **standard graph benchmark datasets**, indicating no improvement in performance

Employment

Visual Information Laboratory, University of Bristol

Jun 2021 - Sep 2021

Summer Research Intern

Project: CVEGAN - Video Super Resolution with Generative Adversarial Networks

- **Migrated project codebase** to PyTorch, achieving an 8x reduction in evaluation latency over previous implementation
- Developed and evaluated novel low-complexity architecture topology, exploiting the spatial redundancy of YCbCr video to further **reduce latency 4x without loss of evaluation performance**
- Leveraged **distributed data parallel** training on multi-GPU HPC clusters, enabling more rapid experimentation

Omdena

Sep 2021 - Nov 2021

Junior Machine Learning Engineer

Project: Dryad - Early Detection of Forest Fires from Remote Sensor Data

- Analysed the per-sensor manufacturing spread present in the **time-series dataset** using Pandas
- Generated **data visualisations** using Matplotlib to detail issues with client's data collection methods
- **Communicated team's findings to client** through remote presentation, informing the methodology for subsequent data collection experiments

Department of Electrical and Electronic Engineering, University of Bristol

Sep 2020 - Jan 2022

Teaching Assistant

Modules: Linear Circuits, Electronics I, Digital Circuits and Systems

- Teaching assistant for three compulsory modules, taught to all first-year undergraduates in the department
- Hosted online **C programming laboratories** for groups of 10 students, demonstrating the use of C within embedded systems and supporting students completing an activity worksheet
- **Supervised groups of 40 students** participating in electronics laboratories, providing support for coursework tasks

Online Courses

HavardX

Introduction to Computer Science

Dec 2021

MITx MicroMasters in Statistics and Data Science

Probability

Aug 2021

Machine Learning with Python

Apr 2021