Redefining Deep Neural Networks (DNNs) through Controlled Approximations.
EPSRC funded PhD studentship with full fee waiver and £21,805 pa stipend (2026/27 rate)

Project Code:	DLA_DTP_2026_10
Main Supervisor:	Dr Mohamed Kentour
Co-Supervisor:	Professor Mauro Vallati
	Professor Simon Parkinson

Project Introduction

Inspired from the brain organisational regions, "Redefining Deep Neural Networks (DNNs) through Controlled Approximations," introduces a novel paradigm for artificial intelligence. Moving beyond conventional architectures, we propose structuring DNNs with brain connectionist principles, where specialised control circuits meticulously govern information flow within artificial regions. This innovative approach aims to instil a deeper understanding and precise management of the inherent approximations within DNNs, fostering not only enhanced interpretability and robustness but also paving the way for more efficient and biologically plausible learning mechanisms in artificial systems. This research promises to unlock new capabilities for AI in critical and complex domains.

Project Details

This PhD project seeks to redefine deep neural network (DNN) design by drawing principled inspiration from the brain's hierarchical organisation, efficiency, and functional specialization. Titled Redefining Deep Neural Networks (DNNs) through Controlled Approximations, the research proposes a transformative architecture composed of specialised artificial regions that mimic cortical areas. Each region is functionally distinct and optimised for particular computational roles, such as feature extraction, integration, or decision refinement. Rather than operating as a homogeneous monolithic structure, the network is governed by control circuits: meta-learning or gating mechanisms that dynamically orchestrate information flow and allocate computational resources across modules.

The central innovation lies in introducing controlled approximations as a formal design principle. Instead of applying uniform computational precision across all inputs and layers, the architecture dynamically adjusts precision and resource intensity according to task complexity and criticality. Less informative features may be processed with lower precision or sparse activation, while high-stakes or uncertain inputs trigger more resource-intensive processing. This adaptive regulation enables efficient neural rewiring and selective activation, conceptually analogous to biological plasticity. The framework will be grounded in control theory, leveraging observability Gramian and Lyapunov stability analysis to formalise interpretability, controllability, and structural robustness.

The project unfolds over three stages. In the first year, the theoretical framework for modular regions and control circuits will be developed and implemented in a prototype architecture. Mathematical formulations will define precision allocation mechanisms and stability constraints, followed by benchmarking against standard DNN baselines to evaluate computational efficiency and predictive performance.

In the second year, adaptive rewiring mechanisms will be introduced. These include learnable structural pruning and dynamic topology reconfiguration governed by control signals. The network will be evaluated for energy efficiency, robustness to adversarial perturbations, and interpretability of decision pathways. Controlled approximation will be analysed both empirically and theoretically, establishing links between resource allocation, observability, and stability.

In the final year, large-scale validation and consolidation will be conducted. Energy consumption, inference cost, robustness metrics, and diagnostic transparency will be systematically measured. Theoretical results will be unified into a coherent framework connecting modularity, control circuits, and stability guarantees.

By reducing computational redundancy while enhancing transparency and resilience, this research addresses the urgent need for sustainable and trustworthy AI. It directly aligns with priorities in energy-efficient computing, AI security, and accountable machine learning, paving the way for scalable, interpretable, and biologically plausible intelligent systems.

Project-specific entry requirements

Master's in Computer Science related degree obtained with a distinction, or a Bachelor's in Computer Science related degree obtained with 2:1 – 2:2 band. Good Data Analytics, Maths (integrals, derivatives, formulation) and programming skills, knowledgeable of AI and Deep Learning, logical skills (reasoning).

Further Information

This call is open to **UK Applicants only**.

Applicants should be of outstanding quality and exceptionally motivated.

The studentships are funded for 3 years (subject to satisfactory annual performance and progression review) and will provide for tuition fees and a tax-free stipend paid monthly.

Please note that there are more projects than funded studentships available and therefore this is a competitive application process which will include an interview. Shortlisted candidates will be contacted for an interview in person or via Teams. After interview the most outstanding applicants will be offered a studentship.

Queries about the application process are welcome and should be emailed to pgrscholarships@hud.ac.uk.

Informal enquiries about this project should be directed to Dr Mohamed Kentour

Type of Award: Doctor of Philosophy (PhD).

Eligibility: UK applicants only. First Class or Upper Second-Class Honours degree or equivalent in a relevant subject area, please refer to the entry requirements on the specific projects being advertised.

Location: Huddersfield.

Funding: 3 years full time research covering tuition fees and a tax-free bursary (stipend) starting at £21,805 for 2026/27 and increasing in line with the EPSRC guidelines for the subsequent years. Funded via the

Engineering and Physical Sciences Research Council Doctoral Training Programme.

Duration: 3 years full-time plus 12 months writing up (please note no funding available for writing up period).

Closing date: 28th April 2026

Start date: 1st October 2026

Application details

- Go to the EPSRC webpage and download the Expression of Interest Form 2026.
- Provide copies of transcripts & certificates of all relevant academic and professional qualifications.
- Provide references from two individuals – please contact your referees and ask them to send them directly to pgrscholarships@hud.ac.uk from their email address.
- Proof of eligibility – e.g. scan of passport photo page.
- Completed forms, including all relevant documents should be submitted via-email to pgrscholarships@hud.ac.uk.

Please note: if you do not attach all the relevant documentation prior to the closing date your application will not be considered.

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