



School of Computing, Engineering, and the Built Environment Edinburgh Napier University

PHD STUDENT PROJECT

Application instructions:

Detailed instructions are available at :

<https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply>

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Dr Md Zia Ullah (Email: m.ullah@napier.ac.uk)
- 2ND SUPERVISOR: Dr Dimitra Gkatzia

Subject Group: Computer Science

Research Areas: Computer Science, Artificial Intelligence, Data Science, Machine Learning

Project Title: Shrinking LLMs using Principled Training Approaches

Project description:

Large Language Models (LLMs) are machine learning models trained to perform general-purpose tasks that can be modeled using text, images, or both. They showcase emerging abilities that result mainly from unsupervised training on vast amounts of data. However, with parameter counts in the billions and datasets often exceeding a trillion tokens, they are expensive to train and run, placing them outside the reach of smaller groups with limited resources. Some recent works suggest that state-of-the-art LLMs may be significantly larger than needed due to inefficiencies in the training process. The Microsoft TinyStories showed that even tiny models can produce coherent short stories provided that the generated text has a limited vocabulary [1]. The Phi1.5 papers then went further, showing that given a high-quality dataset, models with 1-2 billion parameters can sometimes match those 2-3 times larger the size [2].

This PhD. project aims to investigate if a small model (less than 100M parameters) can be trained that maintains a subset of the emerging abilities (e.g., language understanding, common sense, and reasoning skills) exhibited by modern LLMs [GPT-4o], given some careful modifications to its dataset and training setup [3]. Furthermore, the project will find a set of principles to train such models reliably. The project will also aim to develop smaller models for domain-specific tasks, for example, secure code generation.

Prospective applicants are encouraged to contact the supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisor(s).

References:

1. Eldan, Ronen and Li, Yuanzhi, TinyStories: How Small Can Language Models Be and Still Speak Coherent English? arXiv preprint arXiv:2305.07759, 2023.
2. Suriya et al., Textbooks are all you need, arXiv preprint arXiv:2306.11644, 2023
3. Schaeffer et al., Are emergent abilities of large language models a mirage? Advances in Neural Information Processing Systems, 2024

Candidate characteristics

Education:

A first degree (at least a 2.1) ideally in Computer Science or Data Science

Subject knowledge:

Natural language processing (NLP) and Deep learning

Essential attributes:

- Experience of fundamental knowledge of NLP and Deep learning
- Competent in Shell scripting, Python, and PyTorch
- Knowledge of Seq2Seq models, LLMs, and Machine learning
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management