### ACADEMIC PROJECT SUBMISSION DETAILS:

<table>
<thead>
<tr>
<th>Supervisor/s:</th>
<th>Michael Mayo, Dr Ryan Paul, Lynne Chepulis, Hamish Crockett (FHSHP) and Abagail Koay (FCMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title:</td>
<td>Putting machine learning into the closed loop of the artificial pancreas</td>
</tr>
<tr>
<td>Field:</td>
<td>Computer Science</td>
</tr>
<tr>
<td>Division/School:</td>
<td>HECS - Division of Health, Science, Computing &amp; Engineering</td>
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</tbody>
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### EXPECTED OUTCOMES:

1. Understanding of the state of the art algorithms and technologies as implemented in the Nightscout/OpenAPS and the scope (as well as limitations) for using them for further research.
2. Experience using these systems for conducting scientific computational experiments.
3. A scientific publication, and/or a roadmap for a future postgraduate project in this area.

### STUDENT TASKS:

1. Study the openAPS/glucosim simulator here: https://github.com/UVA-DSA/openAPS_GlucoSym_closed_loop_system and understand how it works.
2. Likewise study openAPS's simulator here: https://github.com/openaps/oref0/compare/dev...simple-simulator and understand how it works.
3. Present to the supervisors an overview of the systems linked to above with an evaluation of whether or not they are sufficient for further research (implementing some parts ourselves are possible).
4. Based on 1-3 perform a rigorous set of machine learning experiments with sufficient depth for an initial research publication, and present the results.
5. (Optional, depending on how time goes) See if we can replace the patient simulator from 1 above (which is essentially a set of differential equations) with a neural net trained on real data, and see if there is any difference in how realistic/unrealistic the simulations are.

### REQUIRED SKILLS:

1. Familiarity with the languages used to implement the two systems mentioned, as well as languages (i.e. python) used for data analysis and machine learning.
2. Ability to understand complex code and algorithms and explain it both verbally and in writing in a coherent manner.
3. Prior experience with machine learning and related algorithms, and how to apply them. Prior experience handling large datasets.
4. Ability to carry out a rigorous and comprehensive set of scientific experiments and present the results.
**PROJECT ABSTRACT:**

Closed loop artificial pancreas (AP) systems for patients with type 1 diabetes consist of a continuous glucose monitor for sensing intrstitial glucose levels, a reader or scanner for looking at the data, a microcontroller, and a subcutaneous insulin pump. The microcontroller regulates the insulin pump rate in real time based on recent glucose level values obtained from the monitor. One problem with existing AP technology is that glucose levels are dynamic, unique to the individual, and difficult to control with existing state of the art algorithms. This project will investigate avenues for incorporating machine learning and other artificial intelligence techniques into the decision making process that the AP uses for regulating insulin rates. The aim will be to find new algorithms that increase the amount of time an AP user spends in normoglycemia (defined as neither hypoglycemia nor hyperglycemia). Virtual patients or historical data will be used to evaluate new methods.
**ACADEMIC PROJECT SUBMISSION DETAILS:**

<table>
<thead>
<tr>
<th>Supervisor/s:</th>
<th>Shaoqun Wu and Rory Mitchell (PhD Student)</th>
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<tbody>
<tr>
<td>Project Title:</td>
<td>Producing an implementation of a GPU shuffling algorithm using CUDA</td>
</tr>
<tr>
<td>Field:</td>
<td>Computer Science</td>
</tr>
<tr>
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**EXPECTED OUTCOMES:**

1. One or two parallel shuffling algorithm implementation

**STUDENT TASKS:**

1. Investigate the common shuffling algorithms and understand their strengths and weaknesses
2. Select one or two shuffling algorithms that can be run in parallel
3. Produce an implementation of each algorithm using CUDA
4. Evaluate the implementations
5. Document and produce a parallel shuffling algorithm package
6. Write a report

**REQUIRED SKILLS:**

1. Algorithm analysis
2. C++ programming
3. GPU programming using CUDA

**PROJECT ABSTRACT:**

The purpose of the research is to investigate approaches to and produce an implementation of a GPU shuffling algorithm using CUDA. A shuffling algorithm produces a random permutation of a given input buffer, ideally with all permutations being equally likely (limited by the randomness of the random number generator used). The common approach for CPU shuffles is the Fisher-Yates shuffle which is inherently sequential. A new approach utilising the parallel nature of GPU is needed for the shuffle to be used in general GPU applications. We will start with utilising finite fields to produce a bijective mapping from an initial offset into the output offset, and explore other possibilities.
**ACADEMIC PROJECT SUBMISSION DETAILS:**

<table>
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<tr>
<th>Supervisor/s:</th>
<th>Robi Malik</th>
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<tbody>
<tr>
<td>Project Title:</td>
<td>WATERS Analyser</td>
</tr>
<tr>
<td>Field:</td>
<td>Computer Science</td>
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<tr>
<td>Division/School:</td>
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**EXPECTED OUTCOMES:**

1. The improved features will be implemented in the WATERS software, and made available to users and developers world-wide.
2. WATERS is used in teaching of the paper COMPX552 (Model Checking) at the University of Waikato, so any improvements of the user interface will improve teaching.
3. Publications about new features in WATERS are possible.

**STUDENT TASKS:**

1. Categorise the finite-state machine simplification algorithms in WATERS
2. Design graphical user interface to set parameters for these algorithms
3. Implement graphical user interface to apply specific algorithms to specific state machines in the Waters analyser

**REQUIRED SKILLS:**

1. Object-oriented programming (Java)
2. Graphical user interface development (Java/Swing)
3. An understanding of finite-state machines and formal logic

**PROJECT ABSTRACT:**

In collaboration with Chalmers University of Technology in Sweden, the Formal Methods Group at the Department of Computer Science at Waikato is developing the WATERS Toolkit (Waikato Analysis Tool for Events in Reactive Systems) for the modelling and verification of finite-state systems. The toolkit includes a powerful graphical editor, compiler, and simulator, as well as a wide selection of finite-state machine analysis and synthesis algorithms.

One aspect of current development is the implementation of an improved analyser interface. The analyser is a workbench that allows the user to apply various finite-state machine algorithms interactively and visualise the results, but this part of the tool has become out of date.
WATERS includes more than 30 algorithms for the simplification and abstraction of finite-state machines, but not all are available in the analyser’s graphical user interface. The objective of this project is to design and implement a new user interface that makes it possible to apply specific simplification algorithms with specific parameters to specific state machines in the WATERS analyser.

This project involves programming in Java, using the object-oriented framework of the WATERS software and graphical user interface programming with Swing, as well as conceptual work with extended finite-state machines. You will modify and extend the existing graphical user interface and finite-state machine algorithms.
**ACADEMIC PROJECT SUBMISSION DETAILS:**

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<tr>
<th>Supervisor/s:</th>
<th>Abigail Koay, Dr Richard Nelson and Brad Cowie</th>
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<tr>
<td><strong>PROJECT #:</strong></td>
<td>23</td>
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<tr>
<td><strong>Project Title:</strong></td>
<td>Traffic Classification and Anomaly Detection using Poseidon</td>
</tr>
<tr>
<td><strong>Field:</strong></td>
<td>Computer Science, Cyber Security, Networking</td>
</tr>
<tr>
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**EXPECTED OUTCOMES:**

1. A list of traffic features extracted from Faucet
2. A list of good machine learning algorithms with high accuracy

**STUDENT TASKS:**

2. Identify traffic features and machine learning algorithms that can be extracted from SDN controller (i.e. Faucet) and be applied to Poseidon
3. Work on developing new traffic features/ machine learning algorithms
4. Validation and Testing
5. Visualise data in an interesting way with CRviz

**REQUIRED SKILLS:**

1. Good programming skills - python
2. Machine Learning
3. Understand network traffic protocols

**PROJECT ABSTRACT:**

Poseidon is an open-source, Python-based application that can classify network traffic by leveraging on Software Defined Networks (SDN) and machine learning algorithms. You will be exploring various conventional and non-conventional Machine Learning (ML) algorithms to learn the traffic distributions and patterns for classifying traffic into multiple categories and detect anomalies. You will be exploring various information extracted, such as events from the faucet controller and raw network packets from devices on the network that can be useful to improve overall detection in Poseidon. This data will then be visualised on the CRviz tool included in Poseidon.
The goal of this project is to contribute to the Poseidon Github project (https://github.com/CyberReboot/poseidon) / Faucet development (https://github.com/faucetsdn/faucet) in identifying anomalies and classifying flows in the network.
**ACADEMIC PROJECT SUBMISSION DETAILS:**

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<thead>
<tr>
<th><strong>Supervisor/s:</strong></th>
<th>Nicholas Vanderschantz and Nicola Daly</th>
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<tbody>
<tr>
<td><strong>Project Title:</strong></td>
<td>Reader perceptions relating to the typographic design in dual language</td>
</tr>
<tr>
<td><strong>Field:</strong></td>
<td>Design</td>
</tr>
<tr>
<td><strong>Division/School:</strong></td>
<td>HECS - Division of Health, Science, Computing &amp; Engineering</td>
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**EXPECTED OUTCOMES:**

1. Research materials suitable for this and future studies
2. Annotated bibliography of literature relating to typographic perception
3. Creation of data set relating to the perception of different typographic layouts for bilingual picturebooks
4. Draft article suitable for academic journal in Information Science, Design Studies, Linguistics, or Reading

**STUDENT TASKS:**

1. Design and develop a range of typographic variables for a single spread of a dual language picturebook for use in T2. (Approximately 1 week to complete.)
2. Undertake a literature review and produce an annotated bibliography to guide and refine the proposed methodology. (Approximately 1 week to complete.)
3. Undertake a pre-planned user perceptions interview with adult participant readers. Ethical permission for this process will be obtained before any data is collected. (Approximately 4-6 weeks to complete.)
4. During the data collection phase, the scholar will carry out data input and analysis. (Approximately 2 weeks to complete, ongoing during interviews.)
5. We identify four core tasks for our summer scholar (T1-T4) with an optional, if-time-allows fifth task (T5).
6. T5: Time permitting, the scholar will work with the two supervisors (Vanderschantz and Daly) to outline and draft an initial research paper suitable for publication in an Information Science

**REQUIRED SKILLS:**

1. Well organised
2. Strong communication skills
3. Typographic design experience and knowledge
4. Understanding of design, computer science, ethnographic, or educational research practices
5. Awareness of issues relating to bilingualism and multilingualism
6. Some knowledge of a language additional to English (e.g. Te Reo Māori) will be an advantage
PROJECT ABSTRACT:

This research is part of ongoing investigations at the University of Waikato into the typographic presentation and the linguistic landscape of bilingual picturebooks. The presentation of the full text of a story in two languages on each page presents design challenges relating to the readability of the text and the connotations being communicated. While several studies have examined the ways in which the text for the two languages are placed on the page, studies of the perception of the texts in dual language books does not appear to have been done. Understanding how the printed text in dual language picturebooks is perceived is required if we are to understand how best to design dual (and even multiple) language picturebooks. While there have been many studies of reader perceptions of text presentation, little if anything is reported regarding dual/multi-language text presentation. Dual language picturebooks are little studied locally and globally and therefore design advice for publishers is lacking and so too is assistance with selecting appropriate books for librarians, educators, and readers themselves.

In this project, the student will survey reader perceptions of a range of dual language picturebook text presentations. The first task of the summer scholar will be the design and development of test materials for use in a reader interview study. Reader perceptions will then be garnered through interview and user testing with readers. Finally, the scholar will work with supervisors to write a draft journal article relating to the findings.

The student will benefit by the development of key research skills for use in graphic design and linguistic research and practice. This project will provide a stepping-stone to further postgraduate research opportunities as the student will be introduced to experiment design considerations, data collection, and results analysis.
### ACADEMIC PROJECT SUBMISSION DETAILS:

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<tr>
<th>Supervisors:</th>
<th>Panos Patros</th>
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<tbody>
<tr>
<td><strong>Project Title:</strong></td>
<td>Green Cloud Computing: Regulating Power Consumption on Kubernetes</td>
</tr>
<tr>
<td><strong>Field:</strong></td>
<td>Software Engineering</td>
</tr>
<tr>
<td><strong>Division/School:</strong></td>
<td>HECS - School of Computer Sciences, Maths &amp; Statistics</td>
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### EXPECTED OUTCOMES:

1. Know-how on making changes on Kubernetes  
2. Train a student towards continuing for a masters of research  
3. Create a merge-request for Kubernetes that improves power consumption  
4. Experimental evidence that a control-theoretical approach (e.g., a PID or LQR controller) can regulate power

### STUDENT TASKS:

7. Do background and related-work reading  
8. Compile and run vanilla Kubernetes  
9. Make successful hello-world change on Kubernetes  
10. Implement a simple power management algorithm  
11. Experimentally evaluate baseline and implemented methods  
12. Write up results and create poster

### REQUIRED SKILLS:

7. Software Engineering and systems  
8. Programming  
9. Some Linear Algebra and Calculus

### PROJECT ABSTRACT:

Cloud computing enables the offering of computing resources of clusters in an abstract way. Commonly, CPU, memory, disk and network are the targeted resources. In this project, you will investigate the efficient sharing of power among cloud tenants on a cluster managed by the Kubernetes container orchestration system. Feedback control is the tool of choice for such a task. After making your changes in Kubernetes, which is written in Go, you will run experiments by deploying benchmarking application and testing the efficacy of your solution against the baseline.
This is a great area to conduct research on and I am keen to find a suitable research (preferably masters) student who will take this up as their thesis. Crucially, Kubernetes and cloud computing are important technologies to grasp, for both an academic and a research career. You will need strong Software Engineering and Software Systems skills as well as adequate Mathematical knowledge and reading/writing skills.
# ACADEMIC PROJECT SUBMISSION DETAILS:

<table>
<thead>
<tr>
<th>Supervisors:</th>
<th>Shemana Cassim, Michael Mayo and Lynne Chepulis</th>
</tr>
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<tbody>
<tr>
<td>Project Title:</td>
<td>Designing a website for improving awareness of Lung Health</td>
</tr>
<tr>
<td>Field:</td>
<td>Computer Sciences/ Health Research</td>
</tr>
<tr>
<td>Division/School:</td>
<td>HECS - Division of Health, Science, Computing &amp; Engineering</td>
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</tbody>
</table>

## EXPECTED OUTCOMES:

1. an interactive, user-friendly website to promote awareness of lung health, including symptoms of lung related diseases such as lung cancer, COPD and emphysema.
2. A published output

## STUDENT TASKS:

1. web design - take over and complete the website, and get it to a stage ready for public access and use.
2. work alongside the project team to action feedback on the website provided by the co-design group in Opotiki

## REQUIRED SKILLS:

1. knowledge of website design using javascript
2. familiarity with Django framework, HTML, CSS, Twitter, Bootstrap, Javascript and J query (front end development) and UWSGI and NGINX (for server side development)
3. ability to incorporate external resources and links into web design
4. knowledge of making websites compatible with common web browsers and mobile friendly formats
5. ability to competently test website functionality and usability

## PROJECT ABSTRACT:

The Summer Research Project will contribute to a broader HRC funded project on improving early diagnosis of lung cancer in rural Māori communities. The project began in October 2017, and the team has been working with four rural communities to design interventions for each community that aims to promote awareness of lung cancer and improve early presentation and diagnosis of lung cancer. The project team has been working with a co-design group in one of the localities: Opotiki, to design a website entitled Hā Ora to promote awareness of lung related diseases including lung cancer. Currently, while the Hā Ora website has been established, it is in the early stages of development.
PROJECT ABSTRACT:

The Summer Research Project is intended to complete the website, and to get it to a stage ready for public access and use.

Hā Ora currently has four key interactive sections: a lung health checker, a planner or calendar feature, a list of community resources, and a FAQs section. The summer student will be required to further develop each of these sections in partnership with the project and co-design teams.