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

PHD STUDENT PROJECT

Funding and application details

Funding status: Self-funded students only

Application instructions:
Detailed instructions are available at https://www.napier.ac.uk/research-and-innovation/research-degrees/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: Professor Ashkan Sami (Email: A.Sami@napier.ac.uk)
- 2ND SUPERVISOR: Professor Foutse Khomh Polytechnique Montréal (Canada)

Subject Group: Computer science

Research Areas: Software Engineering, AI, Machine Learning and Data Science

Project Title: Advancing Software Development and Maintenance through Foundation Models

Project description:

Software development and maintenance are complex and resource-intensive processes that often require manual intervention and extensive human expertise. The advent of large language models (LLMs) and foundation models, such as GPT-3 and successors, opens up new possibilities for transforming various aspects of software development and maintenance. This research project aims to explore how foundation models can be applied to enhance these critical software engineering processes.

Sample Research Objectives:

1) Code Generation and Assistance: Develop foundation model-based tools and techniques for generating code snippets, assisting in code completion, and automating repetitive coding tasks. Evaluate the accuracy and efficiency of generated code.
2) Natural Language Interfaces: Investigate the use of foundation models to create natural language interfaces for software development, allowing developers to interact with code and databases using plain language queries and commands.
3) Bug Detection and Resolution: Explore the capability of foundation models to detect and suggest fixes for software bugs, security vulnerabilities, and performance issues through code analysis and understanding.
4) Code Refactoring: Develop methods for automated code refactoring based on best practices and coding standards, using foundation models to assist in identifying and implementing improvements.
5) Ethical and Legal Considerations: Address ethical and legal concerns surrounding the use of foundation models in software development, such as plagiarism detection and intellectual property rights.

Expected Outcomes:

The research is expected to lead to the development of tools and practices that significantly streamline software development and maintenance processes. These outcomes may result in more efficient development, reduced human errors, faster bug resolution, and improved software quality.

Significance:

Software development and maintenance are central to various industries and services. By harnessing the power of foundation models, this research has the potential to revolutionize the way software is created and maintained, making it more accessible, efficient, and error-free.

Please note that this is a high-level topic, and the specific research directions and methodologies would need to be further refined and developed in collaboration with your academic supervisor. Additionally, the field is moving fast and you should keep yourself up-to-date on the developments that are happening. For a comprehensive survey of pre-trained foundation models please look at [1] and for a comprehensive survey of use of Deep Learning in Software Development [2]. LLMs have been use in variety of software development tasks [3], in this project we seek to use foundation models for software development and maintenance.

References:

[1] A comprehensive survey of foundation models: https://arxiv.org/pdf/2302.09419.pdf

[2] Yanming Yang, Xin Xia, David Lo, and John Grundy. 2022. A Survey on Deep Learning for Software Engineering. ACM Comput. Surv. 54, 10s, Article 206 (January 2022), 73 pages. https://doi.org/10.1145/3505243

[3] Hou, Xinyi, et al. "Large language models for software engineering: A systematic literature review." arXiv preprint arXiv:2308.10620 (2023).

Candidate characteristics

Education:

A second class honour degree or equivalent qualification in Computer Science, Software Engineering, Cyber Security or related fields.

Subject knowledge:

- AI, machine learning, software engineering

Essential attributes:

- Experience of fundamental AI, machine learning, software engineering
- Competent in computer programming
- Knowledge of advanced deep learning tools and technologies
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project

Desirable attributes:

- Knowledge of computer architecture, code analysis and deep learning