SCIENCE SUMMER RESEARCH PROGRAM PROJECTS 2021-22

FOR DENISON RESEARCH SCHOLARSHIP

For more information about the 2021-2022 Science Summer Research program, please visit: https://www.sydney.edu.au/science/study/scholarships.html#summer

For more information about the Denison Research Scholarship, please visit: https://www.sydney.edu.au/science/study/scholarships.html

University guidelines regarding COVID safety

- For your safety and the safety of our community, and in line with current COVID-19 safety precautions, Conditions of Entry, exam advice and study information, we expect applicants who apply for a project with an on-campus component to be fully vaccinated before coming to campus. Those students who come to campus must follow the COVID-19 safety precautions, strict conditions of entry, and any project specific COVID-safe plans. Please note that some campus locations require vaccination and screening prior to entry.

- Availability of project specific COVID-safe plans is indicated in the entry for each project. These can be made available to successful applicants, on request. Any questions can be directed to project supervisors.

Click on the School to go straight to their projects

SCHOOL OF CHEMISTRY

CHEM01: ELECTROSTATIC SWITCHING OF MEMBRANE PROTEINS

Many animal membrane proteins, both peripheral and integral, interact with the cytoplasmic surface of the plasma cell membrane. As part of their regulation, trafficking or activity this interaction appears to be modified by an electrostatic switch mechanism, whereby the charge on either the protein segment involved in the interaction or on the membrane surface is modified. The aim of this study is to investigate how widespread this phenomenon is and to identify protein in which it is operative.

Primary Supervisor: A/Prof. Ronald James Clarke
https://www.sydney.edu.au/science/about/our-people/academic-staff/ronald-clarke.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ronald.clarke@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: Staff present on campus to deliver the project remotely to students

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM02: FLUORESCENT SENSORS FOR NEURODEGENERATIVE DISEASES

Neurodegenerative diseases like Alzheimer's and Parkinson's are associated with many chemical changes. In this project, you will develop new fluorescent sensors that will allow us to better understand these chemical changes, and identify new drug strategies. The project will involve organic synthesis and spectroscopy studies, with the opportunity to observe biological studies.

Primary Supervisor: Prof. Liz New
https://www.sydney.edu.au/science/about/our-people/academic-staff/elizabeth-new.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Second-year chemistry

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: elizabeth.new@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Laboratory and office space will be allocated according to physical distancing requirements.

SCHOOL OF CHEMISTRY

CHEM03: EXOBIOLOGY BEYOND THE GOLDILOCKS ZONE

The search for extraterrestrial life is often equated to the search for liquid water - the so-called 'Goldilocks zone.' In this project we will explore which of the necessary conditions for life to emerge can be met in exotic environments beyond the stability range of liquid water.

Primary Supervisor: Prof. Greg Warr
https://www.sydney.edu.au/science/about/our-people/academic-staff/gregory-warr.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year chemistry

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: gregory.warr@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: School of Chemistry and University COVID safety protocols will be followed while on campus.

SCHOOL OF CHEMISTRY

CHEM04: SUPRAMOLECULAR IONOGELS

Intermolecular forces such as H-bonds can be used to assemble small molecules into elongated, entangled fibres that can create gels in water. In this project we will adapt these principles to gel molten salts. These unusual liquids are constituted solely of ions, and are finding many novel applications as environmentally-friendly electrolytes and reaction media.

Primary Supervisor: Prof. Greg Warr

https://www.sydney.edu.au/science/about/our-people/academic-staff/gregory-warr.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year chemistry

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: gregory.warr@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF CHEMISTRY

CHEM05: 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.

Primary Supervisor: Dr. Stephen George-Williams
https://www.sydney.edu.au/science/about/our-people/academic-staff/stephen-george-williams.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: CHEM1011/1111/1911/1991 and CHEM1012/1112/1912/1992

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: stephen.george-williams@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM06: ONLINE VS PAPER-BASED EXAMS: EXPLORING THE IMPACT OF DELIVERY MODE ON QUESTION DESIGN AND STUDENT PERFORMANCE

In 2020, Universities world-wide were forced to teach and assess everything in the online space. While many teaching environments were impacted, end-of-semester examinations remain a challenge for teaching staff due to concerns around question design, academic integrity and technological requirements. In this project, a student will consider how the online CHEM1 examinations undertaken in 2020 compared to those delivered more traditionally in 2019. The student researcher will add to previous work in which question design and composition were investigated. This new project will expand to consider abstract/explicit question design as well as expanding to exams undertaken at Monash University.

Primary Supervisor: Dr. Stephen George-Williams
https://www.sydney.edu.au/science/about/our-people/academic-staff/stephen-george-williams.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 5

Final assessment: Project presentation, 5-10 minutes

For more information, contact: stephen.george-williams@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM07: SYNTHESIS OF FRAGMENT ANALOGUES FOR INHIBITING TELOMERIC CANCER TARGETS

This is a medicinal chemistry project focused on targeting "ALT-positive cancers", an underexplored subtype that is most common in osteosarcomas. In this project, you will synthesise small molecules that are analogues of chemical hits discovered in a fragment-based screen against the FANCM-BTR target in ALT cancers, with the potential opportunity to conduct in vitro assays to assay their therapeutic potential.

Primary Supervisor: Dr. Yu Heng Lau
https://www.sydney.edu.au/science/about/our-people/academic-staff/yuheng-lau.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Preferable to have at least second-year level knowledge of core/organic chemistry, with hands on lab experience if possible

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: yuheng.lau@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Chemistry has local regulations regarding COVID-safe practices. Although they are evolving over time, the current requirements are for approved personnel (<50% occupancy, taking into account room occupancy limits) with a buddy system to avoid lone working (the in-lab project supervisor for Denison, typically a postdoc or senior PhD). Masks should be worn, time spent in communal offices should be kept to a minimum. All individuals are extremely strongly encouraged to be vaccinated.

SCHOOL OF CHEMISTRY

CHEM08: EVOLUTIONARY EXPLORATION OF FLAVIN-BINDING PROTEIN CAGES

This project involves the study of encapsulins, filled cages made from protein/peptide building blocks that self-assemble spontaneously, that often act in nature as catalytic cages that can mimic organelles. In this project, you will recombinantly express and characterise the redox chemistry of encapsulin protein cages derived from different microorganisms, all of which have been predicted to have interesting flavin-binding functions based on studies of their evolutionary relationships.

Primary Supervisor: Dr. Yu Heng Lau
https://www.sydney.edu.au/science/about/our-people/academic-staff/yuheng-lau.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Preferable for student to have at least second-year level of biological chemistry, molecular biology or microbiology knowledge, with lab experience if possible

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: yuheng.lau@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Chemistry has local regulations regarding COVID-safe practices. Although they are evolving over time, the current requirements are for approved personnel (<50% occupancy, taking into account room occupancy limits) with a buddy system to avoid lone working (the in-lab project supervisor for Denison, typically a postdoc or senior PhD). Masks should be worn, time spent in communal offices should be kept to a minimum. All individuals are extremely strongly encouraged to be vaccinated.

SCHOOL OF CHEMISTRY

CHEM09: HALOGEN-BONDED SELF-ASSEMBLED MONOLAYERS

Our group has recently discovered a new family of self-assembled monolayers that can be formed on silicon and other oxide substrates, through halogen bonding, an intermolecular interaction less known but similar to hydrogen bonding. The self-assembled monolayer effectively turns the surface properties of glass into those of teflon, with very little effort. This discovery has opened the way to investigating a mechanism that is little studied in the surface science literature. We have so far established the conditions of formation, stability and uniformity of these monolayers and we have just uncovered an important application: the monolayers have the ability to alter the work function of semiconductors, which could lead to more efficient photovoltaic cells. In this project the Denison scholar will fabricate monolayers using iodoperfluoroalkanes self-assembled on solid substrates. The project will combine experimental procedures already established in the lab to produce new self-assembled monolayers which have attractive surface and electronic properties.

Primary Supervisor: Prof. Chiara Neto
https://neto.sydney.edu.au/

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Interest in experimental work relating to surface science and nanoscience

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: chiara.neto@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: COVID procedures decided by the Faculty and the School must be observed.

SCHOOL OF CHEMISTRY

CHEM10: SURFACES FOR ATMOSPHERIC WATER CAPTURE

We study polymer surfaces that collect water from the atmosphere through condensation of vapour. The Denison project focuses on relating how surface energy (chemical composition) and structure (topography, roughness) of these coatings affects the efficiency of water collection, in a controlled environmental chamber which has been custom-built in the Neto labs. In this project the Denison scholar will combine experimental procedures already established in the group to investigates surface properties that determine droplet nucleation, coalescence and roll-off for water capture applications.

Primary Supervisor: Prof. Chiara Neto
https://neto.sydney.edu.au

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Interest in experimental work relating to surface science and nanoscience

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: chiara.neto@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: COVID procedures decided by the Faculty and the School must be observed.

SCHOOL OF CHEMISTRY

CHEM11: DEVICE SIMULATION OF ORGANIC SOLAR CELLS

Conjugated organic materials offer solution processible, flexible and non-toxic alternatives to silicon and lead halide perovskites for solar cells. State-of-the-art organic solar cell efficiencies have now reached > 17%. Increasing these efficiencies further require a better understanding of their device operation, in particular charge recombination. Photogenerated free charges in organic solar cells must be transported to the respective electrodes before they can recombine resulting in a loss of current. Recently, several research groups have demonstrated that spin of free charges can influence the rate of charge recombination. In this project, you will simulate device operation of organic solar cells with an aim to better understand the role of spin in charge recombination and find strategies to improve device efficiency and stability.

Primary Supervisor: A/Prof. Girish Lakhwani
https://www.sydney.edu.au/science/about/our-people/academic-staff/girish-lakhwani.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: CHEM1111/1911 and CHEM2521/2921

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: girish.lakhwani@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Regular protocols on social distancing and use of masks as mandated by the School

SCHOOL OF CHEMISTRY

CHEM12: COMPUTER SIMULATION OF NEXT-GENERATION SOLAR CELLS

You will learn how to program computer simulations of the fundamental processes that underpin organic electronic devices and solar cells. How these devices function is still incompletely understood, and your code will help explain and improve them.

Primary Supervisor: Prof. Ivan Kassal

https://www.kassal.group

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Some computer programming experience would be helpful

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: ivan.kassal@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM13: CARBON CAPTURE VIA BURIAL OF PYROLYZED PLANT MATERIAL: FEASIBILITY

Complementary to the switch to carbon neutral energy sources, the capture and sequestration of atmospheric carbon can contribute significantly to reducing the concentration of atmospheric CO2. A simple strategy for carbon capture and sequestration is to use rapidly growing plants to capture carbon, then pyrolyze them to reduce their non-carbon content and then bury the compacted residue, ideally in old mines. The aim of this project is to establish whether this is a feasible scheme. The project will involve collecting data on all the relevant aspects of the scheme: growth rate of possible plant species, efficiency of pyrolysis in removing non-carbon content, storage capacity of non-functioning mines, etc and preparing a report on the potential capacity of the scheme.

Primary Supervisor: Prof. Peter Harrowell
https://www.sydney.edu.au/science/about/our-people/academic-staff/peter-harrowell.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 17 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: peter.harrowell@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: Staff present on campus to deliver the project remotely to students

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM14: A ROUTE TO MORE EFFICIENT CATALYSTS

Catalysts are regularly used to speed up chemical reactions, or to make the reactions work. While extremely important, the efficiencies of many of the currently available catalysts still need significant improvements. This project targets the development of a new class of cutting-edge catalysts that contain two rhodium metals within their core, allowing us to access substantially faster catalysts than the ones presently available. The project involves catalyst design, synthesis, including air- and moisture free synthesis, a number of analytical characterization techniques, and a catalytic investigation.

Primary Supervisor: Dr. Indrek Pernik
https://www.sydney.edu.au/science/about/our-people/academic-staff/indrek-pernik.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: indrek.pernik@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: The students and the supervisor will need to follow the up-to-date COVID rules and advice provided by the University of Sydney, the Faculty of Science and the School of Chemistry. In particular, this means that the project timeframe needs to be carefully planned to avoid any unnecessary contact with other people in the building, and to ensure that the different parts of the project can be carried out without limitations arising from the maximum number of people allowed in different areas of F11.

SCHOOL OF CHEMISTRY

CHEM15: ACCESSING RECYCLABLE CATALYSTS

The development of fast catalysts for challenging chemical transformations is a very active field of research. However, many successful catalysts rely on expensive and toxic transition metals, and once used, it is challenging to recover the catalysts from the reaction mixture and use them again. Strategies exist where catalysts are attached to insoluble surfaces allowing for filtration of the catalyst at the end of the reaction, however these catalysts are often less active than their soluble analogues. This project investigates the strategies for improving the activity of these insoluble catalysts to access recyclable catalysts that retain their high catalytic activity. The project involves catalyst design, synthesis, including air- and moisture free synthesis, a number of analytical characterization techniques, surface chemistry and a catalytic investigation.

Primary Supervisor: Dr. Indrek Pernik
https://www.sydney.edu.au/science/about/our-people/academic-staff/indrek-pernik.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: indrek.pernik@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: The students and the supervisor will need to follow the up-to-date COVID rules and advice provided by the University of Sydney, the Faculty of Science and the School of Chemistry. In particular, this means that the project timeframe needs to be carefully planned to avoid any unnecessary contact with other people in the building, and to ensure that the different parts of the project can be carried out without limitations arising from the maximum number of people allowed in different areas of F11.

SCHOOL OF CHEMISTRY

CHEM16: ATMOSPHERIC CHEMISTRY (THEORY)

This project involves computational investigation and/or simulation of novel atmospheric chemical reactions. We have identified a new class of reaction that may occur in a number of important atmospheric molecules and may have significant atmospheric consequences. In this theoretical project, depending on your background and interests, you may use quantum chemistry to study this reaction mechanism, use dynamical simulations to assess how it may occur, do computational modelling to predict the outcome of laboratory experiments, or do global atmospheric modelling to assess the global importance of the mechanism, for a given molecule.

Primary Supervisor: Prof. Meredith Jordan
https://www.sydney.edu.au/science/about/our-people/academic-staff/meredith-jordan.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: meredith.jordan@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM17: QUANTUM THERMODYNAMICS

Quantum effects are important in many chemical applications and need to be included if we are to accurately predict physical and chemical properties and/or rationally design new materials. Feynman's path integral formalism, which is based on the isomorphism between the quantum time-dependent propagator and the thermal density matrix, allows fully quantum thermodynamic parameters to be calculated. This project applies path integral techniques to determine quantum internal energies for molecules that can be incorporated into extremely accurate thermochemical calculations.

Primary Supervisor: Prof. Meredith Jordan
https://www.sydney.edu.au/science/about/our-people/academic-staff/meredith-jordan.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: meredith.jordan@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF CHEMISTRY

CHEM18: TARGETED DRUG DELIVERY IN THE BRAIN USING DNA COMPUTATION

In the past several years, high-throughput neuroscience methods have yielded a comprehensive blueprint of the entire brain. Recently, we have been using machine learning to analyse this whole-brain neuroscience data, to determine patterns of molecular signals, such as mRNA and protein concentrations, that uniquely identify specific brain areas. These signals represent a molecular 'postcode' of a specific brain location. In this project, the student will design and test DNA systems that will compare local chemical signals to a stored chemical postcode. Ultimately, the aim is for these DNA circuits to be used to guide a nanoparticle drug delivery system to a specific target in the brain.

Primary Supervisor: Dr. Shelley Wickham
https://www.sydney.edu.au/science/about/our-people/academic-staff/shelley-wickham.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: shelley.wickham@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: As per School of Chemistry COVID plan

SCHOOL OF CHEMISTRY

CHEM19: SWITCHABLE DNA NANOMACHINES

DNA nanostructures are a new class of advanced self-assembling materials that can be used as nanoscale "pegboards" to precisely arrange guest molecules such as proteins, nanoparticles, and fluorophores. One of the unique properties that DNA nanostructures can offer is switchability, in which the structure can reversibly transform between different shapes in response to specific triggering stimuli. This property has the potential to be utilised in such applications as responsive materials or self-navigating nanorobots for cancer treatments. In this project, students will design, synthesise, and validate switchable DNA nanostructures with an eye towards to achieve more efficient and complex structural transitions. Students will have opportunities to use state-of-the-art techniques including DNA origami, transmission electron microscopy and super-resolution fluorescent microscopy with DNA-PAINT.

Primary Supervisor: Dr. Shelley Wickham
https://www.sydney.edu.au/science/about/our-people/academic-staff/shelley-wickham.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: shelley.wickham@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF CHEMISTRY

CHEM20: ROLLING NANOBOTS ON MOLECULAR OBSTACLE COURSES

Cells and viruses often move around by rolling on biological surfaces, a type of motility that is facilitated by weak interactions with surface-bound ligands. Building synthetic systems with this type of motility can teach us more about how biological systems work and can lead us to new bio-nanotechnological discoveries (eg. Nano Lett. 2019, 19(12), 9138). Using our expertise in DNA nanotechnology, surface functionalisation and microscopy this project will focus on building DNA-based nanobots that roll on surfaces patterned with tiny obstacle courses, allowing us to answer fundamental questions about biology with a view towards molecular medicines.

Primary Supervisor: Dr. Shelley Wickham
https://www.sydney.edu.au/science/about/our-people/academic-staff/shelley-wickham.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: shelley.wickham@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF CHEMISTRY

CHEM21: FURAZAN-BASED ANION TRANSPORTERS AS POTENTIAL ANTI-CANCER AGENTS

This project involves the development of a novel library of compounds able to shuttle anionic species across cellular membranes. The molecules contain a central furazan scaffold, which possess significant electron-withdrawing properties. This project initially involves synthesis of the series in our organic laboratory. You will then quantify their transport ability and mechanism through mimicked membrane studies, followed by an evaluation of its cytotoxicity against multiple cancer cell lines.

Primary Supervisor: Prof. Philip Gale
https://www.sydney.edu.au/science/about/our-people/academic-staff/philip-gale.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: philip.gale@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: COVID procedures for the school of chemistry will be followed. This includes physical distancing in the office and laboratory.

SCHOOL OF CHEMISTRY

CHEM22: ANION TRANSPORT STUDIES ON A NOVEL SERIES OF FLUORINATED MACROCYCLES

Macrocycles have emerged as a class of molecules ideally suited to facilitate high levels of anion transport due to their convergent interactions with a coordinating anion and the exclusion of solvent molecules form the internal cavity during anion binding. Our collaborators in Denmark have synthesised a novel family of biotin[6]uril macrocycles with appended fluorinated aromatic groups that have potential to be highly effective anion transporters. In this project, you will assess the transport properties of these compounds by studying them in model vesicles. Responsibilities and skills will include vesicle preparation, electrode studies, fluorescence spectroscopy and data processing.

Primary Supervisor: Prof. Philip Gale
https://www.sydney.edu.au/science/about/our-people/academic-staff/philip-gale.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: philip.gale@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: COVID procedures for the school of chemistry will be followed. This includes physical distancing in the office and laboratory.

SCHOOL OF CHEMISTRY

CHEM23: SELF-IMMOLATIVE SURFACTANTS: DEGRADABLE AMPHIPHILES FOR PROTEIN DELIVERY

You will be trained in synthetic organic chemistry to synthesise novel surfactants, and employ spectroscopic techniques (NMR, MS, HPLC, light scattering) to analyse their structures and probe their self-assembly

Primary Supervisor: Dr. Derrick Roberts
https://www.sydney.edu.au/science/about/our-people/academic-staff/derrick-roberts.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: An interest in synthetic organic chemistry, no formal training required (practical training equivalent to CHEM3/Honours-level experience will be provided)

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: derrick.roberts@sydney.edu.au

Additional information for on-campus components

On-campus location: Laboratory 513, F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: The School of Chemistry has a strict COVID COVIDsafe plan thta will be adhered to. Students must wear a mask at all times while inside the School, and regular COVID testing is recommended.

SCHOOL OF CHEMISTRY

CHEM24: ALIPHATIC HYDROGEN BONDED FRAMEWORKS

Porous materials have huge potential in the gas adsorption, gas storage and catalysis fields. hydrogen bonded frameworks and other organic frameworks are a world leading generation of porous materials due to their low density and high storage capacity, further increasing their potential applications. This project will involve the investigation of new hydrogen bonded frameworks and organic frameworks for hydrogen storage as part of our national hydrogen energy strategy. This research will provide students with unique skills and training in organic synthesis, materials characterisation and Australian Synchrotron science, encompassing a broad range of fields in the one project. A major outcome expected from this research is a publication of aliphatic ligands used in hydrogen bonded frameworks and training in commercial outreach and engagement.

Primary Supervisor: Dr. Lauren Macreadie
https://www.sydney.edu.au/science/about/our-people/academic-staff/lauren-macreadie.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: General chemistry analytical techniques: NMR, mass spec (this project is designed to further enhance your learning of previous and new techniques and skills)

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: lauren.macreadie@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students will be able to continue their work from home in the event of a university lock-down or if the student feels uncomfortable going to campus at a particular time. On campus COVID restrictions will be in place (ie. sometimes lab roster rotations) to ensure that minimal contact occurs between colleagues to mitigate any future risk of a COVID spread.

SCHOOL OF CHEMISTRY

CHEM25: CYCLIC PEPTIDE ANTIVIRAL DEVELOPMENT FOR COVID

Novel Antiviral Development for COVID The COVID pandemic caused by infection with the novel coronavirus – SARS-CoV-2 – need little introduction. Within 2 years of the first reported COVID case there have been more than 240 million cases and more than 4 million deaths globally as a result of viral infections. We have developed a cutting-edge peptide display platform to discover large families of cyclic peptides that inhibit viral proteins essential for cell entry and replication of SARS-CoV-2. In this Denison scholarship project you will synthesise cyclic peptide antivirals using modified solid-phase peptide synthesis and assess their activity in biochemical assays. Compounds will also be screened against SARS-CoV-2 (with A/Prof Turville, Kirby Institute).

Primary Supervisor: Prof. Richard Payne
https://payneresearchgroup.com

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Second-year chemistry

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: richard.payne@sydney.edu.au

Additional information for on-campus components

On-campus location: F11 Chemistry Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: students need to wear masks in labs at all times and maintain physical distancing (1.5 m)

SCHOOL OF GEOSCIENCES

GEOS01: SYDNEY FAULT ZONES AND FRACTURE NETWORKS

In an urban environment, faults and fractures pose a range of environmental, engineering and hazard issues that need to be understood to be mitigated. These structures weaken the strength of the geological framework that supports surface and underground infrastructures, and they may be at the origin of seismic activities. In this field-based and/or laboratory-based project you will constrain the structure and geometry of fault and fracture networks in Sydney Metropolitan Area, documenting their geohazard consequences.

Primary Supervisor: Dr. Vasileios Chatzaras
https://www.sydney.edu.au/science/about/our-people/academic-staff/vasileios-chatzaras.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Geology

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: vasileios.chatzaras@sydney.edu.au

Additional information for on-campus components

On-campus location: F09 Madsen Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: The project may have a fieldwork component in Sydney Metropolitan area

SCHOOL OF GEOSCIENCES

GEOS02: LANDFORMS AND BIODIVERSITY

Landforms and biodiversity: Complex landscapes shaped by abiotic geological processes provide the biosphere with a wide range of physical habitats, migratory corridors and shelters, climatic conditions, and access to water, nutrients, and energy. The aim of this project is too map landforms across a range of biodiverse regions to evaluate the morphometric attributes that maximizes biodiversity. This aim of this project is to inform conservation policies to mitigate the collapse of biodiversity.

Primary Supervisor: Dr. Patrice Rey
https://www.sydney.edu.au/science/about/our-people/academic-staff/patrice.rey.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: patrice.rey@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: Staff present on campus to deliver the project remotely to students

Additional COVID-related student requirements: N/A

SCHOOL OF GEOSCIENCES

GEOS03: ECO-MORPHODYNAMICS OF CORAL REEF ISLANDS

Coral reef islands are low-lying coastal features controlled by biological, chemical and physical processes and are increasingly under pressure from climate change threats. This project will analyse aerial and satellite imagery of coral islands and will compare these findings with environmental proxies. The aim is to assess the eco-geomorphological stability and susceptibility of coral reef islands across yearly-decadal timescales. A general knowledge of coastal environments and experience using ArcGIS are required, while basic Python coding is recommended but not essential.

Primary Supervisor: Dr. Thomas Fellowes
https://www.sydney.edu.au/science/about/our-people/academic-staff/thomas-fellowes.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Coastal environments/GIS

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: thomas.fellowes@sydney.edu.au

Additional information for on-campus components

On-campus location: F09 Madsen Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: None - On Campus part is not essential

SCHOOL OF GEOSCIENCES

GEOS04: RURAL CHANGE ON THE NSW FAR NORTH COAST: MAPPING THE EXPANSION OF MACADAMIA FARMS

This project is part of a wider research activity being conducted with the NSW Dept of Primary Industry. It will involve using databases developed by the research team to map and analyse the growth of macadamia production on the NSW Far North coast. If conditions allow, a field visit to the region may be incorporated into the project.

Primary Supervisor: Prof. Bill Pritchard
http://www.geosci.usyd.edu.au/people/st_pritchard.shtml

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Knowledge of ArcGIS software; background in Environmental Studies or Geography

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: bill.pritchard@sydney.edu.au

Additional information for on-campus components

On-campus location: F09 Madsen Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: COVID-safe plan will be in place

SCHOOL OF GEOSCIENCES

GEOS05: WAITING FOR THE BUS IN WESTERN SYDNEY

As Sydney's west continues to heat up, there is an increasingly urgent need to rethink the provision of everyday urban infrastructures. This project will focus on the humble suburban bus stop - mapping the location and proportion of sheltered stops across the western suburbs, and working with community partners to think about the design and implementation of more heat-resilient public transport infrastructure.

Primary Supervisor: A/Prof. Kurt Iveson
https://www.sydney.edu.au/science/about/our-people/academic-staff/kurt-iveson.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Basic GIS skills

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: kurt.iveson@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF HISTORY AND PHILOSOPHY OF SCIENCE

HPSC01: INNOVATIONS IN AUSTRALIAN COMMUNITY MENTAL HEALTH

In Australia, mental hospitals started to discharge long-term patient in the early 1970s because of a new deinstitutionalisation policy. Only later were initiatives undertaken to provide mental health care in the community. In the 1980s, Australia was a world-leader in community mental health. In this research project, we will investigate several innovative initiatives in community mental health, the people who organised them, and the people who benefited from them. Special attention is provided to mental health activists and consumer activists, and they role they played in shaping mental health care.

Primary Supervisor: Prof. Hans Pols
https://www.sydney.edu.au/science/about/our-people/academic-staff/hans-pols.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 10

Final assessment: Project presentation, 5-10 minutes

For more information, contact: hans.pols@sydney.edu.au

Additional information for on-campus components

On-campus location: School of HPS, F07 Carslaw Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF MATHEMATICS AND STATISTICS

MATH01: 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 sensory data to predicting meat eating quality. Examples of possible projects include: the analysis of consumer sensory 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 starting benchmark across consumers; and developing methods to evaluate new objective grading technologies.

Primary Supervisor: Dr. Garth Tarr
https://www.sydney.edu.au/science/about/our-people/academic-staff/garth.tarr.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: DATA2002 or DATA2902

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: garth.tarr@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH02: DATA-INTENSIVE SCIENCE TO UNDERSTAND THE MOLECULAR AETIOLOGY OF DISEASE

Biotechnological advances have made it possible to monitor the expression levels of thousands of genes and proteins simultaneously promising exciting, ground-breaking discoveries in complex diseases. This project will focus on the application and/or development of statistical and machine learning methodology to analyse a high-dimensional biomedical experiment. Our lab works on projects spanning multiple diseases including melanoma, ovarian cancer, acute myeloid leukemia, Alzheimer's disease, multiple sclerosis and HIV. We also work with various high-throughput technologies including single-cell RNA-Seq, SWATH-MS, flow cytometry, CyTOF, CODEX imaging and imaging mass cytometry

Primary Supervisor: Dr. Ellis Patrick
https://www.sydney.edu.au/science/about/our-people/academic-staff/ellis.patrick.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: DATA2X02

Maximum number of places available in project: 4

Final assessment: Project report, 1-2 pages

For more information, contact: ellis.patrick@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH03: POLYNOMIAL METHOD IN ADDITIVE COMBINATORICS - EXTENSION OF CAP SETS PROBLEM TO MORE THAN THREE POINTS

The project with focus on the new polynomial method in (additive) combinatorics which allowed to resolve long standing problems such as Kakeya problem over finite fields, cap set problem and Erdos distance problem. We will study the proof by Croot-Pach-Lev-Ellenberg-Gijswijt-Tao of the sub exponential bound for cap-set problem concerning the maximal cardinality of a set A in F_q^n which does not contain distinct x,y,z satisfying x+y = 2z, or in other words sets which do not contain non-trivial three term arithmetic progressions in vector spaces over a finite field. We will also study the work of Lovett on lower bounds of a slice rank of a tensor. Achieving a good lower bound on the latter allowed to resolve the CAP-set problem. The ultimate goal will be to extend the polynomial method to resolve the following conjecture: Show that a set A in F_q^n which does not contain a non-trivial 4-term arithmetic progression is exponentially small in size with respect to q^n (the size of F_q^n).

Primary Supervisor: A/Prof. Alexander Fish
https://www.sydney.edu.au/science/about/our-people/academic-staff/alexander.fish.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Linear Algebra, some sort of abstract algebra (a weak requirement), this project is suitable for students with a minimal background (after year 1)

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: alexander.fish@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH04: SUM-PRODUCT PHENOMENON FOR INFINITE SETS

Erdos and Szemeredi proved that there exists \eps > 0 such that for any finite set A in the integers we have |A+A| or |AA| is O(|A|^{1+\eps}) (for instance, the number of different results in the multiplication table is much bigger than the number of different results in the addition table). We will study the following analog of this result to infinite sets in the integers - namely, if A is a set of integers of positive density then there exists k >=1 such that (A-A)*(A-A) contains k\Z. The ultimate goal is to prove its two-dimensional analogue: Assume that a set E in the two dimensional integer lattice has positive density, then there exists k >= 1 such that the set A = \{ xy | (x,y) in E-E \} contains k\Z, where the set E-E = \{ u - v | u,v in E \}

Primary Supervisor: A/Prof. Alexander Fish
https://www.sydney.edu.au/science/about/our-people/academic-staff/alexander.fish.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Measure Theory, Metric Spaces (preferable)

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: alexander.fish@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH05: SET THEORY AND UNIQUENESS FOR ORTHOGONAL EXPANSIONS OF FUNCTIONS

It is well known that every function square-integrable on a bounded set has unique Fourier series expansion, but Fourier coefficients can be associated to any function integrable on a bounded set. A famous question going back to Riemann is: is such a function uniquely determined by its Fourier coefficients? This question leads to many beautiful and deep problems in the set theory and harmonic analysis. In this project we will learn about the methods used to study such problems, about some open questions and will explore the possibility of extending this theory to other orthogonal series

Primary Supervisor: Prof. Beniamin Goldys
https://www.sydney.edu.au/science/about/our-people/academic-staff/beniamin.goldys.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: This project is for students after the second year, who did the analysis course

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: beniamin.goldys@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH06: 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?

Primary Supervisor: Prof. Stephan Tillmann
https://www.sydney.edu.au/science/about/our-people/academic-staff/stephan.tillmann.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Essential: MATH2922 (or MATH2022). Desirable: MATH2921 (or MATH2021)

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: stephan.tillmann@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH07: ELLIPTIC CURVES

Imagine curves given by $f(x, y)=0$, where $f(x,y)$ in a polynomial in 2 variables. Two families of curves are famous: (i) when f is cubic in x and quadratic in y; and (ii) when f is quadratic in each of x and y - because in these cases, the general curves are parametrized by doubly periodic functions called elliptic functions. In this project, we focus on transformations between these two families, using computer algebra when needed.

Primary Supervisor: Prof. Nalini Joshi

https://www.sydney.edu.au/science/about/our-people/academic-staff/nalini.joshi.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year mathematics courses in calculus and algebra

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: nalini.joshi@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH08: DEVELOPING MACHINE LEARNING MODELS FOR ANOMALY DETECTION IN A SENSOR NETWORK

This project involves developing machine learning models to be used for anomaly detection. More specifically, this project aims to develop anomaly detection algorithms for time series data from a sensor network. The sensors could be the same type of sensors, or they could come from different types of sensors that are looking for the same type of events. The objective is to look into developing novel algorithms for this problem. Projects are available for all levels of students, from website development, coding to implement the model and developing the mathematical theory. For research projects, this will involve a literature review of the techniques currently used and implementing the state-of-the-art techniques in python. For more details, please contact s.luo@sydney.edu.au.

Primary Supervisor: Mr. Simon Luo
https://www.sydney.edu.au/science/about/our-people/academic-staff/s.luo.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Know how to code in Python, have an understanding of machine learning and statistics

Maximum number of places available in project: 5

Final assessment: Project report, 1-2 pages

For more information, contact: s.luo@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH09: CONTRASTIVE LEARNING FOR DISCRETE MARKOV RANDOM FIELD

The parameter inference of discrete Markov random field has the so-called normalizing constant problem. This project aims to investigate learning procedures using a contrastive learning framework. This will involve literature review and conducting experiments in R/ Python.

Primary Supervisor: Dr. Wanchuang Zhu

https://www.sydney.edu.au/science/about/our-people/academic-staff/wanchuang.zhu.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience with R or Python

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: wanchuang.zhu@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH10: 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.

Primary Supervisor: Dr. Jonathan Spreer
https://www.sydney.edu.au/science/about/our-people/academic-staff/jonathan.spreer.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 5

Final assessment: Project report, 1-2 pages

For more information, contact: jonathan.spreer@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH11: UNUSUAL BILLIARDS

Everybody knows about the game of billiards on the standard rectangular desk. How would it be to play that game on a desk of another shape: circle, oval, triangle? Can we imagine billiard on a three-dimensional desk or on some surface? This project will aim to answer to those questions.

Primary Supervisor: A/Prof. Milena Radnovic
https://www.sydney.edu.au/science/about/our-people/academic-staff/milena.radnovic.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year linear algebra

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: milena.radnovic@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH12: FRACTAL GEOMETRY

Fractals are intriguing geometrical objects that appear in mathematics, but also are found in nature. This project aims to explore those beautiful sets, from the points of geometry, dynamics, topology

Primary Supervisor: A/Prof. Milena Radnovic
https://www.sydney.edu.au/science/about/our-people/academic-staff/milena.radnovic.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year linear algebra and calculus

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: milena.radnovic@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH13: 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

Primary Supervisor: A/Prof. Milena Radnovic
https://www.sydney.edu.au/science/about/our-people/academic-staff/milena.radnovic.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First-year linear algebra

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: milena.radnovic@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH14: DATA SCIENCE METHODS FOR CARDIOVASCULAR 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 to deliver better prediction of cardiovascular outcome. In collaboration with Prof Gemma Figtree's team who will provide access to the BioHEART dataset. We will use a unique large scale multi-omics data with over 1,000 samples in lipidomics, proteomics and metabolomics data to by integrating these multi-layered and multi-omics data. There are three different aspects to this project, (i) use machine learning to establish the patient or sample specific accuracy; (ii) use a sequential, machine learning approach to build a multi-level clinical diagnostic tree with multi-omics data and (iii) established a transferable biomarker model for multi-omics data.

Primary Supervisor: Prof. Jean Yang
https://www.sydney.edu.au/science/about/our-people/academic-staff/jean.yang.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: DATA2002 or equivalent

Maximum number of places available in project: 4

Final assessment: Project report, 1-2 pages

For more information, contact: jean.yang@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH15: DATA ANALYTICS WITH MULTI-OMICS COVID19 DATA

Over 30 public COVID19 multi-omics datasets are currently available, including ten single-cell RNA-seq datasets containing hundreds of individuals. The purpose of this project is to curate and process COVID multi-omics datasets in order to construct a multi-modality risk prediction model for risk severity.

Primary Supervisor: Prof. Jean Yang
https://www.sydney.edu.au/science/about/our-people/academic-staff/jean.yang.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: DATA2002 or equivalent

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: jean.yang@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF MATHEMATICS AND STATISTICS

MATH16: THE 3-BODY PROBLEM IN DIMENSION 4

The 3-body problem is one of the most important problems in dynamical systems. The perenial question on the (in)stability of Earth's orbit is unsolved to this day. It turns out that certain problems concerning the stability of solutions are easier to solve in spatial dimension 4 then in dimension 3. The goal of this project is to study the neighbourhood of particular solutions. A combination of numerical and analytical tools will be used.

Primary Supervisor: Prof. Holger Dullin

https://www.sydney.edu.au/science/about/our-people/academic-staff/holger.dullin.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: MATH3977/4077

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: holger.dullin@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS01: (1) HOW DOES THE BRAIN COMPUTE? DISTRIBUTED DYNAMICAL COMPUTATION IN NEURAL CIRCUITS. OR (2) THE PHYSICS OF DEEP LEARNING IN ARTIFICIAL INTELLIGENCE

(1) One of the most fundamental problems about the brain is how it computes. To answer this question, we have presented a concept of distributed dynamical computation (DDC), in which neural computation or information processing is carried out by interacting, propagating neural waves. This concept can merge dynamical and computational perspectives of the brain, which used to have great gaps between each other. The project will involve making further links between neural dynamics and computations, including studying the neural circuit models developed by our group to reveal the physical principles of key brain functions such as visual processing and attention. (2) Deep learning networks widely used in artificial intelligence can be trained to effectively solve many real-world problems such as speech recognition, object detection and drug discovery. However, our understanding of why they are so effective is lacking. The project will involve studying how fractal, self-similar geometry structures of loss function landscapes interact with the gradient descent learning algorithm to give rise to complex learning dynamics and the resultant effectiveness of deep neural networks. These learning dynamics will then be used to develop new learning algorithms.

Primary Supervisor: A/Prof. Pulin Gong
https://www.sydney.edu.au/science/about/our-people/academic-staff/pulin-gong.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: pulin.gong@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS02: PROBING INSIDE STARS USING ASTEROSEISMOLOGY

Asteroseismology involves using the oscillation frequencies of a star to measure its internal properties. Many stars, including the Sun, are observed to oscillate. This project will use data from NASA's Kepler and TESS Missions, which are space telescopes that have discovered thousands of planets transiting other stars, and are also perfect for studying stellar oscillations.

Primary Supervisor: Prof. Tim Bedding
https://www.sydney.edu.au/science/about/our-people/academic-staff/tim-bedding.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Useful to have experience with Python

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: tim.bedding@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS03: EXTREME EVENTS: EXPLORING THE DYNAMIC RADIO SKY WITH ASKAP

Some of the most extreme events in the Universe occur when black holes form as a massive star collapses, or when neutron stars merge. When this happens strong bursts of electromagnetic radiation are released as shocks travel into the interstellar medium and are detected on Earth as transient radio emission. Not only are these events interesting in their own right, they also serve as an astronomical laboratory for exploring physics in extreme conditions. Until now we have had a limited ability to find and study these objects as they appear and disappear on short timescales.

In this project you will work with data hot off the press from the Australian SKA Pathfinder (ASKAP) telescope. You will have access to these unique (and completely unexplored) datasets to look for transient and highly variable radio sources, and then draw on multi-wavelength data and observations from other telescopes to identify what these sources are.

Primary Supervisor: Prof. Tara Murphy
https://www.sydney.edu.au/science/about/our-people/academic-staff/tara-murphy.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Basic Python programming

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: tara.murphy@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS04: MIXED SN-PB HYBRID PEROVSKITE FILMS FOR NEAR-INFRARED PHOTODETECTORS

Mixing Sn into the Pb-based perovskites is an effective route to extend their light response into near-infrared (NIR) range, since their bandgaps can be tuned to below 1.2 eV. We will grow high-quality low-bandgap mixed Sn-Pb halide perovskite films with the optimal NIR absorption properties and then fabricate the high-performance NIR photodetectors through the suitable interfacial engineering.

Primary Supervisor: Prof. Rongkun Zheng

https://www.sydney.edu.au/science/about/our-people/academic-staff/rongkun-zheng.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: rongkun.zheng@sydney.edu.au

Additional information for on-campus components

On-campus location: F09 Madsen Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PHYSICS

PHYS05: FLEXIBLE OPTOELECTRONIC DEVICES BASED ON HALIDE PEROVSKITES

Intrinsically large absorption coefficient and high carrier mobility, in combination with the high solution processability and simple manufacturing, endow halide perovskites with great potential for high-performance optoelectronic devices. More interestingly, recent researches have also demonstrated the high stability nature of halide perovskite devices after the extended bending, holding significant promise for the high-performance flexible devices and the wearable applications. The Project will focus on the realization of flexible optoelectronic devices, particularly photodetectors and phototransistors, via using halide perovskite thin films or thin single crystals. Specifically, the device interface's influence on the device performance will also be investigated in detail.

Primary Supervisor: Dr. Feng Li
https://www.sydney.edu.au/research/opportunities/supervisors/2206

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: feng.li2@sydney.edu.au

Additional information for on-campus components

On-campus location: F09 Madsen Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Staff/students at risk (with symptoms, visited hotspots, close contact etc.) not permitted; social distancing kept all the time; PPE worn all the time; shared equipment cleaned after very use; only visit personal offices and labs

SCHOOL OF PHYSICS

PHYS06: QUANTITATIVE MODELLING OF BRAIN RHYTHMS

Why do we sleep and how does the brain transition into this seemingly unconscious state and out of it? How does sleep loss affect our alertness and memory, and why is long-term sleep loss associated with neurodegenerative disorders like Alzheimer's? We will use biophysical modelling, machine learning, and quantitative data analysis to address these and other neuroscience questions.

Primary Supervisor: Dr. Svetlana Postnova
https://www.sydney.edu.au/science/about/our-people/academic-staff/svetlana-postnova.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Programming in Matlab, Python or similar (required); physics, maths, engineering, or computer science background is of benefit (optional)

Maximum number of places available in project: 4

Final assessment: Project presentation, 5-10 minutes

For more information, contact: svetlana.postnova@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS07: STARSHOT - SENDING PROBES TO THE NEAREST STAR

The Breakthrough Starshot Initiative aims to send a light sail to our neighbouring star system, using a light sail accelerated to 20% of the speed of light by a colossal Earth-based laser. At this speed, the sail would reach its destination and send images back to Earth in about 25 years – all within a human lifetime. Getting there will requiring overcoming numerous scientific and engineering challenges – we offer projects looking at how to keep the lightsail on track within the laser beam over billions of kilometers using clever photonic and mechanics techniques, and on the possibilities of using gas-lenses in space to reduce the massive size (and cost) of the laser.

Primary Supervisor: A/Prof. Boris Kuhlmey
https://www.sydney.edu.au/science/about/our-people/academic-staff/boris-kuhlmey.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Undergraduate physics

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: boris.kuhlmey@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS08: INFERRING AN EMPIRICAL ONTOLOGY OF SCIENTIFIC TIME-SERIES ANALYSIS ALGORITHMS

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.

Primary Supervisor: Dr. Ben Fulcher
https://www.sydney.edu.au/science/about/our-people/academic-staff/ben-fulcher.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: A basic knowledge of coding is required.

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ben.fulcher@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS09: WEIRD AND WONDERFUL SOLITONS

Solitons are stable pulses that balance the effect of dispersion, different frequencies travel at different speeds, and nonlinear effects, different intensities travel at different speeds. Solitons have applications as diverse as lasers and telecommunication. We recently discovered a novel class of solitons that we are investigating theoretically and experimentally. We are trying to understand how the temporal width of the solitons is related to their energy--this may lead to lasers that emit pulses with increased energy, which would unlock a wide range of applications.

Primary Supervisor: Prof. Martijn de Sterke
https://www.sydney.edu.au/science/about/our-people/academic-staff/martijn-desterke.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: martijn.desterke@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS10: NANOSCALE THERMODYNAMICS

This project will carry out simulation work to help in the understanding of how thermodynamics can be used on the nansocale to understand processes at work in diffusion through solid and liquid eledctrolytes relevant in supercapacitor energy strorage, battery strorage and the production of hydrogen for the hydrogen economy.

Primary Supervisor: Prof. David R McKenzie
https://www.sydney.edu.au/science/about/our-people/academic-staff/david-mckenzie.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Matlab computational abilities

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: david.mckenzie@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS11: UNIQUE OR UNREMARKABLE? DISSECTING MILKY WAY ANALOGUES TO UNDERSTAND OUR OWN GALAXY'S FORMATION.

Our Milky Way remains by far the best-studied galaxy in the Universe and is considered a benchmark for understanding galaxy formation. However, it remains to be seen whether our Milky Way galaxy is a special galaxy or unremarkable. By studying "Milky Way Analogues" we can challenge the existing paradigm that our Galaxy is the Rosetta Stone of galaxy formation. In this project you will use the state-of-the-art spatially-resolved optical spectroscopic observations of seven Milky Way Analogue to study their formation history in exquisite detail. You will have the opportunity to work with data from the one of the largest telescopes on Earth and can explore one of the following topics: stellar archaeology, galaxy dynamics, dark matter content, or the inflows and outflows of nearby Milky Way-like galaxies to place our own Galaxy in its proper cosmological context.

Primary Supervisor: Dr. Jesse van de Sande
https://www.sydney.edu.au/science/about/our-people/academic-staff/jesse-vandesande.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Basic Python programming

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: jesse.vandesande@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS12: SILENT BUT DEADLY: A NEW OPTICAL SENSOR FOR METHANE IN THE ENVIRONMENT.

Methane is the second most common greenhouse gas, and per-molecule about 80 times more potent than CO2. Furthermore it is arguably the easiest area to make a large impact as it is not embedded into energy production chains. Enforcing limits on Methane release is problematic, as effective wide-area remote surveillance is not yet possible. This project explores a major innovation in the optical sensing of Methane, exploiting world-leading custom technology of Fibre Bragg Gratings developed at the University of Sydney.

Primary Supervisor: Prof. Peter Tuthill
https://www.sydney.edu.au/science/about/our-people/academic-staff/peter-tuthill.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: peter.tuthill@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS13: THE TOLIMAN SPACE TELESCOPE, DETECTING EXOPLANETS FROM SPACE.

This project will help to establish the design for the TOLIMAN space telescope: a satellite being developed at the University of Sydney dedicated to the detection of exoplanets around our closets neighbours. The project, led by Prof Peter Tuthil, is funded by the Breakthrough Watch Initiative, and has close partnerships with Saber Astronautics and NASA JPL, among others.

The are multiple facets of the project you could work on. Your role could be to help model the innovative principles underlying the detection strategy used by TOLIMAN and help develop computational techniques to measure the exoplanet signal. You could also work on detailed thermal and optical design simulations to help inform the actual design of the telescope and spacecraft.

Primary Supervisor: Dr. Christopher Betters
https://www.sydney.edu.au/science/about/our-people/academic-staff/christopher-betters.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience with machine learning, programming, or mechanical/optical CAD helpful

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: christopher.betters@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PHYSICS

PHYS14: SOFT POLYMER FIBRES FOR CONTINUOUS MONITORING OF BLOOD PRESSURE AND OTHER APPLICATIONS

It is important to be able to continuously monitor blood pressure (BP) to prevent cardiovascular diseases and early deaths worldwide. We have developed a wrist-worn device that can continuously measure arterial BP and the key element of which is a novel type of optical fibre capillary made of relatively soft and stretchable polyurethane. Given that the fibre capillary is five to six orders of magnitude less stiff and two orders of magnitude more rugged than glass, light travelling in it can readily pick up the slightest mechanical perturbations, such as the human radial pulse. With this project, you will have the opportunity to further improve, characterise, and troubleshoot the BP wearable device, work on its signal processing, model and characterise fibre capillaries more thoroughly using simple analytical models and COMSOL Multiphysics, and explore other non-BP applications of soft polymer fibres.

Primary Supervisor: Prof. Simon Fleming
https://www.sydney.edu.au/science/about/our-people/academic-staff/simon-fleming.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: simon.fleming@sydney.edu.au

Additional information for on-campus components

On-campus location: A28 Physics Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PHYSICS

PHYS15: NETWORK DYNAMICS ON SOCIAL MEDIA

This project title encompasses a number of different research problems, all involving working with, and potentially collecting, Twitter data. Depending on the particular choice of problem, the project may involve working with geolocated data, using automated text-processing techniques, or developing community detection algorithms. Applied questions surround topics such as climate change and political polarization: Are international or national actors driving climate change discussion in Australia? How do external events, such as the 2019/2020 bushfires, affect the ongoing climate discussion, and are there differences between the regions and urban centres? More fundamental problems include the detection of communities in an evolving network, and the use of sources to identify information reliability.

Primary Supervisor: Dr. Tristram Alexander
https://www.sydney.edu.au/science/about/our-people/academic-staff/tristram-alexander.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Programming experience (ideally Python)

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: tristram.alexander@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PSYCHOLOGY

PSYC01: MEMORY FOR REPEATED STRESSFUL EVENTS; DOES THE MODALITY OF THE EXPERIENCE MAKE A DIFFERENCE?

Unfortunately, victimisation often happens repeatedly (e.g., domestic violence, sexual abuse). Memory evidence for these types of crimes, is often the only available evidence. As a result, research into memory for repeated stressful events has gained a lot of traction in recent years. A question remains about the validity of the stimuli used in this research. This project will look at the potential differences on memory, and experiences of stress by directly comparing different stimuli modalities. You will be helping with developing stimuli, testing participants and assessing the ecological validity of this type of research.

Primary Supervisor: Dr. Celine van Golde
https://www.sydney.edu.au/science/about/our-people/academic-staff/celine-vangolde.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First- and second-Year PSYC units preferred

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: celine.vangolde@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PSYCHOLOGY

PSYC02: CHILDREN'S THINKING

This project examines how children think, how they learn new concepts, and how they control their behavior to achieve new goals. This project examines what conditions support learning and successful goal-directed behavior, and what conditions make it make it harder. Further, this project examines how these factors change as children develop.

Primary Supervisor: Dr. Micah Goldwater
https://www.sydney.edu.au/science/about/our-people/academic-staff/micah-goldwater.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Preferred knowledge of either Javascript, Python, or R, or at least willingness to learn

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: micah.goldwater@sydney.edu.au

Additional information for on-campus components

On-campus location: A18 Brennan MacCallum Building, Camperdown/Darlington Campus; A19 Griffith Taylor Building, Camperdown/Darlington, or School-based locations (if restrictions allow)

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PSYCHOLOGY

PSYC03: RESPONSE INHIBITION AND TRANSCRANIAL MAGNETIC STIMULATION

Response inhibition is our ability to suppress or cancel actions when required. Deficits in response inhibition are linked with a range of psychopathological disorders including addiction and OCD. Transcranial magnetic stimulation (TMS) can be used to measure neural activity in the motor networks of the brain. This project will use computer tasks measuring response inhibition ability in combination with TMS to study the underlying cognitive and neural processes involved in stopping a response. The project will help to understand how responses are successfully inhibited and why responses are unsuccessfully inhibited.

Primary Supervisor: Dr. Dominic Tran
https://www.sydney.edu.au/science/about/our-people/academic-staff/minh-d-tran.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First- and second-year PSYC units or Neuroscience, but not necessary

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: minh.d.tran@sydney.edu.au

Additional information for on-campus components

On-campus location: 246C Top South Badham, Camperdown/Darlington Campus; A19 Griffith Taylor Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PSYCHOLOGY

PSYC04: FIGHTING BIAS IN SCIENTISTS AND IN JUDGES

"Open science" reforms are sweeping through psychology and the social sciences, resulting in greater transparency in scholarship, faster scientific progress, and potentially less bias in the court system. You will contribute to the evidence base for this movement by helping us assess the transparency and credibility of a sample of scholarly journal articles and the discourse around them. This involves a close reading of articles and us training you in open practices.

Primary Supervisor: Prof. Alex Holcombe
https://www.sydney.edu.au/science/about/our-people/academic-staff/alex-holcombe.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: alex.holcombe@sydney.edu.au

Additional information for on-campus components

On-campus location: A18 Brennan MacCallum Building, Camperdown/Darlington Campus; A19 Griffith Taylor Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PSYCHOLOGY

PSYC05: CLINICIAN PERSPECTIVES ON THE UTILITY OF SMARTPHONE APPS FOR MANAGING GAMBLING PROBLEMS AS AN ADJUNCT TO STANDARD TREATMENT

The availability of smartphone apps to help individuals manage gambling problems is increasing. These apps have various functions, such as providing psychoeducation on gambling, self-guided therapy modules, gambling recovery support networks, budget management tools, and blocking access to gambling websites. Smartphone apps tend to be categorised as 'self-help'; however, little is known about how they could be used to support standard clinical care and potentially improve treatment outcomes. In this project, students will identify and classify publicly available smartphone gambling management apps based on their content and function. Students will then administer an online survey to gambling clinicians to elicit their perspectives on which apps may be most useful to support, and how they can be integrated into, standard treatment. This work is expected to assist gambling help professionals to select and implement appropriate smartphone tools that may lead to enhanced treatment practices.

Primary Supervisor: Dr. Robert Heirene
https://www.sydney.edu.au/science/about/our-people/academic-staff/robert-heirene.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: First- and second-year PSYC units, or Computer Science, or Digital Media. Preferred experience with literature review and survey construction, but not necessary

Maximum number of places available in project: 5

Final assessment: Project presentation, 5-10 minutes

For more information, contact: robert.heirene@sydney.edu.au

Additional information for on-campus components

On-campus location: Brain and Mind Centre, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF PSYCHOLOGY

PSYC06: FINDING A FAST WAY TO SLOW DOWN: TRANSLATING MINDFULNESS THEORY TO EMBEDDED HABITS – QUICKLY

In May 2020, the United Nations issued a policy brief urging the international community to 'protect vulnerable populations' - being adolescents and young adults (WHO, 2020). This project will pilot and evaluate a contemporary, second-generation mindfulness intervention to reduce the negative effects of COVID and other sources of uncertainty on mental health and academic performance. It will extend the work of Yoder (2017) on encouraging self-reflection in business honours students; King and Badham (2020) on designing second-generation mindfulness interventions; and King, Norbury and Rooney (2020) on using film in coaching; while at the same time answering calls for more qualitative research (Athanasopoulou and Dopson, 2018) and process research (Grant, 2016) in coaching. The innovative pedagogy methods include contemplation, reflective writing and film which will be evaluated with a multi modal approach including pre and post, quantitative wellbeing and mindfulness measures, dynamic semi structured interviews, and self-reflective diaries. Expected contributions include enhanced student wellbeing and academic success, novel generalizable pedagogy and at least one paper appropriate for a top level psychology journal.

Primary Supervisor: Dr. Elizabeth King
https://www.sydney.edu.au/science/about/our-people/academic-staff/e-king.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: e.king@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF PSYCHOLOGY

PSYC07: DEVELOPING AND VALIDATING AN INSTRUMENT TO ASSESS PSEUDOSCIENTIFIC BELIEFS

Pseudoscientific beliefs and beliefs in unfounded causal relations are often measured with reference to specific beliefs or issues (e.g., effects of vaccination). There is, however, no instrument designed to capture a general tendency to hold such beliefs, as a relatively stable trait. In the proposed project we will develop and validate such an instrument. The first stage of the project will be a comprehensive literature review to determine the scope of the construct, and to examine how the construct might best be assessed (e.g., self report, vignettes). We seek the assistance of a student through the Science Summer Research Program to for this first stage.

Primary Supervisor: Dr. Daniel Costa
https://www.sydney.edu.au/science/about/our-people/academic-staff/daniel-costa.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Preferred experience with literature review and survey construction, but not necessary

Maximum number of places available in project: 3

Final assessment: Project report, 1-2 pages

For more information, contact: daniel.costa@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE01: CATTLE INTEGRITY

You will work alongside the members of the University of Sydney Livestock Production and Welfare Group to use your engineering/data science skills to improve the integrity of our red meat industry. You will help develop systems to track cattle through the production system and in so doing improve animal wellbeing and farm profitability.

Primary Supervisor: A/Prof. Cameron Clark
https://www.sydney.edu.au/science/about/our-people/academic-staff/cameron-clark.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Engineering/datascience

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: cameron.clark@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE02: SPOT THE COW: USING REMOTE CAMERA AND DRONE IMAGES AND VIDEO TO QUANTIFY GRAZING ACTIVITY IN A NATIVE PASTURE DROUGHT EXPERIMENT ON A UNIVERSITY FARM.

In this project you will work with our team to quantify cattle activity via camera and drone imagery to understand how cattle use native pastures that have had experimental treatments of combinations of applied nutrients and drought conditions. This is important for improving the sustainability of livestock grazing. You will gain exposure to both the International Drought Experiment (https://drought-net.colostate.edu/) and the DigiFarms project (https://sydney.edu.au/agriculture/our-research/Digifarm.html).

Primary Supervisor: Prof. Glenda Wardle
https://www.sydney.edu.au/science/about/our-people/academic-staff/glenda-wardle.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Interest in agroecosystems. Desire to learn image processing. Option to undertake statistical analyses of data depending on interest

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: glenda.wardle@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE03: HIDDEN DIVERSITY: THE EFFECTS OF FIRE AND RAIN ON THE DIVERSITY AND ABUNDANCE OF SEEDS IN THE SIMPSON DESERT.

This opportunity is suited to an individual or small group of students who want to gain lab experience in ecology. You will collect data from samples to discover about how seeds respond in the face of environmental variation such as wildfires, big rain years, or vegetation patterns across the dunefields of the Simpson Desert as part of the long-term studies of the Desert Ecology Research Group (DERG). (https://www.desertecology.edu.au/)

Primary Supervisor: Prof. Glenda Wardle
https://www.sydney.edu.au/science/about/our-people/academic-staff/glenda-wardle.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Willingness to work in a research lab on campus. You will be trained in all methods and gain skills in lab and data management processes that are desirable to employers. COVID vaccination

Maximum number of places available in project: 4

Final assessment: Project report, 1-2 pages

For more information, contact: glenda.wardle@sydney.edu.au

Additional information for on-campus components

On-campus location: Laboratory 310, A08 Heydon-Laurence Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE04: DIGITAL GREENNESS DATA FOR PLANT DEMOGRAPHY

In this project you will work with Canopeo app to extract greenness fractional cover data from plot images to understand plant population response to environmental change. Part of the global Plantpopnet project (https://www.plantpopnet.com/) - A Spatially Distributed Model System for Population Ecology. Depending on interest there is scope to test ideas about competition and density dependence using population models.

Primary Supervisor: Prof. Glenda Wardle
https://www.sydney.edu.au/science/about/our-people/academic-staff/glenda-wardle.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Interest in plant ecology and or modelling

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: glenda.wardle@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE05: USING REMOTE DEVICES TO DETECT SPATIO-TEMPORAL TRENDS IN WILDLIFE

This project will use innovative system of acoustic recorders or camera traps that can be used across pastures, crops and remnant patches of natural vegetation to for monitoring biodiversity (Sub-project of DigiFarms https://sydney.edu.au/agriculture/our-research/Digifarm.html).

Primary Supervisor: Dr. Aaron Greenville
https://www.sydney.edu.au/science/about/our-people/academic-staff/aaron-greenville.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience in R and/or ArcGIS

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: aaron.greenville@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE06: SMART FARMING: INCORPORATING BIODIVERSITY INTO FARMING DECISIONS

This project will test a 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).

Primary Supervisor: Dr. Aaron Greenville
https://www.sydney.edu.au/science/about/our-people/academic-staff/aaron-greenville.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience in R. Desire to learn bird calls

Maximum number of places available in project: 2

Final assessment: Project report, 1-2 pages

For more information, contact: aaron.greenville@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE07: USING ARTIFICIAL FLOWERS TO STUDY THE BEHAVIOUR OF NATIVE POLLINATORS

Artificial flowers have long been used to investigate cognition and flower preferences in bees and other flower visiting insects. However artificial flowers are almost always used either under lab conditions, mainly because wild insects do not seem to recognise artificial flowers as food. In this project, you will help build and test artificial flowers designed to attract with wild, free-flying insects. The project will run outdoors on main campus.

Primary Supervisor: A/Prof. Tanya Latty

https://www.sydney.edu.au/science/about/our-people/academic-staff/tanya-latty.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable working with insects outdoors (on campus)

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: tanya.latty@sydney.edu.au

Additional information for on-campus components

On-campus location: A08 Heydon-Laurence Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE08: USING SITE-DIRECT MUTAGENESIS TO STUDY THE CHROMOPHORE-BINDING SITES IN ALLOPHYCOCYANIN PROTEIN COMPLEXES

Allophycocyanin proteins are core units of phycobilisome in cyanobaqcteria and transfer energy to cholorophylls in photosystems. A unique allophycocyanin complex is isolated from chlorophyll f-producing cyanibacterium, which can capture light beyond 700 nm (far-red light), even beyond the absorption of chlorophyll (650-700 nm). The project aims to understand relationship between chromophore binding sites its spectral properties. The project will use protein overexpression system in E coli and standard protein analysis methods (SDS-PAGE and spectral analysis).

Primary Supervisor: Prof. Min Chen
https://www.sydney.edu.au/science/about/our-people/academic-staff/min-chen.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: PC2 lab safety training (pre-arrangment with supervisor)

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: min.chen@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, F22 LEES Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE09: IRON IMPACT ON PHOTOSYNTHETIC PROTEIN COMPLEXES

Cyanobacteria have evolved many responses to cope with changed nutrient conditions. Iron is the most abundant transition metal and is vital for energy metabolism, including photosynthesis and pigment biosynthesis. Project aims to study iron-stress-induced chlorophyll-binding proteins (IsiA) and to understand how IsiA helps cyanobacteria capture light energy which can be a valuable lesson for human being to use solar energy as well.

Primary Supervisor: Prof. Min Chen

https://www.sydney.edu.au/science/about/our-people/academic-staff/min-chen.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: PC2 lab safety training (pre-arrangment with supervisor)

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: min.chen@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, F22 LEES Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE10: AMINO ACID REQUIREMENT IN LAYING HENS

You will work with laying hens to monitor egg production in order to quantify their dietary amino acid requirments

Primary Supervisor: Dr. Sonia Liu
https://www.sydney.edu.au/science/about/our-people/academic-staff/sonia-liu.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable working with chickens

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: sonia.liu@sydney.edu.au

Additional information for on-campus components

On-campus location: Poultry Farm, Camden Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE11: META-ANALYSIS ON THE IMPACT OF CLIMATE ON NUTRITIONAL VALUE OF GRAINS

You will focus on reading literature and conducting meta analysis how climate influence feed grain quality, including sorghum, wheat, barley and legumes

Primary Supervisor: Dr. Sonia Liu
https://www.sydney.edu.au/science/about/our-people/academic-staff/sonia-liu.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Good reading and statistical skill

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: sonia.liu@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE12: WHAT CONTROLS GLOBAL TROPICAL RAINFALL?

Convection, and therefore heavy rainfall, in the tropics occurs over those parts of the globe where the buoyancy of surface air is highest. This buoyancy is a function of the temperature and humidity of the air; since much of the Earth's tropical belt is covered by ocean, this means that the amount of rainfall that occurs in the tropics is closely governed by sea surface temperatures. Although this influence is well-known, a precise metric to capture this relationship has yet to be developed. In this project, the student will work with Drs Nandini Ramesh and Richard Scalzo to build an interpretable probabilistic model of the relationship, using Bayesian approaches to variable and model selection, which can then be applied to understand how tropical rainfall will vary with climate change.

Primary Supervisor: A/Prof. Willem Vervoort
https://www.sydney.edu.au/science/about/our-people/academic-staff/willem-vervoort.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Coding experience (preferably Python) and some statistics

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: willem.vervoort@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, J12 School of Information Technologies

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE13: DO OYSTER FARMS IMPROVE WATER QUALITY OF ESTUARIES?

Oysters are the kidneys of coastal environments, but most of these important oyster habitats in NSW estuaries have been lost due to harvesting and contamination. Hence, oyster aquaculture farms can be playing a key role in these systems. This project will use remote sensing techniques to assess how oyster farms improve water quality at large temporal and spatial scales.

Primary Supervisor: Dr. Ana Bugnot

https://www.sydney.edu.au/science/about/our-people/academic-staff/ana-bugnot.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ana.bugnot@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE14: CHARACTERIZING BIOTURBATING COMMUNITIES IN MARINE SEDIMENTS CONTAMINATED WITH INPUTS FROM STORMWATER DRAINS

Sediment burrowing animals (bioturbators) play key roles in the healthy functioning of marine sediments. This study will characterise the species living close and far from stormwater outflows in Sydney Harbour and assess their role in promoting contamination remediation.

Primary Supervisor: Dr. Ana Bugnot

https://www.sydney.edu.au/science/about/our-people/academic-staff/ana-bugnot.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable in water, driving licence

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ana.bugnot@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 1, A11 Edgeworth David Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Follwing Sydney Uni COVID guidelines for working on campus and we have a COVID plan for fieldwork

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE15: PROBABILISTIC WATER BALANCE MONITORING

Tracking the movement of water through a catchment is critical for making good water management decisions, but the limited volume and quality of data constraining the water balance can result in large uncertainties in flows. Quantifying these uncertainties leads to more robust hydrological understanding of a catchment, better water management across catchment states consistent with observations, and more efficient survey design for ongoing data collection. Students will work with Dr Gilad Francis and Dr Richard Scalzo to build probabilistic models for common flow processes, such as ratings curves for flows from streams and dams, environmental water use, and licensed extraction from river flow and groundwater, using methods of Bayesian inference.

Primary Supervisor: Dr. Richard Scalzo
https://www.sydney.edu.au/science/about/our-people/academic-staff/richard-scalzo.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Python programming; some experience with Bayesian statistics

Maximum number of places available in project: 3

Final assessment: Project presentation, 5-10 minutes

For more information, contact: richard.scalzo@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, J12 School of Information Technologies

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE16: DOES PROTECTION CONFER GREATER STABILITY AND RESILIENCE OF CORAL REEF DIVERSITY TO ENVIRONMENTAL DISTURBANCE?

Marine Protected Areas (MPAs) have been implemented worldwide to preserve biodiversity. Whether protection from direct human impacts has the capacity to enhance the resilience of marine communities to environmental disturbance is unclear, partly due to the limitations of traditional analyses of turnover, and the lack of available long-term data. This project will analyse the Great Barrier Reef long-term monitoring program data to assess stability, resistance to, and recovery from storm, cyclone, and heatwave events in tropical fish communities.

Primary Supervisor: Dr. Amanda Pettersen
(University profile URL TBC, please contact supervisor via email)

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience using R, in particular data wrangling. Training will be provided in analysis

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: amanda.pettersen@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE17: INVESTIGATING VARIATION IN THE THERMAL TOLERANCE OF KELP SPECIES IN NEW SOUTH WALES

Habitat-forming kelp of the Great Southern Reef support our economy and way of life, yet are under threat due to human mediated stressors, including climate change. Within-species variation in thermal responses (e.g., southern populations experience cooler temperatures than northern populations) means that populations have likely evolved differences in the thermal sensitivity of their carbon balance, to optimise growth and survival under local conditions. This project will experimentally measure the thermal physiology of ealy life stages of kelp species and populations under controlled laboratory conditions.

Primary Supervisor: Dr. Amanda Pettersen
(University profile URL TBC, please contact supervisor via email)

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Confident swimmer/snorkeller, physical work in the subtidal, attention to detail needed to undertake laboratory physiology assays

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: amanda.pettersen@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 1, A11 Edgeworth David Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE18: TRAIT VARIATION AND LOCAL ADAPTATION IN SEAWEEDS

Seaweeds exhibit a fascinating array of phenotypic diversity that is likely to reflect mechanisms of adaptation to their local environment. This project will use a meta-analysis to explore among and within-species variation in key traits (morphology, physiology, and life history) across environmental gradients. The project will assess the nature of selection acting on seaweed populations and predict future species distributions.

Primary Supervisor: Dr. Amanda Pettersen
(University profile URL TBC, please contact supervisor via email)

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience reading and interpreting primary literature

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: amanda.pettersen@sydney.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: N/A

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE19: PROBLEM-SOLVING AND PERSONALITY OF BRUSHTAIL POSSUMS

Are certain individuals better able to solve ecological problems, such as food extraction? If so, what drives these differences within a species? Here we will test whether differences in personality traits will influence the problem-solving approach and ability of free-ranging, urban possums. Personality measures (from boldness to vigilance) will be assessed via an arena test. Problem-solving approach and ability will be analysed by monitoring how free-ranging individuals interact with both a single and multi-step food extraction puzzle.

Primary Supervisor: Prof. Clare McArthur
https://www.sydney.edu.au/science/about/our-people/academic-staff/clare-mcarthur.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable working at night under supervision; able to drive to field sites within the Eastern Suburbs of Sydney; ecological experience at undergraduate level; tetanus and COVID vaccinations

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: clare.mcarthur@sydney.edu.au

Additional information for on-campus components

On-campus location: Rm 302, A08 Heydon-Laurence Building, A12 Macleay Building, A10 Science Road Cottage, Camperdown/Darlington Campus (equipment access); green spaces around Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students must have completed the required approval forms prior to commencing work.

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE20: PERSONALITY AND REVERSE-ZOONOTIC PARASITES IN COMMON BRUSHTAIL POSSUMS

Infectious diseases caused by multi-host pathogens are a major threat to both human and animal health. Individuals within host wildlife species may vary in their likelihood of carrying parasites due to intrinsic characteristics such as their personality. Here we will test whether difference in carrying parasites is related to host personality as characteristics influencing proximity to humans and environmental sources of infections using urban brushtail possum as host, and the protozoan Genus Cryptosporidium and Giardia as parasite. We will quantify personality traits and conducted molecular characterisation of Cryptosporidium, Giardia using nested PCR reactions.

Primary Supervisor: Prof. Clare McArthur
https://www.sydney.edu.au/science/about/our-people/academic-staff/clare-mcarthur.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Interested in studying about disease spread between human and animals; keen to do laboratory based research; comfortable handling brushtail possum scats; undergraduate level experience in basic molecular techniques

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: clare.mcarthur@sydney.edu.au

Additional information for on-campus components

On-campus location: A08 Heydon-Laurence Building, Camperdown/Darlington Campus; Some lab woprk will be conducted in Macquarie university E8A level two PC2 facility

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students must have completed the required approval forms prior to commencing work.

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE21: THE QUOLL BEHAVIOUR PROJECT

We are researching detectability of spotted-tailed quolls and eastern quolls. Over Summer, we will be trialling different lure types to determine which lures, or sets of lures, work best to attract quolls during surveys. You will be assisting with fieldwork in regional NSW and/or the ACT, some on-campus work prepping for field trips and possibly some computer work, such as data input and image analysis. Accommodation for field trips will be covered.

Primary Supervisor: Prof. Clare McArthur
https://www.sydney.edu.au/science/about/our-people/academic-staff/clare-mcarthur.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Ecological experience at undergraduate level; willingness to conduct fieldwork in the bush, hiking short distances off track (under supervision); tetanus and COVID vaccinations

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: clare.mcarthur@sydney.edu.au

Additional information for on-campus components

On-campus location: A08 Heydon-Laurence Building, Camperdown/Darlington Campus; Field sites in regional NSW and ACT, departing from A08 Heydon-Laurence Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students must have completed the required approval forms prior to commencing work.

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE22: NEIGHBOURHOOD WATCH – USING 'VIRTUAL' NEIGHBOURS TO PROTECT PLANTS FROM HERBIVORES DURING HABITAT RESTORATION AND POST-FIRE RECOVERY

In Australia, mammalian herbivores are one of the greatest limiting factors in native seedling recruitment, devastating post-fire recovery and habitat restoration. Current management solutions (e.g. shooting, fencing) are unpopular, especially against native herbivores, costly or ineffective. We need alternative solutions to manage browsing damage. Herbivores rely heavily on the smell of plants when deciding where to go and what to eat. My project will harness the power of plant odour to develop and deploy 'virtual' neighbours (artificial low-quality 'plant smell') to nudge herbivores away from vulnerable plants in areas we want to protect. My overall aim is to help develop new, non-lethal wildlife management solutions.

Primary Supervisor: Prof. Clare McArthur
https://www.sydney.edu.au/science/about/our-people/academic-staff/clare-mcarthur.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable working in the field (Ku-ring-gai chase national park - i.e. heat of summer, lots of walking, carrying equipment); able to drive to field site or meet at the site; ecological experience at undergraduate level; COVID vaccination

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: clare.mcarthur@sydney.edu.au

Additional information for on-campus components

On-campus location: Rm 302, A08 Heydon-Laurence Building, A12 Macleay Building, A10 Science Road Cottage, Camperdown/Darlington Campus (equipment access)

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students must have completed the required approval forms prior to commencing work.

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE23: EVOLUTION AND STRUCTURAL DIVERSITY OF THE INVERTEBRATE ECDYSONE RECEPTOR, AN IMPORTANT TARGET FOR INSECTICIDES

The insect hormone ecdysone is essential for the development of all insects. Ecdysone exerts its effects by binding to a transcription factor (the ecdysone receptor subunit, EcR) that controls the expression of thousands of genes. The EcR represents a promising target for the design of specific insecticides, as it is only present in invertebrates. However, its evolution and structural diversity beyond insects remains poorly understood. In this project, you will perform phylogenetic analysis of invertebrate EcRs present in GenBank to examine their evolution, and use Alphafold2 to predict and survey the structural diversity of the EcR in invertebrates. The project involves collaboration with structural biologists Profs. Joel Mackay and Ronald Hill, who have substantial experience working on transcription factors and EcRs.

Primary Supervisor: Prof. Nathan Lo
https://www.sydney.edu.au/science/about/our-people/academic-staff/nathan-lo.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable with bioinformatic analyses

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: nathan.lo@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, F22 LEES Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: TBC

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE24: IDENTIFYING METABOLITES AND GENE EXPRESSION THAT CHANGE WITH DIFFERENT CANCER TREATMENTS

You will be using a range of statistical and bioinformatics tools to analyze data from mass spectrometry and other experiments to identify and quantify metabolites and gene expression from prostate normal and cancer cell lines that have been treated with different schemes. These metabolite profiles and the associated pathways may inform about the effectiveness of different treatment schemes and lead to better treatment plans.

Primary Supervisor: Dr. Ann Kwan
https://www.sydney.edu.au/science/about/our-people/academic-staff/ann-kwan.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable with computers and statistical analysis, familiarity with R and bioinformatics is strongly preferred

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ann.kwan@sydneu.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: Staff present on campus to deliver the project remotely to students

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE25: MECHANISM OF INSULIN RESISTANCE

This project aims to investigate the molecular mechanisms that cause insulin resistance in cultured cells. The focus will be on the intersection between ceramides and mitchondrial function. You will learn skills in cell biology, cell culture, running gels and using antibodies to probe function.

Primary Supervisor: Prof. David James
https://www.sydney.edu.au/science/about/our-people/academic-staff/david-james.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Biochemistry

Maximum number of places available in project: 2

Final assessment: Project presentation, 5-10 minutes

For more information, contact: david.james@sydney.edu.au

Additional information for on-campus components

On-campus location: D17 Charles Perkins Centre Research and Education Hub, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE26: EXAMINING DECISION MAKING AND FOOD PREFERENCE OF COMMON GARDEN SNAILS

Understanding how animals think can help us come up with novel solutions for old problems. For example, if we know how animals make decisions when they forage, we can apply this information to new pest management strategies. Here we will use cognitive tools (e.g. phantom decoys) to test how snails choose between a selection of foods.

Primary Supervisor: A/Prof. Tanya Latty
https://www.sydney.edu.au/science/about/our-people/academic-staff/tanya-latty.html

Mode of delivery: On Campus

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Keen to do laboratory based research; comfortable working handling snails

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: tanya.latty@sydney.edu.au

Additional information for on-campus components

On-campus location: A08 Heydon-Laurence Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Students must have completed the required approval forms prior to commencing work.

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE27: DEVELOPING NOVEL LEAD MOLECULES TO FIGHT ANTIBIOTIC RESISTANCE

Antibiotic resistance continues to pose as a major health issue in the 21st century. Resistance to currently available antibiotics is increasingly responsible for deaths globally. Despite this pressing issue, in recent years, there have been few new classes of antibiotics introduced. Our project aims to alleviate this issue by developing a novel class of broad-spectrum antibiotics that targets a never-exploited interaction between bacterial Signal Recognition Particle (SRP) and its Receptor (SR).

Primary Supervisor: Dr. Ann Kwan
https://www.sydney.edu.au/science/about/our-people/academic-staff/ann-kwan.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience with working in a biochem wet lab. Comfortable with learning new techniques

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ann.kwan@sydneu.edu.au

Additional information for on-campus components

On-campus location: G08 Molecular Bioscience Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE28: STRUCTURAL STUDIES OF ANTIMICROBIAL TARGETS

In this project, you will be performing structrual studies on antibiotics or antiviral targets using in silico structure determination and docking tools.

Primary Supervisor: Dr. Ann Kwan
https://www.sydney.edu.au/science/about/our-people/academic-staff/ann-kwan.html

Mode of delivery: Remote

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Comfortable with computers and learning new programs. Good analytical skills

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ann.kwan@sydneu.edu.au

Additional information for on-campus components

On-campus location: Online

On-campus activities: Staff present on campus to deliver the project remotely to students

Additional COVID-related student requirements: N/A

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE29: ENGINEERING PROTEIN COATS FOR BIOTECH APPLICATIONS

Hydrophobins are fungal proteins that can naturally self-assemble and coat structures and reverse their wettability. This property can be exploited for coating applications ranging from drug delivery to increasing the biocompatiblity of surfaces. You will be investigating how hydrophobins assemble and coat different materials, including bone scaffolds and drug delivery vehicles.

Primary Supervisor: Dr. Ann Kwan
https://www.sydney.edu.au/science/about/our-people/academic-staff/ann-kwan.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: Experience with working in a biochem wet lab. Comfortable with learning new techniques

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: ann.kwan@sydneu.edu.au

Additional information for on-campus components

On-campus location: G08 Molecular Bioscience Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE30: SOCIAL BEHAVIOUR AND LEARNING IN THE MARINE ISOPOD CIROLANA HARFORDI

The marine isopod is a social animal and likes to gather with other members of its species. When a group of these animals are given a choice of two shelters the group will pick one shelter at random and the majority of animals will shelter together under it. In this project you will use video tracking to determine if the animals can learn to choose the preferred shelter more quickly with experience.

Primary Supervisor: Dr. Murray Thomson
https://www.sydney.edu.au/science/about/our-people/academic-staff/murray-thomson.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project report, 1-2 pages

For more information, contact: murray.thomson@sydney.edu.au

Additional information for on-campus components

On-campus location: A08 Heydon-Laurence Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: Following NSW Health advice and USYD guidelines

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES

SOLE31: FOOD DEFENCE: BEYOND NEEDLES IN STRAWBERRIES

Food safety management systems are not robust to intentional, malicious acts of contamination. Where are the risks? And how we control them? This project investigates food defence in Australian horticulture. It will involve literature review of topics related to threat/vulnerability assessment and risk mitigation.

Primary Supervisor: Dr. Kim-Yen Phan-Thien
https://www.sydney.edu.au/science/about/our-people/academic-staff/kim-yen-phan-thien.html

Mode of delivery: Hybrid (Remote & On Campus)

Project dates: 17 January 2022 to 18 February 2022

Pre-requisites: None

Maximum number of places available in project: 1

Final assessment: Project presentation, 5-10 minutes

For more information, contact: kim-yen.phan-thien@sydney.edu.au

Additional information for on-campus components

On-campus location: Level 5, F22 LEES Building, Camperdown/Darlington Campus

On-campus activities: Staff and students will be physically present in the same location

Additional COVID-related student requirements: No