



THE UNIVERSITY
of ADELAIDE

Adelaide Summer Research Scholarships

School of Computer Science

PROJECTS OFFERED FOR 2018/19

Physical Unclonable Functions: A exploring low cost methods for secure key storage

All devices have fingerprints. We can use these to uniquely identify them. We want to see if we can identify one FPGA chip from another by generating a digital fingerprint and use it to build a key. One way to prevent clones and stop the counterfeiters. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#), Yang Su and Chen Fei ([Auto-ID Labs](#))

Autonomous Drone: Joint path planning and tracking

Civilian drones have many applications from search and rescue, surveillance, reconnaissance to bringing your UBER eats. But realizing them requires achieving autonomy and path planning. Work with our team to help build an autonomous drone platform where your focus will be on developing a path planning and tracking algorithm to allow a drone to autonomously navigate, discover and track targets. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#) and Hoa Nguyen ([Auto-ID Labs](#))

StopFalls: Empowering older people with a falls management app

“Did you know that in 2017 there were 22,576 people admitted to a SA public hospital injured after a fall?” ([SA Health](#)). Develop a mobile phone app to detect falls and help manage falls risk by exploiting numerous sensors on a smart phones and fusing this data together. *If you are interested, come and see me for more information. Suitable for CS students.*

Supervisors: [Dr Damith Ranasinghe](#) and Jaween Eidiraweera ([Auto-ID Labs](#))

Probing Wine Fermentation Tanks

Predictable winemaking depends upon the control of all the factors that affect fermentation, including the grapes, yeast selection, enzyme addition, the size and type of the vats, the temperature control regime, nutrient selection, and pumping regimes. The relationship between yeast behaviour and temperature control is well understood, forming the fundamental basis of winemaking. While manual measurement in small vats is feasible in smaller wineries, large vats in increasingly large commercial tank farms require automated measurement readings within central temperature management systems to provide warnings, guidance and the control of coolant flow. Temperature control in fermentation is crucial to the development of desirable flavours, alcohol levels and colour in all wine making grape varieties. Schmid et al (“Formation of temperature gradients in large- and small-scale red wine fermentations during cap management”, *AJGWR*, 15 (3) 249-255, 2009) identify the problems in measuring temperature across a single vat, where thorough mixing was required to reduce the temperature differential across the must to less than 5 C. Build a

wireless wine fermentation probe to measure and characterise the fermentation process. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#) and [Ian Linke](#) ([Auto-ID Labs](#))

Hack my Drone!

This project is about exploiting vulnerabilities in civilian drone platforms to steal a drone as a starting point. The first task is to understand existing drone platforms and identify attack vectors, there are many. The next task is to mount an attack and demonstrate how one or more vulnerabilities can be exploited. If we make it this far, then we can look at building a trusted drone platform. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#) and Michael Chesser ([Auto-ID Labs](#))

Uncovering Hidden Secrets from your Gait

There is a lot of hidden information in the way we walk, the speed at which we walk and all the biomechanics associated with walking. Use wearable sensors to measure and analyse gait characteristics accurately and compare your approach with the state of the art devices in the gait lab at the new Royal Adelaide Hospital. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisor: [Dr Damith Ranasinghe](#) ([Auto-ID Labs](#))

Malicious Code Injection: How can we trust the veracity of information from wireless sensors?

Computational Radio Frequency Identification devices are generally batteryless, RF-powered computing and sensing systems built on RFID technology. CRFID tags have Application Specific Software or Firmware, ultra low power microcontrollers, power harvesting and management systems and sensors. The limited resources of computational RFID devices restrict implementations of traditional ciphers and implementing security services is extremely challenging. However as a device running software, the inevitable need arises to update the software wireless from devices deployed in applications. How can we prevent malicious code from being updated onto resource constrained devices? In this project you will look at understanding and appreciating the challenges faced in securing these tiny computational platforms, design, develop and evaluate security solutions suitable for such platforms. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#) and Yang Su ([Auto-ID Labs](#))

Gender Analysis of Google Scholar

There are lots of studies looking at gender distributions and the well-known female gender gap for undergraduate and postgraduate students, however little is known about the impact of gender in research profiles, not only in terms of volume and career progression, but also in the collaboration profiles of female researchers compared to their male counterparts.

This project will develop a web crawler that collects Google Scholar publication data from a list of researches and then will analyse their profile in terms of output distribution, collaboration networks and impact.

Supervisor: [Dr Cruz Izu](#)

TrackerBots

Today, radio telemetry or radio tracking is the most important tool employed to study the movement of animals in their natural environments. However, the traditional method of radio tracking typically requires researchers to walk long distances in the field, armed with cumbersome radio receivers with hand-held antennas and battery packs to manually home in on radio signals emitted from radio tagged or collared animals. Consequently, the precious telemetry data acquired through radio tracking comes at a significant cost to researchers in terms of manpower, time and funding. The problem is often compounded by other challenges, such as low animal recapture rates, equipment failures, and the inability to track animals that move into inaccessible terrain. Furthermore, many of our most endangered species also happen to be the most difficult to track due to their small size, inconspicuousness, and location in remote habitats. Therefore a fundamental problem facing conservation practitioners is the notoriously difficult task of collecting precise animal movements, easy and early identification of mortality and activity data necessary to inform natural resource management. **Aims** In this project, we seek to combine VHF telemetry and tracking technologies to develop an integrated, low-cost and easily deployable wildlife tracking solution to autonomously locate and track radio collared animals. *If you are interested, come and see me for more information. Suitable for CS/EEE/Mechatronics students.*

Supervisors: [Dr Damith Ranasinghe](#) and [Hoa Nguyen \(Auto-ID Labs\)](#)

Tracking Transfer of Learning from Workshops/Practicals to Summative Assessment

Many problems in programming exams are variations of problems that students have solved during the course. However, many students that successfully complete a problem in a workshop or practical session are not be able to repeat or extend their solution even a short time later. In other words, they fail to transfer their learning to a different problem that shares a similar context. This may occur for different reasons such as lack of comprehension, limited practice, exam nerves or other reasons.

In this project, you will analyse a subset of the work submitted by students in a level 1 programming course, both formative and summative, to identify how much positive transfer has occurred with various types of formative work. This analysis, in combination with a literature review of "learning for transfer" will inform your design of workshop activities for 2019 with the goal of improving transfer.

Supervisors: [Dr Cruz Izu](#) and [Dr Cheryl Pope](#)

Embodied Referring Expression: discovering an object in a simulator with natural language instruction

In this project, we will provide a well-developed simulator that allows agents/robots to see, move and interact. You will develop a deep learning based algorithm that can control the agent to find a hidden object in the simulator, with natural language based query, for example, 'find me a spoon!' You are expected to have the knowledge of convolutional neural networks, recurrent neural networks, reinforcement learning to apply for this project.

Supervisor: [Dr Qi Wu](#)

Augmenting API documentation with insights from Stack Overflow

Software developers need access to different kinds of information which is often dispersed among different documentation sources, such as API documentation or Stack Overflow. Building on an initial prototype, the goal of this project is to develop a machine learning approach to automatically augment API documentation with "insight sentences" from Stack Overflow -- sentences that are

related to a particular API type and that provide insight not contained in the API documentation of that type.

Supervisor: [Dr Christoph Treude](#)

Solve the Neighbour Coverage Problem

This project consists of two parts. In the first part, you will design and implement a greedy solution to an NP-hard graph problem. In the second part, you will build a Web scraper that collects graph information from the network, creates an instance of the Neighbour Coverage problem, and solves it.

Supervisor: [Dr Yuval Yarom](#)

Side-Channel Attacks

The discovery of the Spectre and Meltdown attacks have raised the awareness of side-channel risks in modern computer architectures. While the main mechanisms behind these attacks are well known, the extent of the attacks, the exact scenarios where they are applicable, and consequently the risk they pose are yet to be determined. In this project you will work on an aspect of these attacks and help improve our understanding of that aspect. Multiple directions for research are available, including reverse engineering of processor features, implementing attack variants, and assessing the efficacy of published defences.

Supervisor: [Dr Yuval Yarom](#)

Break the North Korean Encryption Algorithm

North Korea has its own operating system, Red Star. Embedded in these operating systems are some ciphers that are based on, but are different from, Western cryptography. In this project, you will implement cache-based attacks to break these ciphers.

Supervisor: [Dr Yuval Yarom](#)

Assessing the Impact of Artificial Neural Network Driven Style Transfer on Aesthetic Features of Images

Supervisors: [Dr Brad Alexander](#) and Mrs [Aneta Neumann](#)

Diversity and Features in Evolutionary Image Transition Spaces.

Supervisors: [Dr Brad Alexander](#) and Mrs [Aneta Neumann](#)

Evolutionary Algorithms for Problems with Dynamically Changing Constraints

This project investigates evolutionary algorithms for problems with dynamic constraints. Constraints of an optimisation problem often change over time and evolutionary algorithms provide an effective way of dealing with such problems as they are well suited for adapting to changing environments. The topic is very flexible and theoretical and experimental investigations can be carried out dependent on the background and interest of the student.

Supervisor: [Prof Frank Neumann](#)

Privacy and Social Media at the Post Level

Observational research into social media behaviour often requires collecting significant amounts of publicly available social media data, e.g. tweets, directly from social media platforms APIs. Because this is data generated by humans, ethics and privacy concerns must be addressed. Ethically, it's a low risk activity, similar to watching people's behaviour in a public place, however with regard to

privacy, it's potentially different. Social media data is rich with information relevant to privacy, such as individual's names, photos, and potentially sensitive opinions. An obvious approach to addressing this is to simply keep the content of the social media posts and strip off the identity of the author, however, it is often said that the specific content of any particular social media post (the terms, hashtags and URLs, and their order) is likely to be so unique as to be like a fingerprint to find the original post, and therefore the author of the post. The aim of this project is to determine if that is, in fact, true, and to what degree.

Supervisor: [Prof Frank Neumann](#) and Mr Derek Weber

Using Deep Learning to produce Surrogate Functions for Fast Evolution of Maps of Australia's Continental Crust

Supervisor: [Dr Brad Alexander](#)

A Vulnerability Sharing Mechanism to Improve Social Welfare

Taking existing literature on the pros and cons of the practice of full disclosure of vulnerabilities into account, we consider how a vulnerability sharing mechanism involving the software vendors themselves could be introduced to improve general welfare. The vulnerabilities would be shared not only within the customer base, but also to the general public including potential attackers. This is to encourage timely production of fixing patches from the vendors.

Supervisors: [Dr Mingyu Guo](#) and [Prof Ali Babar](#)

Australian Institute for Machine Learning (AIML)

Cyclist detection using Julia and Flux

The Australian Institute for Machine Learning, in collaboration with the Centre for Automotive Safety Research, has collected and annotated many hours of video footage of cyclists in and around Adelaide. We want to deploy a computer vision system that is capable of reliably detecting and tracking cyclists from various vantage points. You will work on training a deep learning system using the numerical computing language Julia, and the Flux machine learning package. Flux is written using the Julia language and allows models to be written using Julia's simple mathematical syntax.

Supervisors: [Zygmunt Szapak](#) & AIML Team

Cyclist detection using MATLAB

The Australian Institute for Machine Learning, in collaboration with the Centre for Automotive Safety Research, has collected and annotated many hours of video footage of cyclists in and around Adelaide. We want to deploy a computer vision system that is capable of reliably detecting and tracking cyclists from various vantage points. You will work on extending the performance of the current system which is written in MATLAB.

Supervisors: [Zygmunt Szapak](#) & AIML Team

Semantic understanding of mobile eye-tracking dataset

A mobile eye-tracking headset permits one to play back a video with a superimposed marker that indicates where the wearer of the headset was directing their attention. This technology is a game-changer for many disciplines including medicine, cognitive psychology and marketing research. However, the analysis of the recorded data is very tedious since a researcher has to

annotate each and every fixation manually (i.e. they are looking at a door, they are looking at a fridge etc.). You will work on prototyping a machine learning system that will automatically detect various objects in the scene, and will thus be able to automatically annotate what the wearer of the system was looking at.

Supervisors: [Zygmunt Szpak](#) & AIML Team

Image feature detection for the Julia language

The JuliaImages organisation maintains a variety of image processing packages for the numerical computing language Julia. The ImageFeatures package contains a variety of feature detection algorithms that are implemented using the Julia language. You will work on extending the functionality of the package by implementing several additional feature descriptors.

Supervisors: [Zygmunt Szpak](#) & AIML Team

Augmentor: A fast library for increasing the number of training images by applying various transformations.

Augmentor is a real-time image augmentation library designed to render the process of artificial dataset enlargement more convenient, less error-prone, and easier to reproduce.

You will work on extending the functionality of this package which is written in the numerical computing language, Julia. (<https://github.com/Evzero/Augmentor.jl>).

Supervisors: [Zygmunt Szpak](#) & AIML Team

A topic of your choice

We are also willing to consider your own topic that you are passionate. Please arrange to meet with [Zygmunt Szpak](#) to discuss further.

Supervisors: [Zygmunt Szpak](#) & AIML Team