**Cutting-edge postgraduate research projects in Artificial Intelligence, Machine Learning and Data Science**

**Projects with Dr. Rohitash Chandra and Prof. Alok Sharma**

Students can enrol at UNSW Sydney or University of the South Pacific depending on the scholarship.

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Entry requirements: https://research.unsw.edu.au/higher-degree-research-programs

https://research.unsw.edu.au/graduate-research-scholarships

Scholarship requirements: High impact journals (SJR Q1) or listed in Google Scholar metrics under subject area: https://scholar.google.com/citations?view_op=top_venues&hl=en
https://www.scimagojr.com/journalrank.php

**PhD Project 1**

**Bayesian deep learning for protein function detection**

Bayesian inference via Markov Chain Monte Carlo (MCMC) methods provide a probabilistic approach for training neural networks. Parallel tempering MCMC can feature parallel computing with enhanced exploration and exploitation capabilities that make them suitable for deep learning such as LSTMs and convolutional neural networks. Bayesian deep learning addresses the limitations of deep canonical learning by providing rigorous uncertainty quantification in modelling and predictions. This project applies advanced Bayesian deep learning methods for problems for protein function detection.
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**PhD Project 2**

**Bayesian inference for MoRFs and protein-peptide interactions**

Bayesian inference is typically implemented using Markov Chain Monte Carlo (MCMC) that sample from the posterior distribution to estimate and quantify the uncertainty of unknown parameters of interest. These unknown parameters are a challenge in models in the area of bioinformatics that deal with large datasets. Parallel tempering MCMC features parallelism with enhanced exploration and exploitation capabilities and hence can be applied to computationally expensive problems with the power of parallel computing. In this project, we use advanced Bayesian inference methods to estimate the model parameters in molecular recognition of features (MoRFs) in protein sequence and protein-peptide interaction.

**References:**


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**Masters Project 1**

**Cyclone path and intensity prediction with deep insight based deep learning**

Although machine learning has been used extensively, the prediction of cyclone trajectories and intensity remains a challenging problem. Cyclone trajectories are defined by the latitude and the longitudes coordinates as a temporal sequence. Deep insight is a recent addition to the deep learning community that transforms data into images for training convolutional neural networks. The data transformation process takes into account correlation amongst features that can be useful for data with spatial information for prediction of cyclone trajectories using deep learning.

**References**


1. Y. Zhang, R. Chandra and J. Gao, "Cyclone Track Prediction with Matrix Neural Networks," 2018 International Joint Conference on Neural Networks (IJCNN), Rio de Janeiro, 2018, pp. 1-8. doi: 10.1109/IJCNN.2018.8489077
2. Sharma, A., Vans, E., Shigemizu, D., Boroevich, K.A. and Tsunoda, T., 2019. DeepInsight: A methodology to transform a non-image data to an image for convolution neural network architecture. Scientific reports, 9(1), pp.1-7.


**Masters Project 2**

**Indoor path navigation for disabled persons in large buildings**

In large buildings, such as malls and hospitals, it is challenging to navigate as online apps such as Google Maps do not cover indoor building spaces. Navigation and movement become more difficult for people with disabilities and special needs. This project reviews the work done and employs optimisation algorithms for path planning in 3D spaces, given constraints such as access to wheelchair etc.

**References**


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**Masters Project 3**

**Detection of electric cable hazards from Cyclones using a combination of drones with remote sensing and deep learning**

Cyclones and storms pose a significant threat to electric power cables. Given the advances of remote sensing and drones, it is possible for the collection of data for automatic detection of electrical cable hazards. The project requires data collection using drones before and after the cyclones, for assisting electricity authorities, and disaster management departments in creating a map of electric hazards from broken poles, and electrical cables. The project employs deep learning, remote sensing with drones to collect data and automatically establish local hazard maps. As a proof-of-concept, Fiji would be used as a case study for data collection and testing the proposed electric hazard framework.

**References**

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**Masters Project 4**

**Geo-tagging plastic pollution in coastlines using drones and remote sensing**

Given the advances of remote sensing and drones, it is possible to collect data for automatic detection of plastic  waste on the coastlines and in the oceans. The project employs deep learning, remote sensing with drones to collect data and automatically detect plastic wastes and create a geo-tag map for intervention.

**References**


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