THE UNIVERSITY OF SYDNEY

Science Summer Research Program: Denison & Science Research Experience Scholarships

Click on your area of interest to go straight to the section:

Chemistry

Project: (CHEM1) Supramolecular Channels Toward Non-Equilibrium Transmembrane Ion Transport

In Nature, transmembrane proteins maintain ion homeostasis in living systems and create biochemical gradients via active ion pumping processes. Here, we seek to utilise supramolecular interactions based on metal-coordination chemistry to build well-defined channels spanning across the lipid bilayer membrane to facilitate transmembrane ion transport. We aim to build channels which can be precisely modulated to facilitate active ion transport against concentration gradient (a non-equilibrium process) mimicking that of an ion active pump.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Prof. Philip Gale
Supervisor email: philip.gale@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/philip.gale

Chemistry

Project: (CHEM2) Using light to make polymers

We will use light to facilitate polymerisation. Your investigations will be used to develop a new photoreactor and study the formation of polymers under various light conditions. We will use some of the data generated to develop new polymer experiments.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: passed CHEM2 and/or CHEM3 subjects

Supervisor: Dr Markus Muellner
Supervisor email: markus.muellner@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/markus.muellner.php

Chemistry

Project: (CHEM3) Synthetic bottlebrush polymers

We will use controlled polymerisation methods to produce new polymers shaped like the Australian bottlebrush plant (only 1000 times smaller). Polymer architectures like these find applications in nanomedicine and can be used as nanoreactors.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: passed CHEM2 and/or CHEM3 subjects

Supervisor: Dr Markus Muellner
Supervisor email: markus.muellner@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/markus.muellner.php

Chemistry

Project: (CHEM4) ANTI-FOULING SLIPPERY SURFACES

Surface coatings that resist marine fouling without toxic components are important as they allow boats to be greatly more fuel-efficient while preserving marine ecosystems. Nature offers fascinating examples of extremely slippery surfaces, such as the surface of the pitcher plant, on which insects slide due a thin layer of liquid trapped in the microstructure of the pitcher. In our Nano-Interfaces lab we routinely design nanostructured coatings with fascinating surface properties, such as anti-fouling and anti-bacterial properties, as well as extreme water and oil repellence.

In this project the Denison scholar will fabricate artificial slippery surfaces using nanostructured paint coatings. The project will combine experimental procedures already established in the lab to produce new slippery surfaces that are mechanically and thermodynamically robust.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: F11 Chemistry Building, Camperdown Campus

Available as a group project: No

Pre-requisite/s: first year chemsitry or first year physics

Supervisor: A/Prof Chiara Neto

Supervisor email: chiara.neto@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/chemistry/neto/

Chemistry

Project: (CHEM5) Non-stick Surfaces

Surface coatings on which liquids and pastes do not stick are important in many technological applications. Nature offers fascinating examples of extremely slippery surfaces water repellence, such as the surface of the pitcher plant, on which insects slide due a thin layer of liquid trapped in the microstructure of the pitcher.

In this project the Denison scholar will work on treatments that can be applied on surfaces that come in contact with food products, and therefore need to contain only food grade components and processes that leave no residues behind. In this project we will combine experimental procedures already established in the group to produce new non-stick surfaces that are mechanically robust and suited to food applications.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: First year chemistry or first year physics;
Supervisor: A/Prof Chiara Neto
Supervisor email: chiara.neto@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/chemistry/neto/

Chemistry

Project: (CHEM6) Self-assembling protein nanocompartments: catalysis in confined spaces

Nature is a master of self-assembly, constructing incredible nanoscale architectures from simple buildings blocks. One example of self-assembly is the "encapsulin" family of proteins, which can spontaneously form hollow 25-45 nm compartments. This project will involve re-engineering encapsulins, converting them into catalytic nanoreactors with unusual properties.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: A knowledge of some protein biochemistry or molecular biology would be handy.
Supervisor: Dr Yu Heng Lau
Supervisor email: yuheng.lau@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/yuheng.lau.php

Chemistry

Project: (CHEM7) Anti-cancer peptide therapeutics

Macrocyclic peptide-based compounds (mol wt. ~1000-3000) are a highly-underexploited class of molecules in drug development. In particular, stapled peptides are promising inhibitors of protein-protein interactions that are the drivers of many cancers. The stapling process involves the cyclisation of two unnatural amino acid side chains, imparting conformational rigidity which can improve proteolytic stability and cellular uptake.

In this project, we are looking at new targets found at the telomeres of cancer cell DNA, in collaboration with researchers at the CMRI Westmead. The project would involve synthesising and purifying peptides to test for binding to target proteins.

Research period: Nov-Dec

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: F11 Chemistry Building, Camperdown Campus

Available as a group project: No

Pre-requisite/s: N/A

Supervisor: Dr Yu Heng Lau

Supervisor email: yuheng.lau@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/yuheng.lau.php

Chemistry

Project: (CHEM8) Scoping purinergic chemical matter

In the developing brain there is a differential and transient expression of the different purinergic receptors and ectoenzymes responsible for the extracellular catabolism of purines in a spatial and time-dependent manner, which suggests a multi-faceted role of this signalling system in brain development. This project will focus on the design of hybrid molecules capable of targeting specific purinergic signalling pathways.

Research period: Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: Should meet the following criteria;
1. Third year CHEM3011/10 and PCOL3011/12
2. Laboratory experience in multidisciplinary research
3. Year in Industry
Supervisor: Professor Michael Kassiou
Supervisor email: michael.kassiou@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/michael.kassiou.php

Chemistry

Project: (CHEM9) Unravelling Atmospheric Chemistry

Although atmospheric chemistry models are relatively accurate there are still some notable gaps in our ability to predict the concentrations of key atmospheric species. This particularly true in relatively pristine areas, where plant emissions dominate the volatile organic compounds (VOCs) in the atmosphere, for example, we know there are significant sources of OH and/or HO2 radicals missing from the models. In this project we will look at small carbonyls, such as acetaldehyde (ethanal) and methacrolein. These molecules have primary biogenic and anthropogenic sources and are also secondary oxidation products of other atmospheric VOCs. They are particularly important because the C=O bond can absorb UV photons from the sun, which can then lead to the production of carbon-centred radicals that then influence HOx chemistry. Despite their small size, we are still discovering new atmospheric reactions of carbonyls that can have significant global effects. Depending on interest and background, there are a number of directions this project can take take. These include, but are not limited to, using computational chemistry programs to identify and characterise reactions, performing dynamical simulations of collisions with N2 molecules to determine how quickly a photo-excited molecule loses energy and constructing models to simulate all known processes involving an individual carbonyl under atmospheric conditions, which can then be compared to experiment.

Research period: Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: none
Supervisor: A/Prof Meredith Jordan
Supervisor email: meredith.jordan@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/meredith.jordan.php

Chemistry

Project: (CHEM10) Quantum Thermodynamics

Feynman's path integral formulation of quantum mechanics exploits the fact that the quantum propagator is isomorphic to the thermal density matrix. Using a position representation, solving path integrals using Monte Carlo techniques can let us determine quantum thermodynamic estimators for molecular (and condensed) systems. Whilst it is relatively straightforward to determine estimators for the internal energy (and enthalpy), entropy is more problematic and you will investigate a reversible scaling method for determining Helmholtz free energy.

The vast majority applications of path integrals within a chemical context have been to very simple model systems, for example, harmonic oscillators. In this project you will use accurate descriptions of the molecular potential energy surface (PES), that is, how the electronic energy of a molecule depends on geometry within a path integral formalism. Using machine learning to generate and refine the PES you will study solvated metal ions. A particular example is the solvated magnesium ion, [Mg(OH2)6]2+, where, as temperature increases, there is a phase transition between tetrahedral and octahedral coordination. Our goal is to use the quantum Helmholtz free energy to characterise this phase transition.

Research period: Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: A background in one or more of mathematics/physics/theoretical chemistry is required and experience in programming, for example using python, is desirable.
Supervisor: A/Prof Meredith Jordan
Supervisor email: meredith.jordan@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/meredith.jordan.php

Chemistry

Project: (CHEM11) Lipid asymmetry of biological membranes

Biological membranes are known to be asymmetric with respect to their lipid distribution. The negatively charged lipid phosphatidylserine (PS) is found almost exclusively in the cytoplasmic leaflet of the plasma membrane, and if it accumulates in the extracellular leaflet, this is a signal for apoptosis, i.e. programmed cell death. In this project we are interested in the effect that high levels of PS in the membrane have on the binding of cations from the cytoplasm. The motivation for this study is to understand the effect that PS has on the activity of membrane-bound ion pumps, such as the Na+,K+-ATPase and the gastric H+,K+-ATPase which both possess positively charged N-terminal cytoplasmic extensions, which have been hypothesized to interact with the neighbouring membrane surface, thereby regulating ion pumping activity.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: Experience in the following subjects would be advantageous: Chemistry or Biochemistry or Physiology
Supervisor: Associate Professor Ronald James Clarke
Supervisor email: ronald.clarke@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ronald.clarke.php

Chemistry

Project: (CHEM12) Structure-function relationships of new cannabinoids

Cannabinoids are emerging as an important class of therapeutics, with two phytocannabinoids approved by the FDA for the treatment of chemotherapy-induced nausea and vomiting (CINV, Marinol) and Dravet syndrome, a genetic epilepsy affecting children (Epidiolex). Despite this, many aspects of cannabinoid function are poorly understood. There is enormous interest in the development of cannabinoids targeting G protein-coupled receptors (GPCRs) that can selectively activate only certain signalling pathways (e.g. Gi/o activation), and avoid signalling that leads to desensitisation-linked adverse effects (e.g. beta-arrestin recruitment).

This project will involve the design and synthesis of a library of cannabinoid ligands intended to treat neuropathic pain more effectively than opioids and with reduced adverse effects. The synthesised library will be evaluated in vitro at CB1 and CB2 receptors for binding, several modes of functional activity (Gi/o activation, GTP turnover, bArr2 recruitment), and in vivo using radiobiotelemetry in mice. Compounds with suitable in vitro and in vivo profiles will be subjected to further ADME evaluation en route to a clinical lead.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: Basic proficiency in chemical synthesis and analytical chemistry (NMR, LCMS, FTIR). Extensive training will be provided in both areas.
Supervisor: Senior Research Fellow Samuel Banister
Supervisor email: samuel.banister@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/samuel.banister.php

Chemistry

Project: (CHEM13) Synthesis and Evaluation of Fluorescent Molecules for Anion Recognition

Anions are ubiquitous in nature, playing crucial roles in both biological and industrial processes. There is therefore, a real need to develop tools to monitor anions in our environment. The aim of this project is to synthesise and evaluate fluorescent receptors for the selective detection of specific anions. Such receptors will have applications in biomedical and environmental research.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Professor Kate Jolliffe
Supervisor email: kate.jolliffe@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/kate.jolliffe.php

Chemistry

Project: (CHEM14) Using Virtual Reality to aid in the teaching and learning of chemistry

Virtual Reality (VR) has become a much more common household commodity thanks to the proliferation of more affordable VR devices. It is highly likely that you have encountered a VR device as a gaming tool either at home, at a shopping centre or during a gaming convention. We are particularly interested in using this equipment to aid in the teaching and learning of chemistry, and we need your help with that. As an undergraduate student, you are best placed to consider the value of the technology from the perspective of your peers.

This project seeks to generate a range of VR materials designed to support 2nd-year students learning organic chemistry. Additionally, we are interested in creating virtual laboratory environments to better prepare students for experiments they will conduct in our newly refurbished state-of-the-art 1st-year laboratories from 2020. This work will be undertaken in the new VR laboratory in the School of Psychology.

You will research best practice and help develop the learning materials in consultation with your mentors in the School of Chemistry (see below for contact details) and members of staff in the School of Psychology. These materials will then be pilot tested with both students and teaching staff, with all sessions being video and audio recorded. Follow up interviews will also be conducted with all participants. Student understanding will then be tested with theoretical questions or physical laboratory tasks.

You may choose either the creation of one pre-laboratory video or one tutorial activity. If the project moves quickly, additional materials may be generated and tested. Please feel free to reach out to any of the research team (stephen.george-williams@sydney.edu.au or siegbert.schmid@sydney.edu.au) if you have any questions.

We look forward to hearing from you!

Dr Stephen George-Williams and A/Prof. Siegbert Schmid

Research period: Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: F11 Chemistry Building, Camperdown Campus

Available as a group project: Yes

Pre-requisite/s: This project would require the student to have completed both first-year core courses. Ideally, the student may have also completed some core second-year courses (particularly CHEM2401 or an equivalent thereof). The completion of third-year courses is al

Supervisor: Dr Stephen George-Williams

Supervisor email: stephen.george-williams@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/stephen.george-williams.php

Chemistry

Project: (CHEM15) Increasing the context- and inquiry-based nature of first year teaching laboratories

It is becoming a well-known fact that undergraduate teaching laboratories around the world are often expository or recipe-based. You may have even personally experienced several such laboratories wherein you just followed the steps with little to no understanding of why you were doing so. Literature suggests that this is common, with these experiences generally resulting in disengaged students who simply perform the laboratory tasks with little to no critical thought. In response to this, there has been a dramatic increase in the use of context/inquiry-based activities which seek to situate the tasks in real-world activities and to allow students to undertake investigations rather than following a series of steps. Whilst powerful, it is often difficult to generate such experiences so that students are not overwhelmed by the new freedom. As an undergraduate student, you are best placed to be able to consider these laboratories from the perspective of your peers and we are grateful for any perspectives that you may bring.Aside of the activities themselves, significant focus has also been placed on how best to prepare students for laboratory experiences (e.g. through pre-laboratory activities) and on how to appropriately assess and measure the development of students' practical skills. Again, the exact way in which students are prepared and assessed will be greatly enhanced by the perspective of those most affected by it, i.e. you, the student.This project seeks to alter laboratories in the first-year environment in order to increase the number of context- and inquiry- based activities. You will aid in the generation of these laboratories, followed by trials with demonstrators and undergraduate students. You may also, if time permits, consider the best use of pre-laboratory quizzes/tasks alongside the in-class assessment of technical skills.Note that you will only be expected to potentially generate one laboratory activity. If the project moves quickly, additional laboratories or materials (e.g. pre-laboratory quizzes or post- laboratory assessment) may be generated and tested. Please feel free to reach out to any of the research team (stephen.george-williams@sydney.edu.au or siegbert.schmid@sydney.edu.au) if you have any questions. We look forward to hearing from you!Dr Stephen George-Williams and A/Prof. Siegbert Schmidt

Research period: Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: This project would require the student to have completed both first-year core courses. Ideally, the student may have also completed some core second-year courses (particularly CHEM2401 or an equivalent thereof). The completion of third-year courses is al
Supervisor: Dr Stephen George-Williams
Supervisor email: stephen.george-williams@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/stephen.george-williams.php

Chemistry

Project: (CHEM16) 'Transformersomes': shape-shifting polymer nanostructures

Amphiphilic polymers can self-assemble into an impressive spectrum of well-defined nanoscale architectures that behave in intriguing ways, from catalysing chemical reactions to interacting with living cells. In this project, we will design polymer building blocks that can self-assemble into nanostructures that undergo drastic shape transformations when exposed to light (for example changing from spherical capsules to worm-like fibres). The student will synthesise brush copolymers with degradable 'bristles' that break away upon irradiation. These polymers will be used to study controlled morphology transformations in future work. The student will gain experience in organic and polymer synthesis, characterisation techniques and self-assembly.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Derrick Roberts
Supervisor email: derrick.roberts@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/derrick.roberts.php

Chemistry

Project: (CHEM17) ClicketySplit: self-immolative prodrugs activated using 'click' chemistry

Prodrugs are pharmacologically inactive molecules that are converted to their active forms by biological stimuli near or at their target sites. Normal drug molecules can be converted to prodrug forms by 'capping' nucleophilic groups with "self-immolative" linkers, which are cleaved in elimination cascades that resemble a burning fuse. In this project, we will develop a new type of self-immolative linker using highly efficient 'click' reactions between azides and alkynes, and study their release kinetics using NMR and LCMS. The student will develop skills in organic synthesis, chemical characterisation and simple kinetics analysis.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Derrick Roberts
Supervisor email: derrick.roberts@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/derrick.roberts.php

Chemistry

Project: (CHEM18) Hierarchical assembly of DNA origami

To physical and chemical scientists, DNA also has huge potential as a programmable building material for biocompatible nanostructures, which can be self-assembled from the bottom up. This project aims to take inspiration from biological systems and use hierarchical assembly to combine many DNA origami nanostructures into a larger assembly. Projects will generally involve some combination of: computer aided design and modelling of DNA origami, assembly of structures and analysis with advanced imaging techniques, such as transmission electron microscopy (TEM), atomic force microscopy (AFM).

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Shelley Wickham
Supervisor email: shelley.wickham@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/shelley.wickham.php

Chemistry

Project: (CHEM19) Controlling membrane signalling with DNA nanostructures

DNA can be used to make self-assembling nanoscale structures and devices - with almost any shape we want - using a method called DNA origami. In our group, we are designing a lipid-interacting DNA origami nanorobot that can be programmed to transmit chemical and electrical signals across lipid membranes. This could be used for endosomal escape of drug delivery agents, or as part of a synthetic retina. This summer project focuses on targeting lipid-binding DNA origami structures to specific membranes labeled with complementary DNA strands, and testing their activation on addition of chemical or light signals. It will involve designing and testing DNA hybridisation domains, liposome assays to detect membrane transport, as well as optical microscopy.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Shelley Wickham
Supervisor email: shelley.wickham@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/shelley.wickham.php

Chemistry

Project: (CHEM20) Novel electrode materials for lithium-ion batteries

Lithium-ion batteries already dominate the portable electronics sector, and are becoming increasingly important for larger-scale applications such as transport and load-levelling of power generated from renewable sources such as solar. In this project we will design, synthesise and test the real-world performance of new electrode materials for lithium-ion batteries. It will involve computational modelling, high-temperature reactions, crystallography, coin-cell battery fabrication and electrochemistry.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Professor Chris Ling
Supervisor email: chris.ling@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/chris.ling.php

Chemistry

Project: (CHEM21) Faraday Rotation in Organic Semiconductors

Society's over-reliance on information exchange around the world hinges critically on ultrafast data communication using light signals. Faraday Rotation is an optical phenomenon that ensures non-reciprocal transport of light in optical fibers blocking unwanted reflection signals. This project will use a range of complementary experimental approaches to study Faraday Rotation in an emerging class of organic semiconductors.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: Distinction in CHEM2401/2911/2915
Supervisor: Dr Girish Lakhwani
Supervisor email: girish.lakhwani@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/girish.lakhwani.php

Chemistry

Project: (CHEM22) Understanding and designing protein switches

Disulfide linkages (R-S-S-R) form in proteins when the thiol (-SH) functional groups from the sidechains of two cysteine amino acids react to form cross-link. While these often simply reinforce the 3D structure of the protein, sometimes they can be redox-active, i.e. they can break and re-form in response to external stimuli such as the redox potential of the environment. This can allow them to act as switches that control protein function. The aim of this project is to investigate how charged amino acids in the neighbourhood of the disulfide determine both whether a disulfide can act as a switch and at what redox potential it is activated. Bioinformatics techniques will be used to probe how charged residues are arranged around disulfides which are known to be (or not to be) switches, while computational chemistry will be used to investigate how nearby charges affect the thermochemistry of possible switching reactions.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Dr Naomi Haworth
Supervisor email: naomi.haworth@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/naomi.haworth.php

Chemistry

Project: (CHEM23) Computational drug design

Understanding how insulin binds to and activates the insulin receptor is critical for the intelligent design of improved insulin-based diabetes drugs. Molecular dynamics simulations (MD) are a valuable tool for this research, providing important insights into the dynamic behaviour of proteins in the body. For instance, my collaborators and I recently discovered that insulin occasionally undergoes a dynamic process in which one of the alpha helices partially unwinds to give a more loosely bound pi helix – we have shown that this behaviour is essential for insulin engagement with its receptor. In this project, MD will be used to explore how different modifications of the insulin structure affect its ability to undergo this unwinding process, allowing us to identify promising candidates for synthesis and testing as potential new diabetes drugs.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Dr Naomi Haworth
Supervisor email: naomi.haworth@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/naomi.haworth.php

Chemistry

Project: (CHEM24) Dissecting the function of a new oxygen sensing system in humans.

Molecular oxygen is a vital cellular resource required for aerobic energy production and numerous biological reactions. As such, species need adequate mechanisms to respond to conditions where O2 becomes limited (a condition called hypoxia) in order to adapt and survive. This project aims to characterise, evaluate and manipulate a novel enzymatic oxygen sensing system recently identified in humans, which has been shown to regulate the stability of some interesting protein targets in response to oxygen concentration. These include molecules associated with angiogenesis, potentially making the system a good drug target for cardiovascular disease and/or cancer. A few different directions of investigation may be available depending on the scholar's research interest.

Research period: Nov-Dec OR Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: Some background knowledge in chemical biology/biochemistry or similar would be beneficial.
Supervisor: Dr Mark D. White
Supervisor email: mark.white@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/mark.white.php

Chemistry

Project: (CHEM25) Science before Secondary School

The project will explore primary and early years science education from the educator's perspective and develop educational resources that empower educators to teach science, technology, engineering and mathematics to young children. You will a) conduct research that examines the relationship between attitudes, understanding and communication of science and educator confidence and b) develop practical, engaging and scalable STEM activities for use by early childhood educators.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: 2000 level chemistry/science
Supervisor: Dr Alice Motion
Supervisor email: alice.motion@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alice.motion.php

Chemistry

Project: (CHEM26) Citizen Science in Australia

Citizen science is defined as 'the collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists.' In this project, you will explore current attitudes and perceptions of citizen science in Australia and investigate methodologies that could lead to improved outcomes in citizen science projects. Using Breaking Good - a project that engages high school and undergraduate students in drug discovery - as a case study, you will develop resources and infrastructure for open learning and crowdsourced approach to research that are guided by pedagogical research and open science principles.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Dr Alice Motion
Supervisor email: alice.motion@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alice.motion.php

Chemistry

Project: (CHEM27) Phase behaviour of Janus rods and helices

Nanoparticles can now be made that have surfaces with two distinct physical properties. Such Janus particles can exhibit complex phase behaviour ranging from small micelle-like clusters to sheets and twisted assemblies. This provides a scalable way to assemble complex nanostructured materials with unique properties. In this project, you will use computer simulations to investigate the phase behaviour of Janus rods and helices, which will allow you to discover how their phase behaviour differs from those of Janus spheres, hard rods and hard helices.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: No
Pre-requisite/s: No prior experience necessary, but a background in physical chemistry or chemical physics would be an advantage as would an interest in scientific computing.
Supervisor: ARC Future Fellow Asaph Widmer-Cooper
Supervisor email: asaph.widmer-cooper@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/asaph.widmer-cooper.php

Chemistry

Project: (CHEM28) Computer simulation of next-generation solar cells

New technologies promise next-generation solar cells that are cheaper, more flexible, and more efficient than current ones. However, many elementary processes occurring in these solar cells are poorly understood, and your project will be to write and use computer programs to simulate how they work at the fundamental level. Options include studying organic solar cells and hybrid organic-inorganic perovskite solar cells. Programming experience is helpful, but not required.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: F11 Chemistry Building, Camperdown Campus
Available as a group project: Yes
Pre-requisite/s: Second-year chemistry or physics
Supervisor: Dr Ivan Kassal
Supervisor email: ivan.kassal@sydney.edu.au
Supervisor Research Profile URL: http://www.kassal.group

Geosciences

Project: (GEOS1) Understanding long-term changes in global rainfall

Water is one of the most fundamental prerequisites for life. Annual rainfall is a primary driver of chemical and physical weathering, affecting erosion, the transfer of sediments and nutrients into sedimentary basins and the oceans, and the carbon cycle. The Earth is currently experiencing major changes in rainfall patterns, but what will the future hold? In this project, we will connect the geological record of rainfall to computer simulations to understand what drives long-term changes in precipitation over millenia. The project will use the ATOM climate modelling software recently developed by the EarthByte Group at the School of Geosciences to model paleoclimate time series, ground-truthed against precipitation indicators in the geological record.

Research period: Jan-Feb
Research contact hours:
Location of Project:
Available as a group project: No
Pre-requisite/s: GEOS2115/GEOS2915 or GEOS2124/GEOS 2924 or GEOS3103/GEOS3803 or GEOS3104/3804
Supervisor: Prof Dietmar Muller
Supervisor email: dietmar.muller@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/dietmar.muller.php

Geosciences

Project: (GEOS2) A systematic review of the frequency and effects of researcher trauma in the clinical and non-clinical fields

Researchers working in clinical and non-clinical fields can and are being affected by 'researcher vicarious trauma'. Globally, there has been limited work focusing on researchers as the 'subject/object' of the research process nor how researcher vicarious trauma impacts them and their productivity. To establish a baseline understanding, this project will involve conducting a systematic review of all published material on the occurrence and impacts of researcher trauma across all clinical/non-clinical fields; use the review to draft a manuscript for submission to a major international peer-reviewed journal and provide the foundational data necessary to underpin an ARC Discovery grant application.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: yes
Pre-requisite/s: NA
Supervisor: Professor Dale Dominey-Howes
Supervisor email: dale.dominey-howes@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/dale.dominey-howes.php

Geosciences

Project: (GEOS3) The lives and deaths of the Great Barrier Reef – combining data and models to understand the evolution of Australia's iconic reef.

Predicting how the Great Barrier Reef (GBR) will respond in the face of future global climate changes is both poorly constrained and controversial. This relates to our incomplete understanding of how reef systems respond to environmental changes but also the lack of baseline data — particularly on centennial to millennial time scales. The study of the evolution of the GBR over past 500-600 ka can provide unique insights about how this iconic reef system responded to abrupt and major environmental changes over a range of spatio-temporal scales. In this project, you will integrate new and existing sedimentologic, biologic, geochemical, and chronological data sets from a unique suite of fossil reef cores from the GBR. Then you will use sophisticated modelling software (pyReef-Core) that predicts core stratigraphy, facies, and reef communities, in combination with innovative data sciences tools (BayesReef - bayesian inference computational algorithm) to optimize model inputs/parameters, to explore the past evolution of the GBR in response to major global climate and environmental changes.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: No
Pre-requisite/s: GEOS2115/GEOS2915 or GEOS2124/GEOS 2924 or GEOS3103/GEOS3803 or GEOS3104/3804 or GEOS3009/GEOS3909; Some knowledge of Python would be an advantage but not a requirement.
Supervisor: Associate Professor Jody Webster
Supervisor email: jody.webster@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/jody.webster.php

Geosciences

Project: (GEOS4) The last coral reef frontier - quantitative geomorphology of the modern Coral Sea reefs.

The project will investigate new and existing high-resolution remote sensing data (LIDAR & multibeam bathymetry data, aerial photographic imagery) to understand the main processes controlling the geomorphic variation of reef and associated environments in the largely unexplored reefs of the Coral Sea. Using advanced GIS and 3D visualization tools, we will develop a new quantitative morphologic characterisation of the reef and inter-reef areas (ie. terraces, banks, sediment wedges, channels, shoals, sand wave/dunes). We will also explore the relationships between the benthic habitats/sedimentary facies, the quantitative geomorphic data and physical processes operating in the Coral Sea. This project could also incorporate sophisticated new numerical reef model tools (pyBadlands, pyReef) under development by the GRG. The project will have implications for improving our understanding modern reef environments and processes as well enhancing our knowledge of ancient carbonate platforms.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: No
Pre-requisite/s: GEOS2115/GEOS2915 or GEOS2124/GEOS 2924 or GEOS3103/GEOS3803 or GEOS3104/3804 or GEOS3009/GEOS3909; Some knowledge of Python would be an advantage but not a requirement.
Supervisor: Associate Professor Jody Webster
Supervisor email: jody.webster@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/jody.webster.php

Geosciences

Project: (GEOS5) Urban experiments for sustainability in Sydney

Achieving sustainability in Sydney will require a transformation in how we source and consume essential environmental goods and services, including water and energy. But, proposals for how to achieve sustainability in these sectors under a changing climate focus on either building large infrastructures, such as dams or power stations, or micro-changes at the household scale, such as solar panels and rainwater tanks. In this project, we will study experiments and innovations in urban sustainability in the energy and/or water sector that occur at the meso-scale of neighbourhoods and communities, in order to evaluate their potential. The project will involve a review of published academic and grey-literature on relevant sustainability projects in Sydney, and other cities as relevant, and analysis of the benefits and limits of key examples and the conditions – political, financial, environmental, etc – of their success and failure.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed) with meetings on campus weekly
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: yes
Pre-requisite/s: Experience in geography or environmental studies necessary; one of the following classes is preferable GEOS3520/3920, GEOS2121/2921 or GEOS2123/2923
Supervisor: Dr. Sophie Webber
Supervisor email: sophie.webber@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/sophie.webber.php

Geosciences

Project: (GEOS6) Reconstructing the strain geometry of the Earth's upper mantle using X-ray microtomography

One of the aspects of plate tectonics that has not been explored in detail is three-dimensional deformation in the Earth's mantle, particularly along plate boundaries. The aim of this project is to understand the distribution of three-dimensional strain within the oceanic lithosphere that forms in a subduction zone system. You will use X-ray computed tomography, a non-destructive 3D imaging technique, to analyse the alignment and shape of minerals from rocks that formed in the Earth's oceanic upper mantle. These data will inform models of 3D mantle flow in subduction zones.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: no
Pre-requisite/s: GEOS2114/2914
Supervisor: Dr. Vasileios Chatzaras
Supervisor email: vasileios.chatzaras@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/vasileios.chatzaras.php

Geosciences

Project: (GEOS7) Microstructures associated with transient creep in the Earth's oceanic upper mantle

Major earthquakes that nucleate in the seismogenic layer may cause non-steady state deformation and stress cycles in the Earth's upper mantle. Geological evidence for such earthquake-related episodic deformation in the upper mantle, is not well established. This project aims to identify structures in the microscale that formed during transient deformation events associated with stress change in the upper mantle. You will analyse crystal orientation data acquired with the Scanning Electron Microscope - Electron Backscatter Diffraction (SEM-EBSD) technique, to characterize microstructures that were generated at different stress conditions in a fault zone that deformed the Earth's oceanic upper mantle. These data will allow us to build a picture of the seismic cycle in the oceanic lithosphere.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: no
Pre-requisite/s: GEOS2114/2914
Supervisor: Dr. Vasileios Chatzaras
Supervisor email: vasileios.chatzaras@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/vasileios.chatzaras.php

Geosciences

Project: (GEOS8) The role of orthopyroxene in the deformation of oceanic transform faults

Oceanic transform faults play a fundamental role on the generation and evolution of the oceanic lithosphere, affecting the physical, biological, and mineralization processes in oceanic basins. The aim of this project is to assess the processes by which orthopyroxene, the second most abundant rock forming mineral in Earth's upper mantle after olivine, contributes to the deformation of oceanic transform faults. You will analyse a rare suite of samples from the mantle section of a paleo-transform fault that is currently exposed in New Caledonia. You will use crystal orientation data acquired with the Scanning Electron Microscope - Electron Backscatter Diffraction (SEM-EBSD) technique, to produce a detailed characterization of orthopyroxene deformation (e.g., development of crystallographic preferred orientation, active slip systems, grain size distribution) in the microscale.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: no
Pre-requisite/s: GEOS2114/2914
Supervisor: Dr. Vasileios Chatzaras
Supervisor email: vasileios.chatzaras@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/vasileios.chatzaras.php

Geosciences

Project: (GEOS9) Landscapes and Biodiversity

Biodiversity is collapsing at an unprecedented rate, reaching the point from which there can be no recovering. For ecosystems to support human societies new perspectives must be considered. A striking correlation exists between biodiversity and regions of complex landscape. This provides new avenues to urgently address the loss of biodiversity.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: yes
Pre-requisite/s: Interest in ecology or geology, or both.
Supervisor: Associate Professor Patrice Rey
Supervisor email: patrice.rey@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/patrice.rey.php

Geosciences

Project: (GEOS10) Mapping urban resilience in Sydney

In the face of complex and dynamic changes, including climate change and rapid urbanization, cities have instigated programs that aim to achieve resilience – the ability to withstand unpredictable shocks and stresses. Despite the growing prevalence of these initiatives, there has been very little scholarly research about their goals, actions, and achievements. In this project, we will map urban resilience and urban resilience projects in Sydney. Drawing from reviews of the scholarly literature, web sites, and grey literature, we will map spatially where urban resilience projects are being implemented and map the relationships between different stakeholders, including the private sector, governments, and communities. This mapping will form the basis for an analysis of the forms of urban resilience and its outcomes.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed) with meetings on campus weekly
Location of Project: USyd Camperdown, Madsen Building
Available as a group project: yes
Pre-requisite/s: Experience in geography or environmental studies necessary; one of the following classes is preferable GEOS3520/3920, GEOS2121/2921 or GEOS2123/2923
Supervisor: Dr. Sophie Webber
Supervisor email: sophie.webber@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/sophie.webber.php

Geosciences

Project: (GEOS11) Understanding the effect of sea-level changes in deltas with contrasting shelf gradients

Deltas capture the Earth's tectonic and landscape history and host a range of resources of critical importance for the continued functioning of modern society. Additionally, more than two thirds of the worlds' largest and highly populated cities are coastal delta cities or are situated on estuaries vulnerable to rising sea levels. This project seeks to understand the effect of sea-level changes in river-deltas with contrasting shelf gradients by using cutting-edge numerical models. This project provides an extraordinary opportunity to learn about tectonics and surface processes with cutting-edge software tools, which will give students a valuable set of skills that are important for both academia and industry.

Research period: Jan-Feb
Research contact hours: 36 h/week for 6 weeks
Location of Project:
Available as a group project: no
Pre-requisite/s: GEOS2116, GEOS2124, GEOS3104
Supervisor: Dr. Sara Morón
Supervisor email: sara.moronpolanco@sydney.edu.au
Supervisor Research Profile URL:
https://sydney.edu.au/science/people/sara.moronpolanco.php#publications-by-year

Geosciences

Project: (GEOS12) Mapping the privatisation of public space in Sydney

Several trends are contribution to the privatisation of public spaces in Sydney, including: community title and strata housing developments; state privatisation, and; temporary enclosures of public space for commercial events. While the trend is widely discussed, the geographical extent and concentration of this privatisation in Sydney is unknown. In this project, you will work with academic experts to apply methods they have used elsewhere to generate a spatial database and analysis of these different forms of privatised public space.

Research period: Dec – Jan OR Jan - Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Sydney
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Associate Professor Kurt Iveson
Supervisor email: kurt.iveson@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/kurt.iveson.php

Geosciences

(GEOS13) Tectonic drivers of the deep carbon cycle and long-term climate

Plate tectonics controls the exchange of carbon from deep to shallow/surface planetary reservoirs, which modulates climate, biogeochemical processes, and even evolution on Earth. The tectonic driving parameters used in carbon box models are often decades old, leading to a poor quantification of the role of tectonics in driving atmospheric CO2 concentrations on geological timescales. This project will use our latest digital community plate reconstructions from GPlates (www.gplates.org) to link to a community carbon box model. This project will form the basis of future research to better constrain the time-evolving (and relative) contributions of CO2 from the plate-mantle system, and is part of an ongoing collaboration with the interdisciplinary and international Deep Carbon Observatory (https://deepcarbon.net/).

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown, Madsen Building
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Dr Sabin Zahirovic
Supervisor email: sabin.zahirovic@sydney.edu.au
Supervisor Research Profile URL: https://www.earthbyte.org/tag/sabin-zahirovic/

Maths

Project: (MATH1) Self-similar actions and operator algebras

We describe mathematical objects as self-similar if they are similar to some smaller part of themselves. Fractals are well known self-similar objects. In this project we will study group actions of graphs that are self-similar. To such self-similar actions we associate operator algebras (think infinite matrices), and we study how properties of the action are reflected in the associated operator algebra.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: Some second year pure maths
Supervisor: Dr Zahra Afsar
Supervisor email: zahra.afsar@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=Z_Afsar

Maths

Project: (MATH2) Dynamics of hashtags in Twitter

In this project we will use datasets from Twitter to study the flow of information in social media. Our goal is to provide a quantitative characterization and model of the temporal evolution of the frequency of different words and hashtags. The project will involve statistical analysis of the data and dynamical-systems modeling. This project will be in collaboration with Dr. Tristram Alexander (Physics).

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: Coding experience, preference for Python.
Supervisor: A/Prof Eduardo Altmann
Supervisor email: eduardo.altmann@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=EG_Altmann

Maths

Project: (MATH3) Compact quantum groups

The Zappa-Szep product is a way of forming a new group from two old groups. It generalises the direct product, and semi-direct product constructions. In this project we look into introducing this construction for compact quantum groups, which are noncommutative analogues of function spaces on groups. We will focus on discovering new examples.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: Some second year pure maths
Supervisor: Dr Nathan Brownlowe
Supervisor email: nathan.brownlowe@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=N_Brownlowe

Maths

Project: (MATH4) Sample path generation for stochastic processes

Sample path generation enables one to simulate a hitting time, and other functionals of a jump-diffusion dynamics with state-dependent drift, volatility, jump intensity, and jump size. In this project, we will explore a variety of sample path generation methods with a view towards applications, including unbiased estimation of transition densities, hitting probabilities, and many other quantities arising in jump-diffusion and/or fractional dynamics. Some programming experience is essential. Suitable for up to two students.

Research period: Nov-Dec OR Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: STAT3911 and MATH3969
Supervisor: Dr Ray Kawai
Supervisor email: reiichiro.kawai@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=R_Kawai

Maths

Project: (MATH5) Research in false discoveries...

The multiple testing problem arises when we wish to test many hypotheses at once. Initially people tried to control the probability that we falsely reject at least one true null hypothesis. However, in a ground breaking paper Benjamini and Hochberg suggested that alternatively we can control the false discovery rate (FDR): the expected percentage of true null hypotheses among all the rejected hypotheses. Shortly after its introduction FDR became the preferred tool for multiple testing analysis with the original 1995 paper garnering over 55K citations. There are several related problems in the analysis of false discoveries that would be intriguing to explore.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: STAT2911
Supervisor: A/Prof Uri Keich
Supervisor email: uri.keich@sent.com
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=U_Keich

Maths

Project: (MATH6) FDR in mass spectrometry

In a shotgun proteomics experiment tandem mass spectrometry is used to identify the proteins in a sample. The identification begins with associating with each of the thousands of the generated peptide fragmentation spectra an optimal matching peptide among all peptides in a candidate database. Unfortunately, the resulting list of optimal peptide-spectrum matches contains many incorrect, random matches. Thus, we are faced with a formidable statistical problem of estimating the rate of false discoveries in say the top 1000 matches from that list. The problem gets even more complicated when we try to estimate the rate of false discoveries in the candidate proteins which are inferred from the matches to the peptides. We will look at some of these interesting statistical questions that are critical to correct analysis of the promising technology of shotgun proteomics.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: STAT2911
Supervisor: A/Prof Uri Keich
Supervisor email: uri.keich@sent.com
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=U_Keich

Maths

Project: (MATH7) Mathematically modelling the dynamics of human behavior during bushfire evacuation

This project applies mathematical modelling to social dynamics to address a real-world problem. We seek to develop a mathematical model of human behavior during bushfires. Different people respond to evacuation warnings differently, and a recent study identified seven major archetypes: (1) Threat denier – those who deny a threat exists, (2) Responsibility denier – those who do not believe they are responsible for themselves, (3) Dependent evacuator – those who are unable to evacuate on their own, (4) Considered evacuator – those who are determined to evacuate safely, (5) Community guided – those who look to their community for guidance, (6) Worried waverers – those who try to remain, but worry they lack experience to do so successfully, (7) Experienced independents – those who are self-reliant and committed to remaining, until circumstances become highly unfavourable. We will mathematically model populations consisting of varying proportions of the seven behavioural archetypes to investigate how different communities would respond under different bushfire scenarios and how agencies could respond to improve evacuation outcomes. Through modelling and simulation, our goal is to propose, assess, and optimise new protocols to help improve fire agencies' evacuation management.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: None
Supervisor: A/Prof Peter Kim
Supervisor email: peter.kim@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=PS_Kim

Maths

Project: (MATH8) A fresh perspective - High parameter imaging and novel high-dimensional analytics

For the first time, imaging cytometry technologies have reached a maturity such that it is now possible to image the interaction of individual cells with their immediate environment. While the technologies have matured, the possible hypotheses that could be generated with these large datasets are still in their infancy. In this project we can apply or develop cutting-edge high-dimensional statistical machine learning tools to publically available imaging cytometry datasets in order to assess their performance.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: STAT2X12 or DATA2X02
Supervisor: Dr Ellis Patrick
Supervisor email: ellis.patrick@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=ES_Patrick

Maths

Project: (MATH9) The nature of Platonic and Archimedean solids

The aim is to study regular and semi-regular polyhedra, and search for their applications in mathematics and/or occurence in nature.

Research period: Nov-Dec OR Feb

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: Carslaw

Available as a group project: yes

Pre-requisite/s: MATH1X02

Supervisor: Dr Milena Radnovic

Supervisor email: milena.radnovic@sydney.edu.au

Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=M_Radnovic

Maths

Project: (MATH10) Mixing, twisty puzzles, and the fractal geometry of piecewise isometries

A piecewise isometry is a map that cuts and shuffles an object, for example, shuffling a deck of cards or scrambling a Rubik's cube. The mixing properties of these maps are applicable to granular mixing and twisty puzzles (e.g. the Rubik's cube). One remarkable property of piecewise isometries is that the mixing set typically has a complex fractal structure, and the fractal properties correlate with mixing performance. The idea of this project is to explore the mixing capabilities and fractal mixing sets associated with a range of piecewise isometries.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: coding (MATLAB/Mathematica), MATH 1002 / 1902
Supervisor: Dr Lachlan Smith
Supervisor email: lachlan.smith@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=L_Smith

Maths

Project: (MATH11) Chaos via clustering in networks of coupled oscillators

In networks of coupled oscillators, such as neurons in the brain, a typical emergent phenomenon is synchronization, where all the oscillators become phase-locked. In networks with complex topologies, the oscillators may form a number of distinct synchronized clusters. These clusters interact in complex ways, and the inter- and intra-cluster dynamics may be chaotic. The idea of this project is to investigate the dynamics of synchronized clusters for different network structures.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: coding (MATLAB), MATH 1002 / 1902, MATH 2021 / 2921
Supervisor: Dr Lachlan Smith
Supervisor email: lachlan.smith@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=L_Smith

Maths

Project: (MATH12) Graph encoded manifolds

It is quite easy to visualise orientable surfaces such as the sphere or the torus (the surface of a donut) embedded in three-dimensional space. Surfaces are two-dimensional manifolds. It is a challenging task to visualise manifolds of higher dimensions. One general - and perhaps surprising - way of achieving this is by representing a manifold by a graph with coloured edges. Such graph encoded manifolds, or gems, can always be drawn on a sheet of paper while containing all the information about the surface or manifold. While some of this information is very hard (or impossible) to access, some information can be read off the graph quite easily and other bits and pieces can be recovered by simple combinatorial rules. This project is about using these simple combinatorial rules to deduce interesting facts about manifolds, to construct large families of such gems satisfying some given properties (which is interesting for all kinds of reasons), to design a method to randomly generate such gems in certain settings (which is important for even more kinds of reasons), or to do more theoretical work.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: None
Supervisor: Dr Jonathan Spreer
Supervisor email: jonathan.spreer@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=J_Spreer

Maths

Project: (MATH13) Modelling consumer data from the red meat industry

The beef industry in Australia is worth $13 billion annually and the sheep meat industry is worth another $4 billion. A key question concerning the red meat industry is the ability to predict the eating quality of cuts of meat. Doing this well has major financial implications for the industry. This project would focus on the statistical issues associated with analysing consumer trial data to predicting meat eating quality. Examples of possible projects include: the analysis of consumer data which often contains many outliers; determining the relative importance of eating quality factors such as flavour, tenderness and juiciness; looking at the importance of "link product" as a common starter across consumers; and evaluating new objective grading techniques.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: DATA2X02/STAT2X12
Supervisor: Dr Garth Tarr
Supervisor email: garth.tarr@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=GM_Tarr

Maths

Project: (MATH14) Convex projective surfaces

The basic objects of geometric topology are curves and surfaces. This project studies them using techniques from geometry, algebra and combinatorics. The focus will be on projective structures on surfaces -- this includes spherical, euclidean and hyperbolic structures, but also many more! Some basic questions that may be addressed are: How do you put a projective structure on a surface? How do you tell two projective structures on a surface apart? Can you compute the lengths of the shortest curves on a projective surface? The most interesting projective structures are called "convex". The set of all convex projective structures on a surface will be parameterised using the concept of a moduli space. Questions about this moduli space include: What is a natural concept of distance between points in the moduli space? What characterises a shortest curve between two points in the moduli space?

Research period: Nov-Dec OR Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: Some second year mathematics
Supervisor: Dr Stephan Tillmann
Supervisor email: stephan.tillmann@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=S_Tillmann

Maths

Project: (MATH15) Interactive visualisation of trans-omic data

Mass spectrometer (MS) and next generation sequencer (NGS) have become the methods of choices for high-throughput profiling of global proteome, phosphoproteome, transcriptome, and epigenome of cell systems. Data visualisation and summarisation is critical for making sense of these large-scale multilayered omic (i.e. trans-omics) datasets. You will learn interactive visualisation of trans-omic data using R and Shiny applications, which are highly valued skills in data sciences. Furthermore, this project will provide a unique opportunity for developing computational methods for understanding cell systems and their decision-making process.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: None
Supervisor: Dr Pengyi Yang
Supervisor email: pengyi.yang@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=P_Yang

Maths

Project: (MATH16) Trans-omic data integration using machine learning

A major initiative in our group is to integrate trans-omics datasets generated by state-of-the-art mass spectrometer (MS) and next generation sequencer (NGS) from various cell systems. We have now profiled various stem/progenitor cell differentiation processes using a combination of MS and NGS and have generated large-scale trans-omics datasets in these cell systems (see https://doi.org/10.1016/j.cels.2019.03.012). These data provide exciting research direction where data integration across multiple omic layers is the key for comprehensive understanding of the underlying biological systems. In this project, you will learn unsupervised (e.g. clustering, PCA) and supervised (e.g. classification) machine learning techniques for integrating and making sense trans-omics data that capturing the dynamics of stem cell differentiation.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: no
Pre-requisite/s: None
Supervisor: Dr Pengyi Yang
Supervisor email: pengyi.yang@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=P_Yang

Maths

Project: (MATH17) Methods towards precision medicine

Over the past decade, new and more powerful -omic tools have been applied to the study of complex disease such as cancer and generated a myriad of complex data. However, our general ability to analyse this data lags far behind our ability to produce it. This project is to develop computational methods that helps towards identify disease pathways and deliver better prediction of outcome. This project could also investigate whether it is possible to establish the patient or sample specific accuracy by integrating public repository of multi-omics data.

Research period: Nov-Dec OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: Know how to use R
Supervisor: Prof Jean Yang
Supervisor email: jean.yang@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=YH_Yang

Maths

Project: (MATH18) Tools to examine data from diverse oatbread mice

Mouse model has been a popular model organism to study many complex diseases including T2D, cardiovascular disease and other obesity related disease. This project focus on exploring approaches to examine data generated from study using diverse outbred (DO) mice. The DO mice are a new model for better understanding gene and environmental effects as their genetic diversity and variability is closer to the human population. The projects will examine statistics and bioinformatics tools in mouse genetics that are adapted for this type of data.

Research period: Nov-Dec OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Carslaw
Available as a group project: yes
Pre-requisite/s: Know how to use R
Supervisor: Prof Jean Yang
Supervisor email: jean.yang@sydney.edu.au
Supervisor Research Profile URL: http://www.maths.usyd.edu.au/ut/loc/people?who=YH_Yang

Physics

Project: (PHYS1) Exotic Quantum Many-Body Systems for Quantum Computing

Quantum computers are potentially much more powerful than the computers we use today, but building a quantum computer is a huge challenge. Most proposals to construct one involve building it from scratch "atom by atom". What we have shown is that certain materials, when cooled down to a very low temperature, will naturally form a quantum computer on their own. This way, we may be able to get nature to build our quantum computers for us: we just have to find (or synthesize) the right material, then put it in the fridge.

This theory project will be to investigate the zero- and low-temperature quantum phases of some promising spin lattices, and develop techniques for quantum computation that are robust against variations in the Hamiltonian, thermal errors, or other deleterious effects. It will make extensive use of techniques from quantum theory, statistical mechanics, and linear algebra, and will appeal to students with an interest in analytical techniques from mathematics as well as theoretical physics.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Room 4010, Sydney Nanoscience Hub, A31
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Prof Stephen Bartlett
Supervisor email: stephen.bartlett@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/stephen.bartlett.php

Physics

Project: (PHYS2) The Power of Quantum Computing

What gives quantum computers their power? We don't have a good answer to this question. One approach to answering it involves developing (classical) simulation methods for quantum processes. If we can efficiently simulate a quantum circuit on a classical computer, then clearly it's not `quantum powerful'. This theory project will involve coding up a new approach to simulating quantum circuits by using 'negative probabilities', and testing how well these simulations run, with a goal of isolating the key quantum resources.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Room 4010, Sydney Nanoscience Hub, A31
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Prof Stephen Bartlett
Supervisor email: stephen.bartlett@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/stephen.bartlett.php

Physics

Project: (PHYS3) Symmetries and unity of fundamental forces

In this project, we investigate basic concepts of modern fundamental physics and how they are applied to construct unified theories of electromagnetism, week and strong forces. We will look into unified theories and derive new physical phenomena they predict.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28, Rm 367
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Associate Professor Archil Kobakhidze
Supervisor email: archil.kobakhidze@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/research/opportunities/supervisors/1472

Physics

Project: (PHYS4) Shaping the resonators for tailoring the bandgap spectrum in optical fibers

This project will aim about shaping the resonators in a photonic bangap fibers for tailoring the bandgap action. It will have numerous application such as dispersion tailoring, supercontinuum generation in mid-infrared wavelength region etc.

Research period: Nov-Dec

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: Physics A28, Rm303B

Available as a group project: No

Pre-requisite/s: N/A

Supervisor: Dr. Deepak Jain

Supervisor email: deepak.jain@sydney.edu.au

Supervisor Research Profile URL: https://www.linkedin.com/in/deepak-jain-1b95499a/

Physics

Project: (PHYS5) The TOLIMAN space Telescope.

Despite the manifest success witnessed by catalogs of exoplanetary detections climbing into the thousands,
contemporary astronomy is still poorly equipped to answer the basic question of whether there are any potentially temperate planets orbiting any particular star system. This problem becomes particularly acute
when considering stars in our local neighbourhood: close enough for detailed follow-up missions to characterize
on decades timescales, and potentially for exploration by space probe on centuries timescales. Overwhelmingly
the most promising technology to deliver a complete census of nearby habitable zone exoplanets and their properties down to Earth mass is high precision astrometry; to date a quite minor player in the exoplanetary domain. This project will help to establish the design for the TOLIMAN space telescope dedicated to astrometric detection of exoplanets, particularly targeting the Alpha Cen system. A Foundational Mission Study, jointly funded by the Breakthrough Prize Foundation and the University of Sydney, is now underway. The project will model the innovative principles underlying the detection strategy and help specify the following phases of construction and launch.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Professor Peter Tuthill
Supervisor email: peter.tuthill@sydney.edu.au
Supervisor Research Profile URL: http://www.physics.usyd.edu.au/~gekko

Physics

Project: (PHYS6) Rare particle decays and common junk: can we tell them apart?

Particle physics experiments measure many different particles at a time: photons, electrons, muons, pions, kaons, protons, and others. Some special combinations of these particles are due to rare decays of heavy particles, and allow us to make important measurements. Others are "junk", partly due to background processes from the particle accelerator. In our group at Sydney we are developing a new method to tell rare decays apart from junk at the Belle II experiment in Japan. In this project, you will help to put this method through its paces, and to test whether we can out-perform older methods of finding rare decays.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: No
Pre-requisite/s: two years of undergraduate physics and mathematics
Supervisor: Associate Professor Bruce Yabsley
Supervisor email: bruce.yabsley@sydney.edu.au
Supervisor Research Profile URL: http://www.physics.usyd.edu.au/hienergy/index.php/Main_Page

Physics

Project: (PHYS7) Polymer fiber-based pneumatic finger

Soft robots employing intrinsically soft and/or extensible materials (for example, silicone rubbers) can provide an opportunity to bridge the gap between machines and people. This project aims at developing a pneumatic finger based on a soft polyurethane multichannel fibre, which can be dynamically pressurized. The effect of different structural parameters of the fibre will be analysed and the possibility of creating a soft-robotics gripper (pneumatic hand) will be examined.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Professor Simon Fleming
Supervisor email: simon.fleming@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/simon.fleming.php

Physics

Project: (PHYS8) Polymer fiber-based linear actuator

Soft robots employing intrinsically soft and/or extensible materials (for example, silicone rubbers) can provide an opportunity to bridge the gap between machines and people. This project aims at developing a linear actuator based on a soft polyurethane multichannel fibre, which possesses shape memory - contracting upon heating and elongating upon cooling. The effect of different structural parameters of the fibre will be analysed to find the optimum porosity of the fibre that enables the best actuation performance.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Professor Simon Fleming
Supervisor email: simon.fleming@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/simon.fleming.php

Physics

Project: (PHYS9) Polymer fiber-based pressure sensor

In recent years, wearable sensors have been widely used in everyday life and continue to be actively developed by physicists and engineers. This project aims at developing a pressure sensor based on a soft polyurethane hollow fibre, whose optical transmittance depends on its cross-section profile controlled by the external pressure. The effect of different structural parameters of the fibre will be analysed to find the pressure sensitivity range of the sensor.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Professor Simon Fleming
Supervisor email: simon.fleming@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/simon.fleming.php

Physics

Project: (PHYS10) Modelling individual variability in response to sleep deprivation

Insufficient or low quality sleep results in reduced alertness, which leads to an increased risk of accidents. Nearly 40% of Australians suffer from reduced alertness every day. However, there is large individual variability in alertness decrement due to sleep deprivation with some people performing much worth than others. We have developed a physically-based model that predicts alertness for a 'standard' individual. Similar models are used by airlines and railroad companies. However, none of the existing models are yet able to make individual predictions. In this project we will investigate individual variability in objective performance of healthy individuals and test the ability of our model to predict individual differences. The project will involve working with the mathematical model represented by a system of ODEs, maltab codes, and experimental data. It is a multidisciplinary collaborative project between U Sydney and U Liege, Belgium.

Research period: Nov-Dec
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: Room 430, Madsen Building, F09
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Svetlana Postnova
Supervisor email: spostnova@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/svetlana.postnova.php

Physics

Project: (PHYS11) Novel nanolasers: a brighter future for photonic integrated devices

In this project, you will use a fluorescence microscope and a combination of image detection and spectrum collection to evaluate if the samples, constituted by plasmonic perovskite nanowires, are actually lasing. If so you will measure the power threshold and the spectral characteristic of the light emitted.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks
Location of Project: Physics A28
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: A/Prof Stefano Palomba
Supervisor email: stefano.palomba@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/stefano.palomba.php

Physics

Project: (PHYS12) DDMEBT-polymer composite: a new nonlinear material

In this project you will operate a pulsed laser and a custom-built z-scan system to measure the nonlinear optical properties of this polymeric films. You will need to learn first how the setup work, its theory and how to operate the laser source. You will compare the measurements with other nonlinear optical films.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks
Location of Project: Physics A28
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: A/Prof Stefano Palomba
Supervisor email: stefano.palomba@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/stefano.palomba.php

Physics

Project: (PHYS13) B-meson decays with the Belle II experiment at KEK

Belle II is a major new particle physics experiment at the KEK laboratory in Tsukuba, Japan. The SuperKEKB collider uses electron and positron beams to produce large numbers of pairs of B mesons, bound states of a bottom quark/antiquark and a lighter antiquark/quark. Belle II will use the decays of these
particles to search for physics beyond the Standard Model of particle physics. In 2019 Belle II is commencing its first major run of the experiment, and in this project we will use the data taken this year to study B-meson decays. This will give the project student a good taste of how experimental particle physics is carried out.

Research period: Jan-Feb
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: Physics A28, Rm 364
Available as a group project: Yes
Pre-requisite/s: Some knowledge of Python would be an advantage but not a requirement.
Supervisor: Professor Kevin Varvell
Supervisor email: kevin.varvell@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/kevin.varvell.php

Physics

Project: (PHYS14) The ATLAS experiment at CERN's Large Hadron Collider

The ATLAS experiment is one of two large experiments at CERN's Large Hadron Collider, and has been recording proton-proton collisions since 2010. The Higgs boson was discovered by these experiments in 2012, and they continue to search for physics beyond the Standard Model of particle physics. The LHC and ATLAS will undergo staged upgrades over the next few years to increase the rate at which collisions occur and are recorded, and this upgrade presents many technical challenges. In this project, we will study ways to improve the ability of the future detector to track and identify charged particles. The project student can expect to get a good insight into how experimental particle physics is carried out.

Research period: Jan-Feb
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: Physics A28, Rm 364
Available as a group project: No
Pre-requisite/s: Some knowledge of Python would be an advantage but not a requirement.
Supervisor: Professor Kevin Varvell
Supervisor email: kevin.varvell@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/kevin.varvell.php

Physics

Project: (PHYS15) Trapped ion quantum computation

One of the most promising architectures for quantum computation and the simulation of other, less accessible quantum systems is based on trapped atomic ions confined by electric potentials in an ultra-high vacuum environment. Record coherence times and the highest operational fidelities among all qubit implementations have enabled remarkable progress in recent years and, with the only two fully-operational systems in Australia, the quantum control laboratory works at the forefront of research in this area. Our current efforts focus on the development and experimental implementation of new control methods and their application to practical quantum computation and simulation, e.g. of quantum chemistry. This project is laboratory-based and – depending on preference, current needs and prior experience – can range from work with laser optics and microwave systems, to software programming, analytical calculations and numerical simulations.

Research period: Nov-Dec
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: lab 2021, Sydney Nanoscience Hub, A31
Available as a group project: No
Pre-requisite/s: Interest in experimental physics
Supervisor: Dr Cornelius Hempel
Supervisor email: cornelius.hempel@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/cornelius.hempel.php

Physics

Project: (PHYS16) Large scale quantum simulation with trapped ions

The controlled simulation of dynamics in quantum-many body systems is of central interest in the pursuit to further our understanding of phenomena such as superconductivity and quantum magnetism. Specially designed Penning traps enable experimental investigations into these topics using hundreds of ions trapped simultaneously inside a large, superconducting magnet. We have recently brought online the first and only such system in Australia at the Sydney Nanoscience Hub and now routinely trap large crystals of beryllium ions. The current focus of the work is on finalizing the setup of the laser-based qubit manipulation and implementing software-based state analysis. Both topics involve experimental work in the laboratory as well as complementary numerical simulations and will adapt based on starting date and current needs.

Research period: Nov-Dec
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: lab 2021, Sydney Nanoscience Hub, A31
Available as a group project: No
Pre-requisite/s: N/A
Supervisor: Dr Robert Wolf
Supervisor email: robert.wolf@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/robert.wolf.php

Physics

Project: (PHYS17) Inferring the computational logic of real-world dynamics

Time-varying systems are all around us, from biomedicine (heart and brain dynamics) to astrophysics (light curves of stars). Methods to understand the structure of the dynamics produced by these systems have wide-ranging consequences across industry (developing new brain-machine interfaces) and the sciences (understanding astrophysical systems). A recent survey has yielded a comprehensive interdisciplinary library of such methods that remains unstructured, limiting its usefulness for real-world problems. In this project, students will use statistical methods to infer the computational logic in this library, and thereby deduce structure in a literature encapsulating decades of human creativity. Results will be important for a wide range of problems, including those flagged above, by moving toward a future of automated analysis of dynamical systems.

Research period: Jan-Feb
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: Room 415, Madsen Building, F09
Available as a group project: No
Pre-requisite/s: Students must have some experience with or interest in coding.
Supervisor: Dr Ben Fulcher
Supervisor email: ben.fulcher@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ben.fulcher.php

Physics

Project: (PHYS18) Medical Device development for imaging and targeting cancer with radiation therapy

The ACRF Image X Institute builds medical devices for imaging and targeting cancer with radiaiton therapy. We use physics, engineering, mathematics and software development to achieve these goals. Former summer students have been on publications, patent applications and international conferences.

Research period: Preferably Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks

Location of Project: Biomedical Building, C81. In Australian Technology Park, Eveleigh

Available as a group project: Can be individual or group

Pre-requisite/s: We have people from Mathematics, Physics, Engineering and IT backgrounds - can tailor project to suit appplicant

Supervisor: Professor Paul Keall

Supervisor email: paul.keall@sydney.edu.au

Supervisor Research Profile URL:

http://sydney.edu.au/medicine/people/academics/profiles/paul.keall.php

Physics

Project: (PHYS19) Cold drawing of polycaprolactone fibres

Polycaprolactone (PCL) fibres, which can be fabricated by hot drawing from preforms, find multiple uses in tissue engineering and nerve regeneration. This project aims at exploring the potential of cold drawing of PCL fibres as a post processing technique for efficient modification of fibre parameters. The effect of different cold-drawing regimes resulting in different relative elongations of the fibre will be analysed and their effect on the fibre cross section profile will be examined.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: yes
Pre-requisite/s: N/A
Supervisor: Professor Simon Fleming
Supervisor email: simon.fleming@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/simon.fleming.php

Physics

Project: (PHYS20) How does the brain compute? Distributed dynamical computation in neural circuits

One of the most fundamental problems about the brain is how it computes. To answer this question, recently we have presented a concept of distributed dynamical computation (DDC), in which computation or information processing is carried out by interacting, propagating neural waves. The concept can merge dynamics and computation aspects of the brain, which used to have great gaps between each other. The project will involve making further links between dynamics and computation, including studying our current models of spiking neural networks with synaptic dynamics to present novel solutions to associative memory and visual feature binding in pattern recognition, and comparing the distributed parallel computation capacities of DDC with those of conventional distributed computation paradigms.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Room 434, Madsen Building, F09
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Associate Professor Pulin Gong
Supervisor email: pulin.gong@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/pulin.gong.php

Physics

Project: (PHYS21) Galaxy evolution as environmental science

The formation and evolution of galaxies could be regarded at the ultimate environmental science. Galaxies are profoundly influenced by their surroundings, and that leads to fundamental changes in star formation and structure. Using data from the international SAMI Galaxy Survey (led from University of Sydney) we will be connecting the internal properties of galaxies to their larger-scale environment. There are a number of possible projects in this field, including: quantifying the role of super-massive black holes; discovering how galaxies grow by accreting gas; finding novel ways to connect the spin of a galaxy to its surroundings; timing the shut down of star formation. Some coding experience in a language such as python would be an advantage in most of these projects.

Research period: Nov-Dec
Research contact hours: 35 hrs p/w for 6 weeks (flexibly distributed)
Location of Project: Physics A28
Available as a group project: Yes
Pre-requisite/s: N/A
Supervisor: Prof Scott Croom
Supervisor email: scott.croom@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/scott.croom.php

Psychology

Project: (PSYC1) Do people use different emotion regulation strategies to regulate others' anger and anxiety?

This project involves administering an online questionnaire of the strategies that participants report that other people use to regulate the participant's emotions. The aim of the project is to find out whether people use different kinds of strategies for trying to regulate different kinds of emotions. The scholar will program the online questionnaire, recruit participants through a panel website, run the online questionnaire page, clean the data, help analyse the results, and help write a manuscript for publication.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 hrs p/w for 6 weeks or two days per week for 15 weeks
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: PSYC2012 (CR or higher)
Supervisor: A/Prof Carolyn MacCann
Supervisor email: carolyn.maccann@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/carolyn.maccann.php

Psychology

Project: (PSYC2) Judicial perspectives on the effectiveness of gambling courts.

Elevated rates of criminal offences are found in individuals with gambling disorders. Some jurisdictions have introduced special Gambling Courts to manage such offenders. Little is known of the perception of members or the judiciary regarding the usefulness of Gambling Courts. Understanding the views of judges, police officers and lawyers could assist in identifying barriers to referral and developing informational material to inform key stakeholders. This project will require students to conduct a literature review and environmental scan, analyse semi-structured interviews with judicial personnel and write a report and presentation showcasing the research results.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 hrs p/w for 6 weeks or two days per week for 15 weeks
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Basic understanding of empirical research and basic data analysis abilities (e.g. as in the Psychology Program and Major in Psychological Sciences)
Supervisor: Dr Celine van Golde
Supervisor email: celine.vangolde@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/celine.vangolde.php

Psychology

Project: (PSYC3) Children's thinking

This project examines how children construct their understanding of the world around them, how that process changes with age, and how children differ from each other in their understanding. Working on this project entails directly working with children, potentially ranging from 4 to 12 years old. You will take children through experimental procedures, and then further help with data analysis. The aim is that your work will contribute to a novel finding that is published in a peer-reviewed journal of child development

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Needs a 'Working With Children Check' (WWCC). Any programming skills are a bonus, but not necessary.
Supervisor: Dr Micah Goldwater
Supervisor email: micah.goldwater@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/micah.goldwater.php

Psychology

Project: (PSYC4) Investigating problematic use of emerging technologies for gambling among young adults

Young adults have the highest rates of gambling disorder of any age cohort, yet younger generations do not gamble on traditional gaming machines, which have been the focus of past research. Emerging gambling activities are heavily technology-enabled and incorporate gaming mechanics (e.g., skill, social play, achievement, progression, narrative, interactive play). This project will involve a literature review and environmental scan to understand what resources are available to prevent and manage problems related to gambling on emerging activities, and what policies may be useful. The student will be involved in analysing data from a young adult population looking at the impact of participation in emerging gambling activities on mental health problems. The student will work within a collaborative lab environment and gain insight into team projects and a range of research methods.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: Three days per week for 10 weeks, must include Wednesdays.
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Experience conducting literature reviews and analysis of data using SPSS. Some experience with qualitative analysis is desirable.
Supervisor: A/Prof Sally Gainsbury
Supervisor email: sally.gainsbury@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/sally.gainsbury.php

Psychology

Project: (PSYC5) Behavioural Coding of Couple Interaction Data

This project involves coding behavioural interaction data from couples in romantic relationships who participated in laboratory experiments or longitudinal research. Interactions were videorecorded after participants received feedback (or no feedback in the control condition) about their performance on a task and/or during discussion of a conflict in their relationship. Using state-of-the-art Noldus Observer XT software, students will work in groups to code videos of couples for a wide variety of behaviours (e.g., nodding), facial expressions (e.g., smiling, brow furrows), and the verbal content of partners' communication with one another (e.g., sarcasm, support). This project will give students first-hand experience in selecting and refining a coding scheme and working with other students to establish inter-rater reliability. Sophisticated analytical tools will be used once the videos have been coded, which will give students insight into how to run sophisticated analyses for these types of data.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: Three days per week for 10 weeks.
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Experience with behavioural coding is desirable.
Supervisor: Dr Rebecca Pinkus
Supervisor email: rebecca.pinkus@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/rebecca.pinkus.php

Psychology

Project: (PSYC6) Exercise as possibly addictive: A rat model

When placed daily in an activity wheel rats run for a steadily increasing amount. Does this mean they become addicted to exercise? Or are there other explanations?

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks (flexibly distributed)

Location of Project: Camperdown Campus

Available as a group project: no

Pre-requisite/s: PSYC3X11

Supervisor: Emeritus Professor Robert Boakes

Supervisor email: bob.boakes@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/bob.boakes.php

Psychology

Project: (PSYC7) Do prepubescent children show a sex-difference in attention to gendered stimuli?

It is well established that adult heterosexual men and women differ in how they visually attend to gendered visual stimuli (i.e., images of males versus females). It is typically found that adult heterosexual men gaze for longer at female than male stimuli, whereas adult heterosexual women split their attention evenly between both male and female stimuli – and regardless of the sex of stimuli, women attend more so to faces than do men (Alexander, 2009; Hall et al., 2010). One basic question, is whether these sex difference in visual attention patterns, are early emerging and stable, or whether they emerge relatively late in development, as a productive of social learning. This study would be the first to examine visual attention to gendered visual stimuli (images of fully clothed adult men and women) in prepubescent males and females (20 boys and 20 girls) to examine the nature and origins of sex differences in processing of gendered stimuli.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or a three days per week for 10 weeks
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Experience with infra-red eye tracker is desirable, but training will be provided.
Supervisor: Dr James Morandini
Supervisor email: james.morandini@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/james.morandini.php

Psychology

Project: (PSYC8) The effects of distress on memory for events

The research is mixed regarding whether, and how, stress can impact memory. This has important implications when considering victim and witness testimony for a traumatic crime. The successful student will have the opportunity to contribute to an individual or group project that may include methods such as: online surveys, coding and analysis of existing data, and/or analysis of stress hormones such as cortisol (depending on skills: e.g., previous experience with lab techniques such as pipetting and ELISA)

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or a three days per week for 10 weeks
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Basic understanding of empirical research and basic data analysis abilities (e.g. as in the Psychology Program and Major in Psychological Sciences)
Supervisor: Dr Celine van Golde
Supervisor email: celine.vangolde@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/celine.vangolde.php

Psychology

Project: (PSYC9) Watch Me Grow for Real' Project

The 'Watch Me Grow for Real' project aims to track the development and well-being of a large group of children born in the South Western Sydney Local Health District until they are 3 years of age. We aim to better understand the factors associated with child well-being and mental health problems. As such, we seek to improve the future services that are offered to young children and their families. The project currently has 788 families that are invited to attend assessments assessing early signs of child mental health problems and child well-being. These assessments include computer eye-tracking tasks for children, galvanic skin response (GSR) monitoring, play tasks, and questionnaires for mothers.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or a three days per week for 10 weeks
Location of Project: Liverpool Hospital & Ingham Institute
Available as a group project: yes
Pre-requisite/s: Needs a 'Working With Children Check' (WWCC). Ability to communicate sensitively with families from Culturally and Linguistically Diverse (CALD) backgrounds. Ability to engage with young children and families.
Supervisor: Dr Fran Doyle
Supervisor email: frances.doyle@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/frances.doyle.php

Psychology

Project: (PSYC10) Watch Me Grow for Real' ProjectProject Title: Judicial perspectives on the effectiveness of gambling courts.

Elevated rates of criminal offences are found in individuals with gambling disorders. Some jurisdictions have introduced special Gambling Courts to manage such offenders. Little is known of the perception of members or the judiciary regarding the usefulness of Gambling Courts. Understanding the views of judges, police officers and lawyers could assist in identifying barriers to referral and developing informational material to inform key stakeholders. This project will require students to conduct a literature review and environmental scan, analyse semi-structured interviews with judicial personnel and write a report and presentation showcasing the research results.

Research period: Dec-Feb
Research contact hours: 28 h/week for 7.5 weeks
Location of Project: BMC (Gambling Clinic)/School of Psychology, BM
Available as a group project: No
Pre-requisite/s: Understanding of empirical research, and basic data analysis abilities.
Supervisor: Dr Celine van Golde
Supervisor email: celine.vangolde@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/celine.vangolde.php

Soles

Project: (SOLES1) Does plastic pollution interfere with fish behaviour?

Plastics leak endocrine disrupting chemicals that can interfere with multiple physiological systems and thereby alter the ways in which animals interact with each other and their environment. The project will test whether endocrine disrupting chemical alter group behaviour and dispersal of fish.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks
Location of Project: Heydon Laurence
Available as a group project: no
Pre-requisite/s: Biology background
Supervisor: Professor Frank Seebacher
Supervisor email: frank.seebacher@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/frank.seebacher.php

Soles

Project: (SOLES2) The interaction between plastic pollution and other environmental drivers on animal function

Plastics leak endocrine disrupting chemicals that can alter the way animals respond to other environmental factors such as increases in temperature and changes in flow regimes. This project will test hypotheses about these interactions on physiological responses such as locomotion and metabolism.

Research period: Nov-Dec

Research contact hours: 35 h/week for 6 weeks

Location of Project: Heydon Laurence

Available as a group project: no

Pre-requisite/s: Biology background

Supervisor: Professor Frank Seebacher

Supervisor email: frank.seebacher@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/frank.seebacher.php

Soles

Project: (SOLES3) Gene by diet interactions as determinants of lifespan

We know that diet is a strong determinant of median lifespan and shape of aging. However, genes also play a strong role. How do the two interact to govern how long an individual will live? This project will use the drosophila genome reference panel with analytical techniques from quantitative genetics to disentangle the effects of genes and diets and lifespan.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Charles Perkins Centre
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Alistair Senior
Supervisor email: alistair.senior@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alistair.senior.php

Soles

Project: (SOLES4) Diet as a moderator of reproductive senescence

Age is the primary determinant of reproductive output. Post-maturity, individuals typically experience a slow decline in reproduction, termed reproductive senescence. How do diets alter this process, and can genes make a difference too? This project will explore reproductive senescence in Drosophila.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Charles Perkins Centre
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Alistair Senior
Supervisor email: alistair.senior@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alistair.senior.php

Soles

Project: (SOLES5) Gene-diet interaction in starvation sensitivity and activity

The main storage forms of nutrients, triglycerides and glycogen, are mobilized under starvation. Animals' ability to store nutrients, is an important determinant of both its survival and fitness. Genetic background can affect this ability, leading to various problems, including starvation sensitivity or at the other end, obesity. This project will explore the role of genetic background in starvation resistance and activity. We will use the fruit fly, Drosophila as a model organism.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Charles Perkins Centre
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Alistair Senior
Supervisor email: alistair.senior@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alistair.senior.php

Soles

Project: (SOLES6) How do bees choose which flowers to visit?

Bees are an important pollinator of a range of plants. In this project, you will investigate the behavioural strategies that bees use to choose between different types of flowers. You will learn how to make artificial flowers using a 3D printer and how to conduct behavioural experiments with bees.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Heydon Laurence
Available as a group project: yes
Pre-requisite/s: Biology background, not afraid of bees, not allergic to bees
Supervisor: Dr Tanya Latty
Supervisor email: tanya.latty@sydney.edu.au
Supervisor Research Profile URL: www.tanyalatty.com

Soles

Project: (SOLES7) Developing an early warning system for the collapse of honey bee colonies

Honey bee colonies can collapse suddenly and without warning. We will use cutting edge sensor technologies to develop an early warning system that detects stress and impending collapse. You will learn how to work with bees and how to use new sensor technologies. There is also an opportunity to develop mathematical models in collaboration with the school of mathematics if the student is interetsed.

Research period: Jan-Feb (Flexible at students convenience)
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Heydon Laurence
Available as a group project: yes
Pre-requisite/s: Biology background, not afraid of bees, not allergic to bees
Supervisor: Dr Tanya Latty
Supervisor email: tanya.latty@sydney.edu.au
Supervisor Research Profile URL: www.tanyalatty.com

Soles

Project: (SOLES8) How smart are slime moulds?

Despite being brain less, slime mould amoebas are capable of astonishingly complex behaviours including solving mazes, making smart food choices and building efficent transportation networks. In this project you will investigate and compare the decision making abilities of several slime mould species. You will learn how to work with slime moulds in the lab, how to find and culture wild slime moulds, and how to design and analyse behavioural experiments

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Heydon Laurence
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Tanya Latty
Supervisor email: tanya.latty@sydney.edu.au
Supervisor Research Profile URL: www.tanyalatty.com

Soles

Project: (SOLES9) Foraging ecology of mammalian herbivores - can we protect plants with clever odours?

Swamp wallabies and other herbivores such as deer, possums and even elephants find preferred food plants using odour. This project seeks to discover the odour cues they use to differentiate plant species, and how effective they are in different contexts. We also aim to work out how to negate those odours so the plants become "invisible"; a novel way of protecting plants from problem browsing. You will be part of a team setting up and running field trials at Ku-Ring-Gai Chase National Park, including setting up cameras and analysing behaviours of herbivores as they visit different experimental treatments. It would help if you had a drivers licence, but it is not essential.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Heydon Laurence and Ku-Ring-Gai Chase National Park
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Associate Professor Clare McArthur
Supervisor email: clare.mcarthur@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/clare.mcarthur.php

Soles

Project: (SOLES10) Heuristics, phantom decoys and altering preferences of possums and rats

Animals prefer some foods more than others, but this is not just a function of taste and nutritional content. We can alter their relative preferences by providing other options - even "phantom decoys" that are present but not available. This project explores and tests how decoys alter preferences of animals. You will be part of a team running trials with free-ranging animals, including setting up cameras and analysing behaviours as they visit different experimental treatments.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Heydon Laurence and Ku-Ring-Gai Chase National Park
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Associate Professor Clare McArthur
Supervisor email: clare.mcarthur@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/clare.mcarthur.php

Soles

Project: (SOLES11) Technology-enhances object-based learning in Biology

Scholar to investigate feasibility of photogrammetry on Haswell collection objects and botanical inflorescences. Project framed by the scholarly merits of this working with transdisciplinary partners in FASS/Uni Museums, and ICT.

Research period: Dec-Jan
Research contact hours: 35 h/week for 6 weeks
Location of Project: Macleay Building
Available as a group project: yes
Pre-requisite/s: N/A
Supervisor: Associate Professor Rosanne Quinnell
Supervisor email: rosanne.quinnell@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/rosanne.quinnell.php

Soles

Project: (SOLES12) Do microbes influence interactions between marine macroorganisms?

There seems to be more microbes in the Ocean than stars in the known Universe - this is mind-blowing. However, we mostly do not know the role microbes play in influencing ecological interactions among "macrobes". This project combines field and aquarium experiments with microbiological tools to understand how microbes influence interactions between key marine habitat-formers (kelps) and epibiota/consumers.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Edgeworth David Building and Sydney Institute of Marine Science, Chowder Bay
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Ziggy Marzinelli
Supervisor email: e.marzinelli@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/e.marzinelli.php

Soles

Project: (SOLES13) Oyster reefs as bioremediators

Large oyster reefs historically characterised estuaries on the South-East coast of Australia. These reefs played crucial roles in processing nutrients and other pollutants. Nowadays, subtidal oyster reefs are mostly absent in the area due to human factors, including the harvesting of shells and live oysters since the 18th century. This project aims to evaluate how remnant oyster reefs affect surrounding sediments in order to evalute the potential benefits of restoration efforts on estaurine rehabilitation.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Edgeworth David Building
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Ana Bugnot
Supervisor email: ana.bugnot@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ana.bugnot.php

Soles

Project: (SOLES14) Assessing the strategies for ecosystem restoration strategies

Oyster reefs and seagrass beds have been highly disturbed by human activities in many estuaries along the New South Wales coast for over two centuries. Despite improved water quality, restoration strategies to restore these species (habitat restoration) are largely unsuccessful. This may be because restoration efforts focus on re-introducing either seagrass or oysters, rather than trying to restore the esturine ecosystem (multiple habitats). Thus, we aim to understand the synergies between these habitats in Australian estuaries by assessing the mechanisms behind nutrient exchange between the seagrasses Zostera capricorni and Sydney Rock oysters Saccostrea glomerata. The results of this study will help undertsand the advantages of ecosystem restoration over habitat-focussed restoration.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Edgeworth David Building
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Ana Bugnot
Supervisor email: ana.bugnot@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ana.bugnot.php

Soles

Project: (SOLES20) Can Australian native bees adapt to a changing climate?

Bees are important pollinators of both crops and native plants. Their sensitivity to forecast changes in climate remain largely unknown, and depend in part on their capacity to adapt. In this project, you will assess the thermal and dessication tolerance of a range of Australian native bees, with the aim of identifying which groups of bees may face constraints on adaptation to hotter, drier climates.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks
Location of Project: Macleay Building
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Ros Gloag
Supervisor email: ros.gloag@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ros.gloag.php

Soles

Project: (SOLES21) Discovering the ecology and behaviour of a forgotten pollinator

The expansion of urban areas provides an unprecedented opportunity to study the effects of human disturbance on native fauna. Populations –of numerous animals– display modified behaviours and morphological adaptations to urban environments. Despite the overwhelming importance of insect pollinators, it is still unclear how they adapt and behave in cities. In this project, we will explore the diversity and behaviour of hoverfly populations in an urban gradient. You will learn how to conduct pollinator surveys and to perform behavioural experiments under laboratory conditions and in the wild.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: USyd Camperdown/Heydon Laurence
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: A/Prof Dieter Hochuli
Supervisor email: dieter.hochuli@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/dieter.hochuli.php

Soles

Project: (SOLES22) Smart farming: incorporating biodiversity into farming decisions

This project will develop and test an innovative system of acoustic recorders that can be used across pastures, crops and remnant patches of natural vegetation to evaluate the utility of ecoacoustics for monitoring biodiversity (Sub-project of DigiFarms https://sydney.edu.au/agriculture/our-research/Digifarm.html).

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown and L'lara, Narrabri
Available as a group project: yes
Pre-requisite/s: Biology or Agriculture background. Knowledge of R and bird calls desirable.
Supervisor: Dr Aaron Greenville
Supervisor email: aaron.greenville@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/aaron.greenville.php

Soles

Project: (SOLES23) Simpson Snapshots: designing Citizen Science programs for identifying wildlife in remote camera trap images

Remote camera traps are now commonly used in wildlife studies around the globe. They are a powerful and cost-effective method to survey wildlife due to their ease in deployment and ability to continually monitor populations across time. This project will work with DigiVol at the Australian Museum and the Desert Ecology Research Group, SOLES to design and test the utility of using citizen scientists to identify wildlife from remote camera photographs from the Simpson Desert.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, ATP/Heydon-Laurence
Available as a group project: yes
Pre-requisite/s: Biology or social science background
Supervisor: Dr Aaron Greenville
Supervisor email: aaron.greenville@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/aaron.greenville.php

Soles

Project: (SOLES24) WildCount: can machine learning be used to accurately identify wildlife in remote camera trap images?

A common limitation of remote wildlife camera traps is that they capture millions of images that need to be processed visually by an observer. This project investigates if machine learning techniques can provide a powerful and exciting opportunity to automate image processing. The project can be used as a pilot for a fully-funded Honours project in 2020, with the NSW Office of Environment and Heritage.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, ATP/Heydon-Laurence
Available as a group project: yes
Pre-requisite/s: Biology or Maths background. Knowledge or R and/or Python required.
Supervisor: Dr Aaron Greenville
Supervisor email: aaron.greenville@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/aaron.greenville.php

Soles

Project: (SOLES25) How do city bees find food?

Humans are altering the natural world on an unprecedented scale, with consequence for the basic tasks --- such as foraging --- faced by animals living therein. In this project you will investigate how bees visually locate flowers amidst the 'noise' of urban, as compared to natural, environments. You will conduct behavioural experiments with native bees, and learn how to analyse the colourful visual world of insects using full-spectrum photography and spectrometry.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Macleay/Heydon-Laurence
Available as a group project: yes
Pre-requisite/s: Biology background, not allergic to bees
Supervisor: Dr Thomas White
Supervisor email: thomas.white@sydney.edu.au
Supervisor Research Profile URL: https://tomwhite.io

Soles

Project: (SOLES26) What can dancing flies teach us about sexual selection, conflict, and communication?

Visual communication is ubiquitous, and the need to transmit information effectively is a challenge faced by all living things. In this project you will spend your summer at beautiful nearby beaches examining the elaborate courtships of shore-dwelling flies whose colourful faces, iridescent wings, and dramatic dances raise basic questions about communication, sexual selection, and adaptation. You will also develop skills in the experimental design, and analysis of colour and vision in nature using full-spectrum photography and spectrometry, as well as mathematical modelling if so interested.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Macleay/Heydon-Laurence
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Thomas White
Supervisor email: thomas.white@sydney.edu.au
Supervisor Research Profile URL: https://tomwhite.io

Soles

Project: (SOLES27) Unglueing the ecology and behaviour of an ancient invertebrate

Velvet worms are carnivorous invertebrates that spend their days inside logs and leaf-litter, glueing and devouring hapless insects that wander by. As the sister group to all arthropods they occupy a significant place in tree of life, yet we know almost nothing about their ecology or behaviour. In this project you will use lab experiments and/or fieldwork to answer any one of dozens of open questions, including: to what extent are velvet worms forage and live together, and what can this tell us about the early evolution of sociality? And how does a dark-dwelling invertebrate with a limited sensory repertoire distinguish friend from food?

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USyd Camperdown, Macleay/Heydon-Laurence
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Thomas White
Supervisor email: thomas.white@sydney.edu.au
Supervisor Research Profile URL: https://tomwhite.io

Soles

Project: (SOLES28) Pancreatic beta-cells in type 2 diabetes.

A major feature in the pathogenesis of type 2 diabetes (T2D) is the loss of pancreatic β-cell function. This manifests mainly as a reduction in glucose-stimulated insulin secretion. The molecular mechanisms that control β-cell failure during the progression to T2D remain poorly understood. Our research interest is to understand the mechanisms of β-cell failure in the pathogenesis of T2D. The current projects in the lab focus on understanding the mechanisms behind insulin biogenesis, maturation, stability and targeting for secretion.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Charles Perkins Centre
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Melkam Kebede
Supervisor email: melkam.kebede@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/melkam.kebede.php

Soles

Project: (SOLES29) Understanding the role of cell type boundaries in leaf development

This project will investigate how cell-type boundaries control the growth of plant leaves. It will involve live-imaging using confocal microscopy and different coloured variants of GFP to mark different cell types. It will also involve using recombination techniques to alter gene expression in defined sets of cells to see how neighbouring cells respond.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: LEES
Available as a group project: n/a
Pre-requisite/s: Biology background
Supervisor: A/Prof Marcus Heisler
Supervisor email: marcus.heisler@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/marcus.heisler.php

Soles

Project: (SOLES30) Investigating cell-cell communication in coordinating cell polarity in plants

This project aims to understand how cells know which direction to orient their growth and internal organelles so that tissues can grow in a coordinated manner. It will involve live-imaging using confocal microscopy as well as recombination techniques that enable changes in gene expression down to the single cell level. These techniques allow us to interrogate cell-cell communication to understand how cells coordinate and ultimately how plants generate their shapes and symmetries.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: LEES
Available as a group project: n/a
Pre-requisite/s: Biology background, not afraid of bees, not allergic to bees
Supervisor: A/Prof Marcus Heisler
Supervisor email: marcus.heisler@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/marcus.heisler.php

Soles

Project: (SOLES31) Determining demographic patterns of corals in NSW

Did you know there are corals in Sydney Harbour? Corals are abundant on many rocky reefs in NSW and this project aims to understand their ecology. You will work with underwater photographs to help understand the demographic strategies by which corals persist at their southern range limits.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown, Edgeworth David Building
Available as a group project: no
Pre-requisite/s: Biology background, attention to detail
Supervisor: Dr Brigitte Sommer
Supervisor email: brigitte.sommer@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/brigitte.sommer.php

Soles

Project: (SOLES32) Ecological dynamics on subtropical reefs

Subtropical rocky reefs of NSW are home to corals at their southern range limits and are already experiencing the effects of climate change. You will learn how to identify corals and other marine species from underwater photographs and determine spatial and temporal patterns in seafloor communities. This will help understand the ecology of these dynamic systems that are already being transformed by changes in species distributions and interactions in response to warming.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown, Edgeworth David Building
Available as a group project: no
Pre-requisite/s: Biology background, attention to detail
Supervisor: Dr Brigitte Sommer
Supervisor email: brigitte.sommer@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/brigitte.sommer.php

Soles

Project: (SOLES33) Cherry ripe. Growing cherries with digital agriculture

Everyone loves cherries for Christmas. You will learn digital agricuture skills such as GPS, drones, yield mapping, soil mapping and horticulture crop agronomy in a cherry orchard at Mudgee. Knowledge of the specific tree location, yield (and fruit size), soil of individual cherry trees will enable farmers to connect with consumers from paddock to plate with sustainability data.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks
Location of Project: Mudgee Farm and ATP Sydney.
Available as a group project: yes
Pre-requisite/s: prepared to work outdoors in the field in Mudgee, NSW. Accomodation can be arranged
Supervisor: A/Prof Guy Roth
Supervisor email: guy.roth@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/guy.roth.php

Soles

Project: (SOLES34) Using eDNA to assess public health risks associated with mosquitoes in urban wetlands

Wetlands built in urban areas to manage stormwater are also incredibly valuable food and habitat resources for many urban animals. Balancing these wetland values against potential mosquito risks presented by the wetlands is a challenging issue for environmental managers and scientists. In this project, we will use cutting-edge eDNA technology to evaluate the potential mosquito risks presented by a set of urban wetlands, how these risks may vary under different management regimes, and if these risks are adequately captured using traditional sampling techniques. You will learn how to collect water samples for eDNA analyses, conduct traditional mosquito sampling surveys, mosquito identification and learn about urban wetland ecology.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD/field/SOP/Westmead (but TBD)
Available as a group project: yes
Pre-requisite/s: biology background, working in field
Supervisor: a/Prof Dieter Hochuli
Supervisor email: dieter.hochuli@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/dieter.hochuli.php

Soles

Project: (SOLES35) How do elevated mutation rates affect protein structure in insect endosymbionts?

Most insect species are infected by intracellular endosymbiotic microbes that strongly influence their biology. Our lab has recently discovered endosymbiotic Blattabacterium species in cockroaches which have particularly high mutation rates and high rates of amino acid change in their proteins. This project will investigate use online tools to investigate how protein structure is affected by these increases.

Research period: Nov-Dec
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown, Edgeworth David Building
Available as a group project: no
Pre-requisite/s: Biology background, with interest in biochemistry
Supervisor: Prof Nate Lo
Supervisor email: nathan.lo@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/nathan.lo.php

Soles

Project: (SOLES36) Effects of dietary glucose, fructose and fat intake on insulin, nutrient and inflammatory signalling.

The global epidemic of obesity and diabetes has been linked to increased consumption of 'western diets' containing an abundance of processed foods rich in fat and 'simple carbohydrates'. Starch (a polysaccharide of glucose monomers) and sucrose (a disaccharide of fructose and glucose) are the two major carbohydrates in our diet. We aim to investigate how glucose, fructose and fat intake affects insulin, nutrient and inflammatory signalling in the adipose tissue and skeletal muscle. This will involve using adipose and muscle tissues harvested from mice maintained on diets with various ratios of fat, glucose and fructose and studying the expression of candidate genes associated with insulin signalling, lipogenesis, lipid oxidation and inflammatory cytokines.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Charles Perkins Centre
Available as a group project: no
Pre-requisite/s: Biology background, with interest in biochemistry
Supervisor: Dr Jibran Wali
Supervisor email: jibran.wali@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/jibran.wali.php

Soles

Project: (SOLES37) Understanding how diet and the gut bacteria (microbiome) modulate the immune system

Diet has a profound influence on our immune system. This may be in part mediated by changes to gut microbiota composition and function. Gut bacteria can produce extracellular vesicles, short-chain fatty acids (from the fermentation of dietary fiber) and other metabolites such as succinate to alter host physiology. This project will investigate the mechanism of how these gut microbial-derived products modulate the immune system.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Charles Perkins Centre
Available as a group project: no
Pre-requisite/s: Biology background
Supervisor: Dr Jibran Wali
Supervisor email: jibran.wali@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/jibran.wali.php

Soles

Project: (SOLES38) Exploring subtropical reef tractories though time from 3D models

The mid north coast of NSW represents a tropical-temperate transition zone where typically rocky temperate reefs are covered in corals. These sub-tropical regions represent potential refgia for the effects of climate. This project will use 3D models of the reef from 2016 and 2019 to evalute changes in reef structure and coral demographics.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown/Edgeworth David Building
Available as a group project: no
Pre-requisite/s: Biology background, attention to detail
Supervisor: Associate Professor Will Figueira
Supervisor email: will.figueira@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/will.figueira.php

Soles

Project: (SOLES39) Assessing spatial variation in patterns of coral growth using innovative tools

Coral growth forms can vary along environmental gradients and this has ramifications for their ecology. This project will use innovative 3D modelling and comparison tools to evaluate changes in the 3D structure of coral taxa across a range of latitudinal and reef shelf gradients. The participant will learn how to build and compare 3D models as well as participate in novel data extraction. There may be the opportunity to particiapte in local, snorkel based field-work to refine methodologies.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: USYD Camperdown, Edgeworth David Building
Available as a group project: no
Pre-requisite/s: Biology background, attention to detail
Supervisor: Associate Professor Will Figueira
Supervisor email: will.figueira@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/will.figueira.php

Soles

Project: (SOLES40) Skynet for weeds: rise of the machine learning for weed classification and control

The prospective student will employ python-based (e.g. tensorflow, pytorch, keras) machine learning frameworks for the detection and site-specific control of summer weeds in fallow and crop. This will invole planting and managing plots of summer crops/weeds for the development of a training image dataset used in training and testing machine learning algorithms. Summer weeds could include barnyard grass, feathertop rhodes, sowthistle and fleabane in sorghum and mungbean. Efficacy, accuracy and robustness of the algorithm will be tested through an available targeting platform using site-specific spraying. A report will be written on the process and outcome of weeds classification, with opportunities for publication.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Narrabri Campus, Camperdown
Available as a group project: yes
Pre-requisite/s: Engineering/Computer Science background. Intermediate-advanced Python required
Supervisor: Research Associate Caleb Squires
Supervisor email: caleb.squires@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/caleb.squires.php

Soles

Project: (SOLES41) Understanding crop - weed interactions under changing climate

Changes in the atmospheric CO2 levels have important consequences for the crop - weed interactions that are likely to vary by crop and weed type. Differential responses of C3 / C4 crops and weeds to CO2 enrichment are reported. This study will investigate the effect of elevated CO2 on competitive interaction of a C3 crop (mungbean) and C4 weed (awnless barnyard grass). The growth and photosynthetic responses of crop and weed to elevated conditions will be evaluated when grown with or without competition scenarios.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Narrabri Campus
Available as a group project: yes
Pre-requisite/s: Plant biology background
Supervisor: Research Associate Asad Shabbir
Supervisor email: asad.shabbir@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/asad.shabbir.php

Soles

Project: (SOLES42) Cover crops for sustainable agro-systems in northern cropping region

Cover crops are implemented between two main crops and are known to provide various benefits in agro-ecosystems, such as protection against soil erosion, soil moisture conservation, improvement of soil quality, and the reduction of weeds, especially during fallows. Soil stored moisture during the summer fallow period is critical for the planting of winter crops in the northern grain region of Australia. This project will examine the ability of potential cover crop species to produce rapid biomass and soil surface coverage as well as their effect on soil moisture conservation during a summer fallow period in the region.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Narrabri Campus
Available as a group project: yes
Pre-requisite/s: Plant biology background
Supervisor: Research Associate Asad Shabbir
Supervisor email: asad.shabbir@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/asad.shabbir.php

Soles

Project: (SOLES43) Ginger Snaps: Image-based robotic weed control for ginger production systems

Weed control in ginger is a costly problem for growers due to heavy reliance on manual labour. This project will use python-based (e.g. OpenCV, tensorflow, pytorch, keras) image processing/machine learning frameworks for the detection of nutgrass in ginger. There will be opportunities to develop site-specific herbicide delivery hardware mounted on an existing autonomous platform.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Narrabri Campus
Available as a group project: yes
Pre-requisite/s: Engineering/Computer Science background. Intermediate-advanced Python required
Supervisor: Guy Coleman
Supervisor email: guy.coleman@sydney.edu.au
Supervisor Research Profile URL: http://sydney.edu.au/science/people/guy.coleman.php

Soles

Project: (SOLES44) Improving yields during drought; Metabolic biomarker discovery in chickpea.

Metabolic biomarkers are routinely used in medicine to diagnose but they are never used in crop plants. In this project, samples taken from different crop varieties at a range of time-points will be screened for the presence of metabolic biomarkers using biochemical techniques. The time-point with the highest correlation between trait (yield) and the markers will be used in the following growing season to screen new varieties to allow drought tolerant lines to be identified more quickly.

Research period: Nov-Dec OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus
Available as a group project: no
Pre-requisite/s: Plant Biology, Biochemistry an advantage. Must be able to use a pipette.
Supervisor: Dr Sarah Purdy
Supervisor email: sarah.purdy@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/sarah.purdy.php

Soles

Project: (SOLES45) The quest for a more bountiful chickpea.

We have discovered a number of metabolites that are associated with increased pea size in chickpea. However, it is unknown whether these relationships are causal, i.e would applying these metabolites to the crop increase the grain size and ultimately the yield for farmers? Would you like to find out by supplying them to the plants in soil and glasshouse experiments and then measuring the grain yield? If yes, apply for this project!

Research period: Nov-Dec OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus
Available as a group project: no
Pre-requisite/s: Plant Biology, Biochemistry an advantage. Must be able to use a pipette.
Supervisor: Dr Sarah Purdy
Supervisor email: sarah.purdy@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/sarah.purdy.php

Soles

Project: (SOLES46) Role of light intensity on biomass partitioning in chickpea

Chickpea varieties display different growth responses to high and low light intensities. The aim of this project is to determine the time when the plants perceive the signal.

Research period: Jan-Feb

Research contact hours: 35 h/week for 6 weeks

Location of Project: Narrabri Campus (glasshouse)

Available as a group project: yes

Pre-requisite/s: 1st year biology and an interest in plant biology or sustainable agriculture

Supervisor: Dr Helen Bramley

Supervisor email: helen.bramley@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES47) Wilting points as a predictor of drought tolerance in wheat and chickpea

When leaves dehydrate under drought, bulk leaf turgor pressure decreases. The turgor loss point (also called permanent wilting point) is the leaf water potential when turgor is zero. At this point, many metabolic and physiological processes are impaired. Drought tolerance across ecological gradients has been associated with lower wilting points. This project will investigate whether there is genetic variation in wilting points of chickpea varieties and if it is related to their drought tolerance.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus (glasshouse)
Available as a group project: no
Pre-requisite/s: 1st year biology and an interest in plant biology or sustainable agriculture
Supervisor: Dr Helen Bramley
Supervisor email: helen.bramley@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES48) Heat stress in wheat

Wheat crops in Australia often experience high temperatures during their reproductive and grain filling stages, which causes major yield losses. This project will examine whether the yield in wheat genotypes that vary in their tolerance to high temperature is related to their ability to store and remobilise water soluble carbohydrates during the grain filling stage.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus (lab)
Available as a group project: no
Pre-requisite/s: 1st year biology and an interest in plant biology or sustainable agriculture
Supervisor: Dr Helen Bramley
Supervisor email: helen.bramley@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES49) Recycling transpired water using nanotechnology to improve water use efficiency

Most of the water taken up by a plant is "lost" to the atmosphere through transpiration as a consequence of the plant needing to open stomata to facilitate diffusion of CO2 into the leaf for photosynthesis. If we could capture and reuse even a modest 10% of that transpired water for irrigation, it would have major economic savings for the agricultural industry. This project will use modelling and experimentation to determine the impact of a new nanotechnology (in collaboration with the Sydney Nano Institute) that collects moisture from the air on plant physiology and the water cycle.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus (glasshouse) and ATP
Available as a group project: yes
Pre-requisite/s: 1st year biology, plant physiology an advantage
Supervisor: Dr Helen Bramley
Supervisor email: helen.bramley@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES50) Role of light intensity on chickpeas response to terminal drought

Chickpea varieties display different growth responses to high and low light intensities, which impacts their root growth. Smaller root systems may influence their ability to take up water from the soil under terminal drought and ultimately affect yield. This project will test this hypothesis using a novel lysimeter system and using shade to impact root growth.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus (glasshouse)
Available as a group project: yes
Pre-requisite/s: 1st year biology, plant physiology an advantage
Supervisor: Dr Helen Bramley
Supervisor email: helen.bramley@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES51) Plasma crops

Treatment of seeds with cold activated plasma can stimulate earlier and better germination rates. This project aims to determine what processes are involved and whether this early effect also improves later growth and productivity.

Research period: Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Narrabri Campus (glasshouse), Camden and Camperdown
Available as a group project: yes
Pre-requisite/s: 1st year biology and an interest in plant biology or sustainable agriculture
Supervisor: Dr Helen Bramley
Supervisor email: helen.bramley@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/helen.bramley.php

Soles

Project: (SOLES52) Wild worm hunting

Caenorhabditis elegans is a widely used model organism that has been isolated worldwide. Curiously, it has never been found in or near Sydney: this probably is due to a lack of sampling rather than indicative of absence. This project will attempt to be the first to find a Sydney isolate of this important model organism.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Alyson Ashe
Supervisor email: alyson.ashe@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alyson.ashe.php

Soles

Project: (SOLES53) Detecting RNA travelling between generations

Epigenetic inheritance is the exciting idea that signal mediated by the environment can be passed from parent to offspring. This project will use novel techniques to label RNA to determine whether it is the mediator of epigenetic inheritance.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Biochemistry background
Supervisor: Dr Alyson Ashe
Supervisor email: alyson.ashe@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alyson.ashe.php

Soles

Project: (SOLES54) Mechanisms of epigenetic inheritance

Epigenetic inheritance is the exciting idea that signal mediated by the environment can be passed from parent to offspring. This project will use confocal microscopy and DNA fluoresence in situ hybridisation to determine whether DNA position in the nucleus is important in this information transfer.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Biochemistry background
Supervisor: Dr Alyson Ashe
Supervisor email: alyson.ashe@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/alyson.ashe.php

Soles

Project: (SOLES55) Developing a novel class of antibiotics using fragment-based drug design

Antibiotic resistance is an increasing problem globally and in this project you will participate in developing a new class of broad spectrum antiobiotics by targeting a never exploited interactions in a bacterial protein:RNA complex using a range of techniques from structural biology to whole cell assays.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks

Location of Project: Camperdown Campus

Available as a group project: yes

Pre-requisite/s: Biochemistry or chemistry or biomedical engineering background

Supervisor: Dr Ann Kwan

Supervisor email: ann.kwan@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/ann.kwan.php

Soles

Project: (SOLES56) Engineering of hydrophobin proteins for coating bone scaffold

Hydrophobins are fungal proteins that can naturally self-assemble and coat structures and reverse their wettability. In this project, you will be engineering hydrophobins that can promote the adhesion and growth of osteoblasts in PEEK bone implants in collaboration with researchers at the Chris O'brien Lifehouse.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks
Location of Project: Camperdown Campus
Available as a group project: no
Pre-requisite/s: Biochemistry or chemistry or pharmacology background
Supervisor: Dr Ann Kwan
Supervisor email: ann.kwan@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/ann.kwan.php

Soles

Project: (SOLES57) CRISPR-based chromosomal engineering

Complexity and novelty in plants can arise slowly through the accumulation of small genetic changes or more rapidly through large scale chromosomal rearrangements and whole-genome duplications. CRISPR/Cas has given us the opportunity to engineer chromosomal rearrangements, with the potential of creating novel species. This project uses CRISPR-based molecular genetics to engineer chromosomal rearrangements and genetic novelty in tomato.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or Three days per week for 10 weeks.
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Biology or molecular biology background
Supervisor: A/Prof Brian Jones
Supervisor email: brian.jones@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/brian.jones.php

Soles

Project: (SOLES58) Plant stem cell transformation

Plant stem cell niches exist to produce the new cells required for continued growth. This project uses cutting edge nanotechnologies and CRISPR to directly modify plant stem cells. The project combines molecular biology and nanotechnology to modify the growth and environmental responses of legumes.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or Three days per week for 10 weeks.
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Biology or molecular biology background
Supervisor: A/Prof Brian Jones
Supervisor email: brian.jones@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/brian.jones.php

Soles

Project: (SOLES59) Gene editing to modify the flavour of edible mushrooms

Non-browning button mushrooms (Agaricus bisporus) were the first gene edited food targeted for the US market. This project uses a similar gene editing approach to alter flavor compounds in button mushrooms.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb

Research contact hours: 35 h/week for 6 weeks or Three days per week for 10 weeks.

Location of Project: Camperdown Campus

Available as a group project: yes

Pre-requisite/s: Biology or molecular biology background

Supervisor: A/Prof Brian Jones

Supervisor email: brian.jones@sydney.edu.au

Supervisor Research Profile URL: https://sydney.edu.au/science/people/brian.jones.php

Soles

Project: (SOLES60) Beyond Meat: the attitudes of young people to genetically modified food

Beyond Meat is a plant protein-based meat substitute that is rapidly gaining popularity. The company makes a point of publicizing that they use genetically modified yeast to produce a plant-based blood substitute in their burgers. They weigh this against their environmental and animal welfare claims. This project involves administering a questionnaire to determine the strategies young people use to make decisions about complex food choices. The student/s will run the questionnaire and analyse and prepare the results for publication.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks or Three days per week for 10 weeks.
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Biology or molecular biology background
Supervisor: A/Prof Brian Jones
Supervisor email: brian.jones@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/brian.jones.php

Soles

Project: (SOLES61) Scavenger interactions and dynamics across Australia

This project will assess vertebrate scavenger (dingo, eagle, fox, cat, ravens etc) presence and interactions around kangaroo carcasses based on two years of camera trap data collected from three biomes in Australia (Alpine, Desert, Forest). Individuals or groups will record the scavengers, and then determine how different scavengers affect ecosystem processes around carcasses.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: Camperdown Campus
Available as a group project: yes
Pre-requisite/s: Biology background
Supervisor: Dr Thomas Newsome
Supervisor email: thomas.newsome@sydney.edu.au
Supervisor Research Profile URL: https://thomasnewsome.com

Soles

Project: (SOLES62) App Development for Fungal Diagnostics

The student will design and test an app for mobile platforms. This app will be tied with the diagnostic device we are creating to survey rust fungus in crops like wheat. It will provide a means for end users to submit results and for us to share information and provide feedback.

Research period: Nov-Dec OR Dec-Jan OR Jan-Feb
Research contact hours: 35 h/week for 6 weeks (flexibly distributed)
Location of Project: ATP or LEES (depends on move)
Available as a group project: yes
Pre-requisite/s: At least one team member must have prior app development experience. All team members must have coding experience.
Supervisor: Dr Priyanka Surana
Supervisor email: priyanka.surana@sydney.edu.au
Supervisor Research Profile URL: https://sydney.edu.au/science/people/priyanka.surana.php