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: Prof Xiaodong Liu (Email: x.liu@napier.ac.uk)
- 2ND SUPERVISOR: Dr Oluwaseun Bamgboye

Subject Group: Computer Science

Research Areas: Software Engineering, Artificial Intelligence

Project Title: Automating Software Development with Semantic-based Generative AI

Project description:
Automatic design and development of software applications has been the dream of software communities for decades. Although it can bring significant benefits including increasing productivity, reducing human errors and speeding up development, automatic software development has never been realised properly due to the limitation of software engineering technologies, lack of AI support or the limitation of the existing AI technologies, and leaves the automatic generation of software infeasible, inaccurate, unscalable, untrustworthy and with no explainability of its underlining logic.

There are different software engineering technologies to support automatic software development. Automatic code generation is the technology that automatically generates source code or other software artefacts of a software application using tools or frameworks. Generative programming and its related term meta-programming are concepts whereby programs are written to produce software components in an automatic manner. The goal of generative programming is to improve the productivity of software developers. It is often

related to code-reuse topics such as component-based software engineering. Model-driven engineering (MDE) is a software development methodology which focuses on creating domain models and using them in driving the software application development. The MDE approach aims to increase productivity by maximizing commonality between systems via reuse of standardized models.

In this PhD project, the successful candidate will explore the current state of the art on generative AI (e.g. ChatGPT), semantic models, and software development (e.g. model-driven development and software product line) and then develop a new approach to endorsing the generative AI and the semantic model to the software development so that the design and development of the software applications will be automated, generative, explainable, and trustworthy. The approach will provide a transformative solution to the software engineering technologies.

Applications from potential part-time students are also welcomed.

References:
[1] EU Project: Swarmchestrate: Application-level Swarm-based Orchestration Across the Cloud-to-Things Continuum", HORIZON-CL4-2023-DATA-01-04 - Cognitive Computing Continuum: Intelligence and automation for more efficient data processing (AI, data and robotics partnership), Co-Investigator, 2023-2026.
[2] Qi Liu, Lei Zeng, Muhammad Bilal, Houbing Song, Xiaodong Liu, Yonghong Zhang, Xuefei Cao. (in press). A Multi-Swarm PSO Approach to Large-Scale Task Scheduling in a Sustainable Supply Chain Datacenter. IEEE Transactions on Green Communications and Networking, https://doi.org/10.1109/tgcn.2023.3283509, 2023.
[3] Claus Pahl, Frank Fowley, Pooyan Jamshidi, Daren Fang and Xiaodong Liu, A classification and comparison framework for cloud service brokerage architectures, IEEE Transactions on Cloud Computing, 6(2), 2018.
[4] Daren Fang, Xiaodong Liu, Imed Romdhani and Claus Pahl, An agility-oriented and fuzziness-embedded semantic model for collaborative cloud service search, retrieval and recommendation. Future Generation Computer Systems, Elsevier, Vol. 56, Issue C, pp 11-26, 2016.

Candidate characteristics

Education:
A second class honour degree or equivalent qualification in Computer Science with a good knowledge of Software Engineering or Artificial Intelligence.

Subject knowledge:
- Software Engineering and/or Artificial Intelligence

Essential attributes:
- Experience of fundamental software design and development;
- Competent in design of software applications;
- Knowledge of generative AI and semantic models;
- Good written and oral communication skills;
- Strong motivation, with evidence of independent research skills relevant to the project;
- Good time management;

Desirable attributes:
- Some knowledge of machine learning would be beneficial.