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://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/

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 Oluwaseun Bamgboye (Email: O.Bamgboye@napier.ac.uk)
- 2ND SUPERVISOR: Prof Xiaodong Liu, Dr kehinde Babaagba

Subject Group: Computer science

Research Areas: Internet of Things, Computer Science, Software Engineering, Data Science

Project Title: Enhanced Deep Learning and Semantic-based Predictive Analytics for Reactive IoT Applications and Streaming Data

Project description:

The emergence of Internet of Things (IoT) has formed a bridge that connects most of the real-world entities with the related computer entities. Its general objectives includes: Sensing critical information from the external physical environment; sampling of internal system signals and; obtaining meaningful information from sensor data to perform monitoring and proactive decision-making process.

Furthermore, the application of IoT technologies and data analytics has been found to provide opportunities for innovative applications across fields such as: Industrial IoT and cyber-physical systems, intelligent transportation systems (ITSs), smart building, and many other related areas. In these domains, data streams produced from different sensors can form meaningful insights by drawing patterns to support real-time events in reactive and Complex Event Processing systems(CEPs).

Mostly IoT streaming data comes with various quality and data heterogeneity challenges that prevents interoperability requirements of data and associated smart systems. These streaming data requires some semantic or Intelligent-driven processing to achieve data interoperability, analysis and automated inferencing to support real-time prediction and proactive management of some smart systems and safety-critical systems.

The field of Complex event Processing is known to be capable of real-time processing of IoT streaming data, but unable to provide the predictive functionalities that are readily provided the Machine Learning nd related statistical models. In addition CEP uses set of rules to support the processing IoT streaming data but does not include support for historical data, which in itself can help in drawing pattern from the data and gaining better insights.

On the contrary, Machine Learning approach has been known for its ability to support predictive analytics, but are not suitable to support data and device interoperability, semantic stream modelling and real-time reasoning of IoT streaming data.

Therefore, it is necessary to set a foundation that can form a bridge between these technologies and the semantic technology in order to be able to achieve both effective and efficient stream analysis and proactive prediction of events in real-time safety-critical systems. The objectives of the PhD study is not limited to the following:

- Develop an adaptive Machine Learning or AI model suitable for the processing and analysis of IoT Streaming data for real-time event prediction
- Adopt a suitable approach for the combination of historical and rea-time IoT streaming data to support the continuous analysis and correlation for accurate and trusted predictions from events to support reactive applications or systems.
- Develop a prototype intelligent-driven software architecture that support IoT stream quality management and predictive analytics from integration of semantic-based processing and enhanced AI-based models, thereby forming a bridge between ML-based data analytics and semantic technologies.

References:

[1] Akbar, A., Khan, A., Carrez, F., & Moessner, K. (2017). Predictive analytics for complex IoT data streams. IEEE Internet of Things Journal, 4(5), 1571-1582.

[2] Bamgboye, O., Liu, X., & Cruickshank, P. (2019, July). Semantic stream management framework for data consistency in smart spaces. In 2019 IEEE 43rd Annual Computer Software and Applications Conference (COMPSAC) (Vol. 2, pp. 85-90). IEEE.

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Computer Science/Computing, Mathematics, Data Science, Computer engineering/Electronics, Any other numerate discipline

Subject knowledge:

- Software Engineering
- Internet of Things
- Data processing and analytics
- Semantic Technologies and Modelling
- Machine Learning including Artificial Intelligence
- Cloud Computing

Essential attributes:

- Fundamentals of Software Engineering, AI and Programming
- Competent in scientific research
- Ability to undertake independent research
- Good knowledge of IoT
- Good written and Oral communication skills
- Strong motivation and evidence of undertaking independent research
- Excellent Time management

Desirable attributes:

- Familiarity with data processing and understanding of IoT and reactive systems
- understanding of large graph models
- Familiarity with CEPs
- Data Modelling
- Public speaking