Alex O. Davies

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Personal Profile

A PhD researcher with the UKRI Interactive AI Centre for Doctoral Training based in Bristol, UK, with masters qualifications in physics and data science. Main research focuses include graph neural networks, generative deep learning and dimensionality reduction.

Projects

Unsupervised Categorisation with Photometric Data for Photo-z Estimation

Bristol, UK

MSc Data Science Thesis

Jun 2021 - Sep 2021

- Catalogues of astronomic object photometries
- Imperfectly labelled where labels are available
- Insufficient labels for supervised classification
- UMAP and HDBSCAN as an unsupervised classification pipeline

Realistic Synthetic Social Networks with Graph Neural Networks

Bristol, UK

CDT Training Year Summer Project

May 2022 - Sept 2022

- GNN graph generation models have shown great capabilities in chemistry and other domains
- Social network data faces many of the same privacy limitations in distribution as, for example, medical data
- We evaluate the capability of GRAN (Liao et. al. 2019) in producing social network structures
- Evaluation via the kernel method Maximum Mean Discrepancy (MMD) shows that below a certain scale GNN methods far out-perform the current rule-based methods
- *Available at* `https://arxiv.org/abs/2212.07843`

Hierarchical GNNs for Large Graph Generation

Bristol, UK

PhD Research

Oct 2022 - Ongoing

- Graph generation models are currently limited to $|G| \simeq 400$ nodes with attribution
- My PhD research aims to extend the capacity of these methods to much larger graphs (e.g. social networks, road networks, ...)
- My first PhD research project investigated the capacity of recent graph diffusion models to condition each other's generation in hierarchies.
- The proposed framework extended the possible size of generated attributed graphs by quadratic order
- As a demonstration we produce graphs of up to twenty thousand nodes with categorical attributes.
- *This work is currently under-review for NeurIPS 23, but a non-distributable version is available at* `https://arxiv.org/abs/2306.11412`

Education

Durham University

Durham, UK

MPhys Physics with Astronomy, 2:1

Oct 2016 - Jun 2020

- Statistical methods through classical mechanics and thermodynamics
- Linear and tensor algebra through quantum mechanics and general relativity
- Masters thesis on numerical N-body simulation
- **Courses:** General & Special Relativity, Scientific Computing, Lasers and Qubits, Spectrometry and Photometry, Advanced Astronomy

University of Bristol

Bristol, UK

MSc Data Science, Distinction

Oct 2020 - Oct 2021

- Thesis on semi-supervised classification with dimensionality reduction
- Data processing & cloud computing
- Non-neural machine learning & deep-learning
- **Courses:** Technology Innovation Business and Society, Large Scale Data Engineering, Introduction to Artificial Intelligence, Data-Science Mini-Project

Interactive Artificial Intelligence CDT

Bristol, UK

CDT Training Year

Oct 2021 - Jun 2022

- Image, language and audio deep-learning
- Inductive logic programming
- Human-computer interaction design
- **Courses:** Applied Deep Learning, Learning Computation & the Brain, Interaction Design, Advanced AI, Natural Language Processing, Uncertainty Modelling, Machine Learning Paradigms

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References available upon request.