Charlie Tan

github.com/char-tan
char-tan.github.io

Education

University of Oxford   Oct 2023 - Present
DPhil Computer Science
Funded by Departmental Scholarship
Research Interests: Graph Neural Networks, Generative Machine Learning, Machine Learning Systems, Hardware Efficient Sparsity, Applications within Biology and Chemistry
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%** - **Ranked #1 in Department**
Dissertation: Learned Image Compression with Transformers
Supervised by Dr Aaron Zhang

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
- Implemented proposed algorithm in both **JAX and PyTorch**
- **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

Control-Approach to Graph Neural Networks   Mar 2023 - May 2023
MPhil Module Group Project
- Proposed inclusion of **control terms in graph neural networks**, extending work casting them as dynamic systems
- Implemented novel framework for graph representation learning using PyTorch Geometric, in which a simple backbone network is **augmented with control terms**
- Evaluated proposed method on **standard graph benchmark datasets**, indicating no improvement in performance

Pruning and Accelerating Fine-Structured Sparsity　　　　　　　　　　　　Nov 2022 - Jan 2023
MPhil Module Group Project
- Benchmarked the performance of **NVIDIA sparse tensor cores** relative to standard matrix multiplication methods
- Evaluated iterative magnitude pruning for producing the **fine-structured sparsity** required for acceleration with sparse tensor cores, demonstrating a marginal improvement over one-shot pruning
- Implemented **custom C++** / **CUDA extensions** for PyTorch

Employment

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

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

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 (150 students per year)
- 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

Relevant Skills

- Five years experience with **Python**, including object oriented programming
- Proficient with **Linux** systems
- Three years using **PyTorch** in a wide variety of machine learning projects
- Project experience coding with **JAX**
- Extensive experience employing **high performance computing** resources, including multi-GPU distributed training
- Experience with **Google Cloud Compute** resources

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