2024 Winter Research Project Description

Project title:	Developing an automated platform for Transformer replacement criteria
Hours of engagement & delivery mode	For the Winter program, students will be engaged for 4 weeks only. Hours of engagement will be between 20 – 36 hrs per week. *This project is offered through a hybrid arrangement. Student will develop the programme remotely. However testing will be done on site*.
Description:	*In this project student will work on developing a platform to identify the transformer replacement criteria. The analysis depends on statistical analysis of transformer failures and number of condition monitoring data. Student should have good understanding about programming, statistical analysis and web tools.*
Expected learning outcomes and deliverables:	*Scholars may gain skills in data collection, statistical analysis be involved in automating outcomes of standards based on measured data, and have an opportunity to generate publications from their research. Students may also be asked to produce a report or oral presentation at the end of their project.*
Suitable for:	*This project is open to applications from students with a background in data analytics and understanding operation of power system assets.*
Primary Supervisor:	Chandima Ekanayake
Further info:	Students can reach supervisor before submitting an application by contacting chandima@eecs.uq.edu.au

2024 Winter Research Project Description

Project title:	Home Energy Management System
Hours of engagement & delivery mode	30 hours for 4 weeks. The project will be offered on-site
Description:	Residential consumers are playing an important role in the modern power grid and therefore home energy management system is drawing increasing attention. However, the load scheduling optimisation problem in home energy management is of high computation complexity. To deal with this issue, this project aims at developing an Iterative method. Rather than solving the optimisation problem by conventional optimisation algorithms, the iterative method is to select one of the actions that can reduce the daily electricity cost each time and adjust the energy storage system operation schedule accordingly.
Expected learning outcomes and deliverables:	Scholars may gain skills in machine learning techniques for load forecasting and optimization. The student will be asked to do a presentation.
Suitable for:	This project is open to applications from students with a background in computer science and fluent in programming.
Primary Supervisor:	Dr Hui Ma
Further info:	huima@eecs.uq.edu.au Please make an appointment with me if you want to know more about the project.

2024 Winter Research Project Description

Project title:	**An Automated Matlab Framework for Multidimensional Linear Filter Synthesis**
Hours of engagement & delivery mode	Duration 4 weeks Hours of engagement: 20 – 36 hrs per week Project activities will be in-person at St Lucia campus
Description:	Multidimensional (MD) digital filters are employed in numerous signal processing applications ranging from image/video processing, radar, sonar and other communication systems involving an array of antennas/sensors. Such MD filters often requires tailored filter synthesis approaches to achieve lower computational complexity and desired performance. This project aims to develop an automated framework for synthesising a special family of such MD filters which are based on a passive LRC network prototype. The proposed framework takes filter specifications as the user input and is expected to produce final filter coefficients, which subsequently allows the filters to be directly implemented on an FPGA based hardware platform exploiting parallel processing. The project requires prior knowledge of Matlab (or Python) and Digital Signal Processing.
Expected learning outcomes and deliverables:	After completion of the project the participant will be able to gain experience on: Reading and comprehending journal articles on the topic Matlab based programming for Digital Signal Processing applications Applications of various MD digital filters Challenges of implementing such filtering algorithms on digital hardware
Suitable for:	This project is open to 3-4th year students with background in Digital Signal Processing and Matlab.
Primary Supervisor:	Chamith Wijenayake
Further info:	Supervisor's contact details: c.wijenayake@uq.edu.au

2024 Winter Research Project Description

Project title:	Tracking outdoor augmented reality head-mounted display wearing users on a large campus
Hours of engagement & delivery mode	This project will be four (4) weeks in length with an approximate workload of 30 hours per week over the Winter Vacation period. This project is offered on-site, with the student expected to be on-site for the majority of their working time.
Description:	Augmented reality head-mounted displays can give users real-time information and updates about their surroundings. As the form factor of these devices is refined and starts to become more ubiquitous, we will reach a point where wearing these won't be a novelty but rather an everyday aid. To prepare for this eventuality, we need to consider the design and development challenges or considerations of the devices. This project will look at one aspect of this. Consider the following scenario. In the scenario, we will use the St Lucia UQ campus as the location, but it could be applied to other industries and locations. *UQ Properties and Facilities (P&F) and Security respond to many calls for assistance of various degrees of severity and type across the entire campus. Field personnel have been equipped with a see-through augmented reality head-mounted display to provide information about the calls they are responding to and directions/instructions relevant to the call.* *Currently, progress on calls and the location of field personnel are manually tracked by the central control centre. The central control centre can observe security cameras to get updates on incidents and relay this information to the field personnel while they are en route.* This project aims to develop a proof-of-concept platform for demonstrating real-time tracking of location and information exchange between a central control centre and field personnel responding to incidents on a large campus. Personnel in the central control centre need to be able to monitor the location and status of field personnel and provide them with updates, including routing security camera feeds to them. Field personnel need to be able to share images and updates with the central control centre and other field personnel. The project's central control system aspect may use the Illumicave. The Illumicave is a large high definition multi-screen curved display located within the School of Electrical Engineering and Computer Science. It consists of three multi-touch enabled panels flanked by two regular panels. The panels are in portrait orientation producing and overall display resolution of 10800x3840. The panels are driven by three machines plus a single central hub machine with its own display. The Illumicave can be seen in the following news report: https://www.youtube.com/watch?v=iI9kjAqo_v4.
Expected learning outcomes and deliverables:	Students will gain skills in developing a single software project across multiple different platforms and devices, including Microsoft HoloLens 2, web-based mobile, and web servers. They may also gain skills in computer vision, extended reality, and geographical information systems. Students must give a presentation and demonstration to the HCC research group at the end of their project. Students will need to make their codebase available to the project team. Following the project's conclusion, there are opportunities to be included in future research projects and papers stemming from this work should it be continued.
Suitable for:	Final year student in an IT, CS, or ENG(Software) program. It is strongly recommended that the student has strong to excellent programming skills. Experience with network programming and programming for multiple devices/platforms is recommended. Prior experience with XR, mobile development, and server/web development is a plus but not required – on-project upskilling can occur where these skills are absent.
Primary Supervisor:	**Primary supervisor** - Jason Weigel (j.weigel@uq.edu.au) **Secondary supervisor** - Mashhuda Glencross
Further info:	For further information on this project, please contact Jason Weigel (j.weigel@uq.edu.au). Jason may be contacted before applying to discuss the project and project suitability. Project IP: Individuals doing this project will need to assign IP to UQ and provide the application/code base as is with no expectation of continued warranty support. Individuals may be engaged after the project for work and/or research purposes.

2024 Winter Research Project Description

Project title:	Advanced Graph and Network Modelling Method in Real World Using Graph Neural Networks
Hours of engagement & delivery mode	For the Winter program, students will be engaged for 4 weeks only. Hours of engagement will be between 20 – 36 hrs per week
Description:	This project is titled as "Graph and Network Modelling in Real-world Using Graph Neural Networks". Its main purpose is to apply and research suitable graph neural networks (GNNs) methods to handle the requirements to deal with graph and network modelling in real world such as in social network or e-commerce platforms. This project has significant meanings from both the artificial intelligence and the social science aspects. On the one hand, this real-life application can potentially foster further investigation and development of the techniques for artificial intelligence and graph neural networks. On the other hand, an advanced GNN tools can effectively help digital platforms to extract valuable information from numerous sources including interactions and contents etc.
Expected learning outcomes and deliverables:	In this project, students will study the advance machine learning and deep learning techniques for GNN, such as Graph Convolutional Networks and Graph Attention Layers, to analyse the database from online platforms. A basic requirement for a student is to develop appropriate algorithms for GNN and an interactive user interface (e.g., dashboard) to visualise the achieved analysis insights using the learned techniques. A more advance direction is to develop novel algorithms that can improve over existing models. This project can possibly lead to academic paper publications.
Suitable for:	This project is open to applications from students with a background in data science and machine learning with STRONG self-motivation who has future research plan. Students are expected to have prerequisite knowledge in classification, regression, neural network, supervised/unsupervised learning as well as good programming skills.
Primary Supervisor:	Ruihong Qiu (r.qiu@uq.edu.au) Helen Huang (helen.huang@uq.edu.au)
Further info:	**Outcome of previous students:** UQ at #SMM4H 2023: Balanced and Explainable Social Media Analysis for Public Health with Large Language Models, Winner of SMM4H competition at AMIA 2023 Balanced and Explainable Social Media Analysis for Public Health with Large Language Models, Best Paper Award at ADC 2023 5/5 previous thesis students obtained UQ PhD scholarship Prospective students please look at https://ruihongqiu.github.io/recruit/ and email your **CV** and **transcripts** to r.qiu@uq.edu.au

2024 Winter Research Project Description

Project title:	Power Network Situational Awareness and Visualization
Hours of engagement & delivery mode	Length of the project: 4 weeks The applicant will be required on-site for the project.
Description:	With more renewable energy integration into distribution networks, the behaviours of the distribution networks become much more complicated and invisible due to newly emerged inverter-based distribution generators. In recent years, distribution phasor measurement units (PMU) and power quality meter, high precision GPS-based monitoring device are starting installed into distribution networks in Australia to make the distribution system visible. Subsequently, the big data is coming for power networks and the key is to transfer the data to knowledge to make the power network issues more visible and predictable. The main objective of this project is to develop a user-friendly interface to visualise the network events based on the big data from a big number of PMUs in Australian distribution networks.
Expected learning outcomes and deliverables:	**The student can gain/learn following skills from this project**: (1) Understand the data management system of the power networks; (2) Enhance the programming ability. (3) The student will have the chance to play with the real power network data and the real distribution networks, which will increase the employment possibility in utilities. **The expectation to complete the project**: (1) Establish a visualization tool for real-time PMU data; (2) Produce a report to summarize all the conducted work and results.
Suitable for:	This project is open to applications from students with a background in Computer Science and Electrical Engineering, UQ enrolled *3rd – 4th year* students only, good at programming and good understanding about the power system.
Primary Supervisor:	Dr Feifei Bai
Further info:	f.bai@uq.edu.au The supervisor wishes to be contacted by students prior to submitting an application.

2024 Winter Research Project Description

Project title:	Real-Time Object Recognition in Video Games: A Case Study on League of Legends
Hours of engagement & delivery mode	The project duration is set at 4 weeks, during which participants are expected to engage for 20 to 36 hours per week. All activities must be conducted within the designated official program dates. The project will adopt a hybrid format, allowing for a mix of on-site and remote participation.
Description:	This project aims to develop a cutting-edge computer vision system capable of recognizing objects in real time within the dynamic and visually complex environment of video games, with a specific focus on League of Legends (LoL). By leveraging advanced machine learning algorithms and optimization techniques for high frame rate (FPS) processing, the project seeks to achieve rapid and accurate object recognition. This will involve collecting and annotating a vast dataset of in-game footage, training a model on this dataset, and implementing the model in a way that supports real-time analysis without significant latency. The project will address challenges such as varying object appearances, in-game visual effects, and the need for high-speed processing to maintain the game's immersive experience.
Expected learning outcomes and deliverables:	Upon completion of the project, participants are anticipated to have acquired advanced skills in computer vision techniques, real-time data processing, and machine learning model development, particularly in the context of video game environments like League of Legends. The project will yield a comprehensive academic paper that details the methodologies, challenges, and solutions encountered, along with system performance benchmarks and implications for game design. Additionally, a demonstration application will be developed to showcase the real-time object recognition capabilities within League of Legends, complemented by the public release of the collected dataset and trained models to support further academic and practical advancements in the field.
Suitable for:	This project is suitable for students with a background in computer science, particularly those focused on machine learning, computer vision, and real-time systems. It is also relevant for game developers interested in integrating advanced object recognition features into their games.
Primary Supervisor:	Miao Xu (miao.xu@uq.edu.au)
Further info:	If you have any questions, feel free to contact Dr Miao Xu (miao.xu@uq.edu.au).

2024 Winter Research Project Description

Project title:	Evaluation of community battery storage and EVs as means to mitigate technical and economic effects of rooftop PV
Hours of engagement & delivery mode	The project duration is set at 4 weeks, during which participants are expected to engage for 20 to 36 hours per week.
Description:	Whilst rooftop solar are desirable for environmental benefits and economic benefits to homeowner, they tend to be nuisance for the broader grid and a economically detrimental to bulk generators including large solar and wind farms which are somewhat controllable. This project will evaluate how community batteries and EVs together can mitigate the challenges posed by rooftop solar.
Primary Supervisor:	Rahul Sharma (rahul.sharma@uq.edu.au)

2024 Winter Research Project Description

Project title:	Individualised Virtual Reality for Mental Health
Hours of engagement & delivery mode	The project duration is set at 4 weeks, during which participants are expected to engage for 20 to 36 hours per week.
Description:	Looking for a highly motivated student to work on an existing VR for Mental health project, as we continue to improve the interface and avatars. The project builds on what we have currently developed: JMIR Mental Health - Individualized Virtual Reality for Increasing Self-Compassion: Evaluation Study
Suitable for:	Strong knowledge of Unity and C# programming is ideal. No need to have any mental health background.
Primary Supervisor:	Nell Baghaei (n.baghaei@uq.edu.au)

2024 Winter Research Project Description

Project title:	Taint analysis on low-level code
Hours of engagement & delivery mode	The project duration is set at 4 weeks, during which participants are expected to engage for 20 to 36 hours per week. The project will be offered on-site and the participant will be working alongside a team of researchers which are working on automated program verification.
Description:	The project is placed in a wider context of research on automated program analysis conducted on binary code. Within the existing analysis framework, the program to be analysed is represented in an intermediate langue (IL). The task is to track the flow of information through programs to inform further analyses down-stream (e.g., inferring procedure frames and types). This will be achieved by implementing a taint analysis within our existing binary analysis framework and feeding these results into subsequent analysis stages. The project will be built in Scala within a existing analysis framework.
Suitable for:	The project will be offered on-site and the participant will be working alongside a team of researchers which are working on automated program verification.
Primary Supervisor:	Kirsten Winter (kirsten@eecs.uq.edu.au)
Further info:	For further information on the project please contact Kirsten Winter (kirsten@eecs.uq.edu.au).

2024 Winter Research Project Description

Project title:	AI based Network Intrusion Detection for Internet of Things/CPS
Hours of engagement & delivery mode	The project duration is set at 4 weeks, during which participants are expected to engage for 20 to 36 hours per week.
Description:	This project aims to collect new data using the existing Internet of Things (IoT) testbed at UQ and process the raw data to make a publicly available dataset for intrusion detection in IoT and possibly in cyber-physical systems (CPSes). The student(s) must use the existing IoT testbed consisting of smart things and generate benign and attack sample data. The students may need to add additional IoT devices if necessary. The existing and collected dataset will be used to build intrusion detection models using various Machine Learning and Deep Learning-based algorithms. Also, advanced ML/DL techniques including one-shot learning, meta-learning, and meta-transfer learning will be investigated and used for this project. Additional topics will be practical adversarial attacks and defences for IoT and CPS.
Primary Supervisor:	Dr Dan Kim is an Associate Professor in Cybersecurity in the Cybersecurity and Software Engineering Research Group at The University of Queensland (UQ), Brisbane, Australia. His research interests are in cybersecurity for various systems and networks including IoT, Cloud computing, and Software-Defined Networking. Google Scholar (5900+ citations): https://scholar.google.com/citations?user=dIIYVQkAAAAJ&hl=en DBLP (170+ publications): https://dblp.org/pid/k/DongSeongKim.html