

Isaac Reid

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Research interests

I am interested in problems at the interface of ML, statistical physics and applied mathematics, especially where theoretical results have proved elusive, applications are high-impact, or both.

Education

Machine Learning Group, University of Cambridge

Oct 2022 - present

PhD in Engineering

Supervisors: Dr Adrian Weller and Prof. Rich Turner

Advisor: Prof. Carl Rasmussen

Subject: Scalable and data-efficient machine learning. Ongoing collaboration with Prof. Krzysztof Choromanski (Google DeepMind and Columbia University, New York).

Physics, University of Oxford

Oct 2017 - Jun 2021

Master of Physics, MPhys

Grade: First class, 92%, top of Oxford cohort

Modules: Theoretical physics, condensed matter, fluid dynamics, general relativity

Research project: Quantum entanglement barriers in dual-unitary circuits

Supervisor: Dr Bruno Bertini

Publications and select preprints

Repelling Random Walks

ICLR 2024

Isaac Reid, Eli Berger, Krzysztof Choromanski, Adrian Weller

Synopsis: A QMC scheme that correlates the directions of walkers on a graph, providing better sample efficiency and improving the concentration of a host of statistical estimators

<https://arxiv.org/abs/2310.04854>

Universal Graph Random Features

ICLR 2024

Isaac Reid*, Krzysztof Choromanski*, Eli Berger*, Adrian Weller

Synopsis: A random feature mechanism to approximate arbitrary functions of a weighted adjacency matrix, unlocking kernel-based learning on very large graphs

<https://arxiv.org/abs/2310.04859>

Quasi-Monte Carlo Graph Random Features

NeurIPS 2023, accepted as spotlight paper

Isaac Reid, Krzysztof Choromanski, Adrian Weller

Synopsis: A QMC scheme that induces correlations between the lengths of terminating random walks on a graph, with possible applications in bioinformatics and graph-based Transformers

<https://arxiv.org/abs/2305.12470>

Simplex Random Features

ICML 2023, accepted with oral presentation

Isaac Reid, Krzysztof Choromanski, Valerii Likhoshesterov, Adrian Weller

Synopsis: Derivation of an optimal random feature mechanism for unbiased approximation of the Gaussian kernel, motivated by a host of new analytical results and tested with Transformer experiments

<https://arXiv.org/abs/2301.13856>

Entanglement Barriers in Dual-Unitary Circuits

Phys. Rev. B 104, 014301 – Published 1 July 2021

Isaac Reid, Bruno Bertini

Synopsis: Exact characterisation of the dynamics of quantum entanglement arising after a quantum quench in a many-body, locally interacting system, including both the integrable and completely chaotic regimes

<https://arxiv.org/abs/2103.12794>

Teaching

Engineering 2P7

Michaelmas 2023

Synopsis: Supervisions in mathematics for engineers (vector calculus, linear algebra and probability)

Pembroke International Summer Programme

Jun-Aug 2023

Synopsis: Research project on density ratio estimation in machine learning

Talks

Quasi-Monte Carlo Graph Random Features – NeurIPS@Cambridge, Cambridge

Dec 2023

Synopsis: Invited talk to accompany NeurIPS spotlight paper

Simplex Random Features – ICML 2023, Honolulu

July 2023

Synopsis: Oral presentation to accompany paper

Simplex Random Features – Microsoft Research, Cambridge

Jun 2023

Synopsis: Research talk on ICML paper

Random Features for Kernel Approximation – Machine Learning Group, Cambridge

Mar 2023

Synopsis: Seminar on random feature methods and recent QMC schemes to improve their convergence

Experience

Student Researcher, Google

May 2024 - present

Joining [Silvio Lattanzi](#)'s team for an exciting project, working closely with [Krzysztof Choromanski](#) and [Avi Dubey](#)

Systems Engineer, Opsydia

Sep 2021 - Sep 2022

R&D engineer at deep-tech startup specialising in laser technology and adaptive optics, spun out of Oxford University Engineering Department

Research Intern, Max Planck Institute for Dynamics and Self-Organisation, Göttingen

Summer 2020

Computational study of Bose-Einstein condensation in active matter, applying theoretical results from many-body quantum physics to classical clustering phenomena observed in Kob-Andersen particle dynamics

Supervisors: [Dr Benoit Mahault](#) and [Prof. Ramin Golestanian](#)

Research Intern, Rudolf Peierls Centre for Theoretical Physics, Oxford

Summer 2019

Study of relationship between spectral properties of Hessian of loss function and Bayesian prior upon deep neural network initialisation, estimated using random sampling of weights and Gaussian processes

Supervisor: [Prof. Ard Louis](#)

Scholarships and awards

G-Research Grant

July 2023

Financial award to help fund attendance of ICML conference

IQ Capital Deeptech Fellowship

2023

Advising investment portfolio in climate-tech startups

Trinity College External Studentship

2022-2025

Full scholarship for a PhD in Machine Learning

Encaenia

Jun 2022

One of six undergraduate students invited to attend Oxford's historic [Encaenia ceremony](#)

Gibbs Prize For submitting the highest scoring MPhys research project (87%)	<i>2020-2021</i>
Scott Prize For best overall performance in the MPhys (92%)	<i>2017-2021</i>
Scott Prize For best performance in the third year (92%)	<i>2019-2020</i>
Winton Capital Prize For best performance in the second year (93%)	<i>2018-2019</i>
Hertford College Academic Scholarship For performance in first year (88%)	<i>2018-2021</i>
Physics Practical Prize For performance in laboratory and computational work	<i>2018-2020</i>