THE UNIVERSITY OF SYDNEY

Project List

2026 Science Summer Research Program (Denison)

Faculty of Science

The Science Summer Research Program (Denison) is a 6-week program that takes place during the Intensive February study session, which will run from 19 January to 1 March 2026.

The program provides students with an opportunity to engage in research whilst completing their undergraduate studies, which enhances their student experience and provides insight into potential further research studies. This year we have 100 scholarships to award students who will be paid $3,000 for 6 weeks, full-time participation (equivalent to 35 hours per week) in a supervised research project run by a science academic.

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School of Chemistry

CHEM01: Renewable hydrogen cycle

Project Subject Area: Chemistry

Hydrogen, an emerging green energy source, holds great promise for our sustainable future. Electrochemistry plays a pivotal role in the renewable hydrogen cycle. The electrochemical processes involved in the hydrogen cycle are highly sensitive to surface characteristics, with reaction paths diverging based on material elements and surface structures. In this project, you will utilise state-of-the-art scanning electrochemical probe microscopy techniques to directly unveil the structure-electrochemical activity of electrode surfaces, providing nanoscale electrochemical maps and movies. Additionally, you will investigate hydrogen production and consumption at the bulk scale, establishing a link between nanoscale behaviours and macroscopic phenomena.

Project Details

Supervisor(s): Dr Kaye Minkyung Kang
Contact: minkyung.kang@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Interest in surface science and nanoscience

Student Preparation:
- The candidate will be required to attend a one-day demonstration session for using equipment in the lab and to conduct a short literature review (2 research articles) prior to the Intensive February session

Project Location:
Chemistry Building (F11), Rooms 148/113

Attendance Mode:
On Campus
Most of the on-campus research will involve laboratory activities in the School of Chemistry, under supervision to ensure safety. Data analysis, literature review, and meetings can be arranged remotely, if required.

CHEM02: Heterologous expression of microbial natural products

Project Subject Area: Chemistry

This project focuses on understanding new biosynthetic pathways from microbes that generate leads as antibiotics. Through this work you will identify new gene clusters and perform molecular biology to integrate them into new pathways.

Project Details

Supervisor(s): Dr Constance Bailey
Contact: constance.bailey@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
Undergraduate level experience in basic molecular techniques, proficiency in organic chemistry

Student Preparation:
- Induction, including OGTR PC2 induction

Project Location:
- Molecular Bioscience Building (G08), 3rd floor labs

Attendance Mode:
On Campus (100%)

CHEM03: New electrolyte additives for lithium-ion batteries

Project Subject Area: Chemistry

Sustainable lithium-ion batteries require new electrolytes to enable high performance and long-term stability. This project will focus on understanding the behaviour of new electrolyte additives in next-generation lithium-ion or sodium-ion batteries, involving electrochemical cell testing, operando gas analysis, and post-test analysis of materials using NMR spectroscopy and GC-MS.

Project Details

Supervisor(s): Dr Wesley Dose
Contact: wesley.dose@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- An interest in materials chemistry and hands-on experience

Student Preparation:
- N/A

Project Location:
Chemistry Building (F11)

Attendance Mode:
On Campus (100%)

CHEM04: Developing operando x-ray diffraction and spectroscopy techniques to decipher the reaction mechanisms of battery materials

Project Subject Area: Chemistry

X-ray techniques are commonly used to study materials for rechargeable batteries. Operando X-ray diffraction (XRD) and X-ray absorption spectroscopy (XAS) provide real-time insights into the crystal structure, local electronic structure, oxidation states, and coordination environments of materials. This project will develop operando X-ray methods to study lithium-ion and sodium-ion batteries, leveraging the single-layer pouch cell fabrication facility in the Dose Lab, Sydney Analytical's most advanced laboratory powder diffractometer, and the only lab-based XAS in the southern hemisphere.

Project Details

Supervisor(s): Dr Wesley Dose
Contact: wesley.dose@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- An interest in materials chemistry and hands-on experience

Student Preparation:
- N/A

Project Location:
Chemistry Building (F11)

Attendance Mode:
On Campus (100%)

CHEM05: Quantum control of chiral light-matter interactions

Project Subject Area: Chemistry

Chiral mirrors and interfaces offer an innovative approach to quantum control of light–matter interactions, with the potential to transform information processing and computing. Mirrors are essential optical components that redirect light in devices such as microscopes, cameras, lasers and communication networks. Conventional mirrors usually reflect linear polarisation of light without alteration, but invert the handedness of circularly polarised light, which significantly impedes quantum control in chiral light-matter interactions. In this project, you will fabricate new chiral thin film interfaces and use optical spectroscopy to examine their application as chiral mirrors.

Project Details

Supervisor(s): Professor Girish Lakhwani
Contact: girish.lakhwani@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Credit average or above in CHEM2521
- HSC Mathematics (or equivalent)
- An interest in physical chemistry, chemical physics and/or applied physics

Student Preparation:
- N/A

Project Location:
School of Chemistry labs in adjacent buildings F11 and F09

Attendance Mode:
On Campus (100%)

CHEM06: New pH sensors for environmental and medical studies

Project Subject Area: Chemistry

Carefully controlled pH is essential for many processes, from the health of environmental waterways to the shelf-life of foods to the ability of cells to fight disease. This project will involve the design and study of new fluorescent molecules that can be used to accurately measure and image pH changes in cells and in environmental samples. The project will involve organic synthesis, fluorescence spectroscopy, with an opportunity to observe biological studies. Students will learn to use ChemDraw and to carry out data analysis using Origin or Prism.

Project Details

Supervisor(s): Professor Elizabeth New
Contact: elizabeth.new@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of at least two 2000-level Chemistry units
- Hands-on laboratory experience
- Proficiency with excel for data analysis

Student Preparation:
- School of Chemistry induction processes (e.g. safety) will be completed on the first days of the session

Project Location:
Chemistry Building (F11), Rooms 401-404, 411, 418

Attendance Mode:
On Campus
Approximately 30 hours per week in the lab
There will be some associated data analysis, which can be undertaken online

CHEM07: A novel fluorescence assay for enzyme activity

Project Subject Area: Chemistry

Variations in biological redox state can lead to a range of diseases including hypertension and diabetes. There are many enzymes that are essential for maintaining biological redox state within cells. In this project we will develop and study new fluorescent molecules that can monitor activity of these enzymes. The project will involve synthesis and fluorescence spectroscopy, with an opportunity to be involved in studies of biological samples.

Project Details

Supervisor(s): Professor Elizabeth New
Contact: elizabeth.new@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of at least two 2000-level Chemistry units
- Hands-on laboratory experience
- Proficiency with excel for data analysis

Student Preparation:
- School of Chemistry induction processes (e.g. safety) will be completed on the first days of the session.

Project Location:
Chemistry Building (F11), Rooms 404-5, 410, 411

Attendance Mode:
On Campus
Approximately 30 hours per week in the lab
There will be some associated data analysis, which can be undertaken online

CHEM08: Next-generation organic light-emitting materials

Project Subject Area: Chemistry

Organic light-emitting diodes (OLEDs) offer distinct advantages over traditional lighting technologies, like flexibility, lightweight design, and lower processing costs. However, their efficiency is limited by loss pathways to non-emissive triplet states. Thermally activated delayed fluorescence (TADF) can enhance OLED efficiency by converting these triplet states into emissive singlet states using thermal energy. In this project, students will perform spectroscopy measurements to investigate photophysical processes involved in TADF and assess their efficiency in OLEDs.

Project Details

Supervisor(s): Professor Girish Lakhwani
Contact: girish.lakhwani@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Credit or above in CHEM2521
- HSC Mathematics (or equivalent)
- Interest in physical chemistry, chemical physics and/or materials chemistry

Student Preparation:
- N/A

Project Location:
School of Chemistry labs in adjacent buildings F11 and F09

Attendance Mode:
On Campus (100%)

CHEM09: Novel fluorescent sensors for the detection of phosphoinositides

Project Subject Area: Molecules, Cells & Organisms

Phosphoinositides are crucial signalling lipids in mammalian cells, and their dyshomeostasis is linked to various metabolic and neurological disorders. Fluorescent sensors facilitate the detection of lipids, enabling detailed analysis of their cellular localization and function. However, there are currently few sensors available that are specific to phosphoinositides. In this project, you will develop a fluorescent biosensor utilizing a protein domain that selectively recognizes phosphoinositides. You will be trained in molecular cloning, genetic incorporation of unnatural amino acids into proteins, protein purification, and evaluation of protein-lipid interactions.

Project Details

Supervisor(s): Dr Bilge Ercan & Dr Kate Jolliffe
Contact: bilge.ercan@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Hands-on molecular biology lab experience is highly regarded but not essential
- Flexibility with time is essential

Student Preparation:
- Completion of all required training and induction is mandatory prior to commencing work in the laboratories.

If you are allocated to this project, please contact bilge.ercan@sydney.edu.au two to three weeks before the official start date to ensure all required training is completed in time.

Project Location:
Sydney Analytical Lab Space (G08) & Chemistry Building (F11), Level 5 Robinson Labs

Attendance Mode:
On Campus (100%)

CHEM10: Chemical origin of life in space

Project Subject Area: Chemistry

What are the early steps in the chemical origin of life on Earth and possibly on other planets, prior to the existence of complex organic molecules and biological systems? Our group tests the “Frankenstein” scenario, experimentally mimicking cloud-to-ground lightning strikes under a prebiotic environment on the bench top. We explore reaction pathways uniquely enabled by plasma- and radical- chemistry, as well as the role of mineral surfaces in electrochemical synthesis.

Project Details

Supervisor(s): Dr Haihui Joy Jiang
Contact: joy.jiang@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of CHEM1 and CHEM2, preferably in the Advanced or Dalyell stream
- Genuine interests in the chemical origin of life, electrochemistry, catalysis or organic synthesis research
- Prior experimental research experience in science or engineering with plans to continue doing experimental research in the future (e.g., over S1 2026) (Desirable)

Student Preparation:
- If you are allocated to this project, you must contact the supervisor to arrange the necessary paperwork and safety training (both online and in-person), and to receive the required reading materials

Project Location:
School of Chemistry (F11), Lab 319

Attendance Mode:
On Campus (100%)

CHEM11: Synthesising novel cyclic peptides for AI drug discovery

Project Subject Area: Chemistry

Cyclic peptides are an effective therapeutic modality due to their structure and conformation. Emergent machine learning (ML) methods promise novel avenues to design new and improve existing drug structures. This project will task the student with synthesising, purifying, and characterising cyclic peptides proposed through ML.

Project Details

Supervisor(s): Dr Sameer Kulkarni
Contact: sameer.kulkarni@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Experience with chemistry laboratories
- Familiarity with chemical biology (e.g. CHEM2523) is preferred

Student Preparation:
- Relevant safety training (i.e. School of Chemistry induction) will need to be completed prior to the start of the program

Project Location:
The work will take place in a research lab within the Chemistry Building (F11) and will require on-site presence each day for the duration of the project

Attendance Mode:
On Campus (100%)

CHEM12: Developing novel machine learning methods for AI drug discovery

Project Subject Area: Chemistry

Cyclic peptides are an effective therapeutic modality due to their structure and conformation. Emergent machine learning (ML) methods promise novel avenues to design new and improve existing drug structures. This project will task the student with developing ML methods to optimise peptide structures with internal and external peptide datasets.

Project Details

Supervisor(s): Dr Sameer Kulkarni
Contact: sameer.kulkarni@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Experience with Python.
- Familiarity with Pytorch and Scikit-Learn is preferred.

Student Preparation:
- N/A

Project Location:
The work is computational and can be conducted online

Attendance Mode:
Hybrid

CHEM13: Modernising the chemistry undergraduate laboratory program

Project Subject Area: Chemistry

Work integrated learning (WIL) improves student employability by integrating the theory of academic learning with its application in practice. In the laboratory environment, this is delivered through modern day experiments and contemporary laboratory techniques. In this project, students will aid in the design and testing of new laboratory experiments to be introduced into the Chemistry undergraduate laboratory programs. In the design phase, students will aid in the experiment design (and variations), develop resources (lab manual, CANVAS pages, videos) and pitch potential assessment opportunities (pre-lab, competency, post-lab). In the testing phase, students will enter the laboratory to perform the experiments, optimise the

conditions, trial variations, and determine adequate timing for a student to complete.
Scription

Project Details

Supervisor(s): Dr Shane Wilkinson
Contact: shane.wilkinson@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 1000-level Chemistry units

Student Preparation:
- School safety induction to be performed on the first day on the project

Project Location:
School of Chemistry (F11), Level 4 Undergraduate Laboratories
Some data analysis and digital work can be performed remotely

Attendance Mode:
Hybrid
60-80% on campus (in the laboratory) and 20-40% remote/online

CHEM14: Merging worlds: Gas accumulation and the dynamics of droplet coalescence

Project Subject Area: Chemistry

Have you ever wondered what happens when two tiny emulsion droplets meet and merge? What if there's gas involved — how does that change the story? This project exposes you to the microscopic world of droplet coalescence, focusing on how gas accumulation influences the way droplets deform, drain, and finally combine. You'll use a high-speed imaging setup to capture these rapid, subtle events in real time.

Project Details

Supervisor(s): Professor Chiara Neto
Contact: chiara.neto@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 1000-level Physics units
- Interest in surface science and fluid dynamics

- Background in physical chemistry, nanoscience or physics is a bonus
- Interest in experimental work relating to surface science and nanoscience expected

Student Preparation:
- N/A

Project Location:
School of Chemistry (F11), Lab 319

Attendance Mode:
On Campus or Hybrid
Students are expected to conduct lab work in the School of Chemistry (F11) most of the week and will be supervised by a postdoctoral research associate during their time in the lab
Data analysis and report preparation will require approximately half to one full day per week and can be completed remotely or in the office space provided by the School

CHEM15: Synthesis of novel cannabinoid therapeutics at the Lambert Initiative

Project Subject Area: Chemistry

The natural products isolated from cannabis, namely cannabidiol (CBD) and tetrahydrocannabinol (THC) are currently being utilised for broad therapeutic benefit. At The Lambert Initiative, we are investigating novel analogues of these natural products (phytocannabinoids) for their use in three major areas: Sleep, Epilepsy and Ageing. This project will involve hands-on synthesis and characterisation of novel natural product analogues and testing of their pharmacokinetic properties and will contribute to the broad phenotypic screening in one of the major areas of interest. Students will learn advanced synthetic organic chemistry skills, NMR (1H and 13C, 1D and 2D) and LCMS characterisation of new compounds and understand our broader phenotypic screening process.

Project Details

Supervisor(s): Dr Patrick Ryan
Contact: patrick.ryan1@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Students should have an interest in medicinal chemistry and drug design and have completed at least one 3000-level Chemistry unit

Student Preparation:

– Students should undertake and complete all BMC inductions prior to the beginning of the February session, including one of the fortnightly in-person inductions run by Brain and Mind Centre (BMC) staff

Project Location:
The Brain and Mind Centre (BMC), Level 6 & Mallett St Building (M02F) & School of Chemistry (F11)

Attendance Mode:
Hybrid
Hours are flexible but should be expected to be approximately 80% in-person

CHEM16: Developing improved methods for the synthesis of therapeutic peptides

Project Subject Area: Chemistry

Solid phase peptide synthesis (SPPS) is an important process for synthesis of high value pharmaceuticals. However, despite the technology being more than 60 years old, SPPS still possesses a number of drawbacks that pose challenges on a commercial scale. These disadvantages include extremely poor atom economy, use of toxic solvents and reagents, high solvent demand, and side reactions that complicate purification of the final product. This project seeks to modernise SPPS and thereby deliver a process that is practical and environmentally benign for the commercial scale production of peptides. During this project you will gain hands-on experience with organic synthesis and techniques, compound characterisation, solid phase synthesis and compound purification.

Project Details

Supervisor(s): Dr Leo Corcilius
Contact: leo.corcilius@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Must be enrolled in a CHEM2 unit of study at the time of application
- Students should have a strong interest in organic synthesis

Student Preparation:
– Onsite laboratory induction prior to commencement

Project Location:
School of Chemistry Building (F11), Cornforth/Robinson labs (Room 528/532)

Attendance Mode:
On Campus

CHEM17: Peptidomimetic fluorescent probes for the detection of phospholipids in live cells

Project Subject Area: Other

Phospholipids play crucial roles beyond cell structure, including cell signaling, cargo trafficking, and disease progression. However, there are currently no effective tools to track specific phospholipids in live cells in real time. This project focuses on developing and validating fluorescent sensors for phospholipids, enabling spatial and temporal imaging. You will test these sensors in simple model systems (like liposomes and giant unilamellar vesicles) and complex systems (like healthy and cancer cells), assessing their selectivity, toxicity, and localisation using fluorescence microscopy. The project is supported by the ARC Centre of Excellence and provides access to advanced tools such as organelle markers, endocytosis inhibitors, and plasmids to manipulate phospholipid levels.

Project Details

Supervisor(s): Professor Kate Jolliffe & Dr Nian Kee Tan
Contact: nian.tan@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Students should have a genuine interest in Chemical Biology
- Students may learn these skills:
    - Wet lab techniques/SPPS
    - Cell culture experience
- Desirable (but non-essential):
    - Basic understanding of statistics
    - Coding skills to support high-throughput data analysis
    - Familiarity with machine learning tools

Student Preparation:
- Students must complete the following inductions at least one week prior to starting. These typically take 1–2 days to complete:
    - Chemistry Building induction
    - Biological Safety induction
    - Chemical Safety induction
    - Risk assessment and Safe Work Procedure for Sydney Microscopy and Microanalysis (SMM)

Project Location:
School of Chemistry (F11) Office, Room 209
School of Chemistry (F11), lab 528
Madsen Building (F09) Cell culture/fluorescence microscope –1-132B

Attendance Mode:
On Campus (100%)

School of Geosciences

GEOS01: Microgeodynamics of the mantle-crust transition zone

Project Subject Area: Geology & Geophysics

The mantle-crust transition zone is the most important mechanical boundary in the Earth's lithosphere. The goal is to inform models on the structure, kinematics, and petrophysical properties of the transition zone. In this project, you will analyse samples from the Moho in the Oman ophiolite by integrating light and electron microscopy data.

Project Details

Supervisor(s): Dr Vasileios Chatzaras
Contact: vasileios.chatzaras@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 2000-level Geology and Geophysics units
- Interest in microscopy
- Familiarity with Python is recommended but not required

Student Preparation:
- N/A

Project Location:
Madsen Building (F09), Sydney Geology Lab, Room 305

Attendance Mode:
Hybrid
70% on campus and 30% online
On-campus research involves using light microscopes and processing electron microscopy data with dedicated software tools

GEOS02: Lesson from coral reefs systems on the edge: investigating the impact of rapid environmental change on reef development

Project Subject Area: Marine Science

This project investigates how coral reefs responded to rapid environmental change over the past 500,000 years, with implications for their future under rising sea levels, warming, acidification and poor water quality. Using fossil reef records from across the Indo-Pacific—including the Great Barrier Reef, Tahiti, Hawaii, and the Northwest Shelf of Australia—we will reconstruct past reef growth, stress, and collapse events. Geochemical proxies (e.g., isotopes, trace and rare earth elements) and quantitative analyses of reef assemblages, growth rates, and bioerosion will be combined to test whether reef responses were random or predictable. Innovative ecological and stratigraphic modelling will simulate how reefs reacted to shifts in sea level, water quality, and wave energy. The project is part of a major ARC Discovery-funded collaboration and will be based at the University of Sydney, School of Geosciences with the Geocoastal Research Group.

Project Details

Supervisor(s): Professor Jody Webster
Contact: jody.webster@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- An interest in geosciences, biological sciences, and marine sciences

Student Preparation:
- N/A

Project Location:
Madsen Building (F09), GeoReef lab (Room 206) and associated Geoscience labs.

Attendance Mode:
Hybrid
80% on campus and 20% online

School of Physics

PHYS01: AB initio computational design of advanced materials for CO2 utilization

Project Subject Area: Physics

This project will use accurate quantum mechanical calculations carried out on high performance computers to study the adsorption of atoms and molecules on surfaces of advanced materials such as monolayer structures. The associated chemical and physical properties will be investigated along with the calculation of reaction pathways for the adsorbed species to form targeted products. New computational skills will be learnt as well as deepened knowledge about condensed matter physics and materials, relevant for heterogeneous catalysis.

Project Details

Supervisor(s): Professor Catherine Stampfl
Contact: catherine.stampfl@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Interest in surface science and nanoscience
- Proficiency with computers

Student Preparation:
- Familiarity with Python, Unix/Linux, and Overleaf

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS02: Precision measurements of Higgs boson properties with the ATLAS experiment

Project Subject Area: Physics

The Higgs boson plays a central role in the Standard Model of particle physics, as well as in many new physics theories. It was experimentally observed by the ATLAS and CMS experiments at the LHC in 2012. Since its discovery, precision

measurements of the Higgs boson's properties have become one of the primary objectives of the LHC physics program. In this project, the student will measure the strength of the Higgs boson's interaction with the top quark using data collected by the ATLAS experiment. By analysing the kinematic and topological properties of the top quark and the Higgs boson, the student will develop selection criteria to distinguish signal events containing the Higgs boson and top quarks from background events. Special relativity principles and advanced statistical methods will also be applied in this project. Prior basic knowledge of Python or C++ would be useful for this project, but it is not required.

Project Details

Supervisor(s): Dr Harish Potti
Contact: harish.potti@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of 1000-level Physics units
- Some proficiency with computers and statistical analysis
- Interest in Particle Physics

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28), Room 343A

Attendance Mode:
On Campus

PHYS03: What switches a super-massive black hole on and off?

Project Subject Area: Astronomy and Astrophysics

At the centre of most galaxies is a super-massive black hole that can accrete gas and grow over cosmic time. The material they accrete forms a disk that can heat up and radiate energy, sometimes outshining the rest of the galaxy. These objects, called quasars, show signatures of gas moving rapidly around the black hole, in the form of broad emission lines in their spectra. We have recently identified a galaxy with a super-massive black hole that has rapidly changed its luminosity and emission lines. In this project you will analyse the spectra and look at time-domain imaging data to try to better understand what may be driving these changes.

Project Details

Supervisor(s): Professor Scott Croom
Contact: scott.croom@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of 2000-level Physics units
- Experience using Python for scientific applications
- Some experience using Python to analyse astronomical spectra or time-domain imaging would be valuable, though not required

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus (100%)

PHYS04: Fault-tolerant quantum logic gates

Project Subject Area: Physics

Quantum error-correcting codes are designed to catch and correct errors that occur during a quantum computation. Without quantum error correction, a computation is quickly overwhelmed by noise. With quantum error correction, a computation can be performed fault-tolerantly to deliver a reliable answer even in the presence of noise. In this project we will take recent breakthroughs in the theory of fault-tolerant logic gates and explore how these ideas can be implemented on existing or future quantum hardware, such as IBM's superconducting quantum devices. We will analyze and simulate different implementations of fault-tolerant quantum logic gates to evaluate the most promising approaches.

Project Details

Supervisor(s): Dr Dominic Williamson, Dr Georgia Nixon & Dr Campbell McLauchlan
Contact: dominic.williamson@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of second year physics quantum mechanics module (Required)
- Completion of third year physics quantum mechanics module (Desirable)
- Proficiency with linear algebra and Python (Desirable)

Student Preparation:
- Background reading:
    - https://arxiv.org/abs/quant-ph/0110143

- Reference textbooks:
    - https://profmcruz.wordpress.com/wp-content/uploads/2017/08/quantum-computation-and-quantum-information-nielsen-chuang.pdf
    - https://www.cs.umd.edu/class/spring2024/cmsc858G/QECCbook-2024-ch1-8.pdf

Project Location:
School of Physics, Brennan Maccallum Building (A28), Room 321

Attendance Mode:
Hybrid
60% on campus and 40% online
The suggested schedule is remote research on Mondays and Fridays, with on-campus research conducted on Tuesdays, Wednesdays, and Thursdays each week

PHYS05: Neutrinos from nuclear reactors

Project Subject Area: Physics

When nuclear fission takes place, a tiny fraction of the energy released is in the form of neutrinos. Neutrinos are elementary particles that possess almost no mass and only interact with matter through the Weak nuclear force. They are extremely challenging to detect, but the availability of commercial or research nuclear reactors provides a convenient source we can use to study their mysterious nature as long as we can develop the highly sensitive detectors needed to capture them. This project would be about designing and assessing the feasibility of a reactor neutrino experiment in Australia using ANSTO's 20 MW research reactor. This project is primarily theoretical in nature and will involve a mixture of particle physics calculations and data analysis in Python.

Project Details

Supervisor(s): Dr Ciaran O'Hare
Contact: ciaran.ohare@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Familiarity with a programming language
- Some knowledge of particle and/or nuclear physics is advantageous but not required

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28).
Students will be provided with a desk and are strongly encouraged to work on campus and actively engage with the Particle Physics research group

Attendance Mode:
On Campus

PHYS06: Interstellar exploration with lightsails

Project Subject Area: Physics

Lightsails, extremely thin probes accelerated to 20% of the speed of light by powerful earth-based lasers, could be exploring the planets orbiting Alpha-Centauri within your lifetime. While the technology is now within reach, much of the detailed physics of the launch phase still remains to be understood. This project will look at how to improve the stability of lightsails within the laser beam, by optimizing diffractive gratings that can provide stabilizing photonic forces due to relativistic effects. This project requires good knowledge of python.

Project Details

Supervisor(s): Professor Boris Kuhlmey
Contact: boris.kuhlmey@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of 2000-level Physics units, ideally including PHYS2013
- Proficiency in Python

Student Preparation:
- N/A

Project Location:

This project is coding-based and can be conducted remotely. While attending in-person meetings at the School of Physics, Brennan MacCallum Building (A28) is preferred, it is not required

Attendance Mode:
Hybrid

PHYS07: The spinning of galaxies over the last 4 billion years

Project Subject Area: Physics

The shape and spin of galaxies depend strongly on the density of their surrounding environment, but how environment drives these changes remains unclear. We aim to map the local and cosmic environments of distant galaxies observed as they were evolving about 4 billion years ago, providing a unique laboratory to study environmental effects on galaxy spin and their role in galaxy evolution. Our work will use spectroscopic data from the MAGPI survey at the Very Large Telescope in Chile, combined with observations of nearby galaxies from the SAMI survey at the Anglo-Australian Telescope. This comparison will allow us to link galaxy evolution from the distant past to today. Students involved will gain skills in computer science, data collection, data analysis, and statistics.

Project Details

Supervisor(s): Dr Stefania Barsanti
Contact: stefania.barsanti@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Interest in astronomy and/or data science
- Familiarity with Python

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28), Room 328

Attendance Mode:
Hybrid

Hours Per Week:
50% on campus and 50% online

PHYS09: Time-domain asteroseismology from multiple space missions

Project Subject Area: Astronomy and Astrophysics

Asteroseismology - the study of oscillations in stars, which can be measured as tiny fluctuations in their brightness or colour - reveals subtle details about stellar interiors that cannot be measured by other techniques. Sometimes we have contemporaneous observations of a star from multiple sources. The undergraduate researcher will work with Dr. Joel Ong to apply newly developed multichannel methods to concurrently analyse multiple data sets at once, with a particular focus on recovering signals of stellar oscillations. This may help improve our ability to process data from the NASA TESS and James Webb space telescopes, as well as assist in our preparatory efforts for the upcoming Nancy Grace Roman space telescope.

Project Details

Supervisor(s): Professor Tim Bedding
Contact: tim.bedding@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 1000-level Maths and Physics units
- Some experience with numerical programming (e.g. in Python).

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS10: Soliton interactions

Project Subject Area: Physics

We are interested in optical solitons, short light pulses that balance the effects of dispersion (refractive index depends on frequency) and nonlinearity (refractive index depends on intensity). This project is about calculations of the interactions between different solitons, and under what conditions they attract or repel. In this project students will learn about solitons, will do some programming, and will carry out

numerical calculations using existing packages. This work will complement our ongoing laboratory experiments in this area.

Project Details

Supervisor(s): Professor Martijn de Sterke
Contact: martijn.desterke@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 1000-level Physics units

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28), Room 310
One or two days of travel may be required to attend part of a workshop in Wollongong.

Attendance Mode:
On Campus and on-site (100%)

PHYS11: Simulating galaxy-galaxy gravitational lenses

Project Subject Area: Astronomy and Astrophysics

Strong gravitational lensing occurs when a foreground galaxy's mass deforms the spacetime between the observer and a higher redshift background galaxy, causing the background galaxy to appear magnified and multiply-imaged. The student(s) will write Python code to generate images of galaxy-galaxy lens systems, and learn about how changes to how mass is distributed in the foreground galaxy can alter the morphological properties of observed gravitational lenses. This suite of simulations will be a useful tool for studying cosmology, dark matter, galaxy evolution, or the behaviour of gravity itself on extragalactic scales. There is therefore lots of scope to expand or tailor this project towards the specific interests of the student(s).

Project Details

Supervisor(s): Dr Daniel Ballard
Contact: daniel.ballard@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Proficiency with Python (Desirable)

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS12: Characterisation of R Coronae Borealis dust properties

Project Subject Area: Astronomy and Astrophysics

This project focuses on a rare type of dusty variable star known as the R Coronae Borealis variables. We will be creating a code that will automatically detect when these stars produce dust by using the dips in their light curves. The student will be given the freedom to experiment and decide on their own creative methods to solve this problem.

Project Details

Supervisor(s): Dr Courtney Crawford
Contact: courtney.crawford@sydney.edu.au

Maximum number of places available:
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Interest in astronomy and data driven analysis as well as experience with Python coding (Required)
- Experience with machine learning techniques and statistics (Desirable)

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)
The student will be allowed a desk to sit in the Physics Building.

Attendance Mode:
On Campus

A hybrid format is negotiable

PHYS13: Real-time cosmic ray detection for next-generation weather forecasting in Australia

Project Subject Area: Physics

This project will establish Australia's first experimental muon detector network to improve weather forecasting using cosmic ray measurements. Students will build and deploy approximately five 1m² muon detectors around Sydney, working in collaboration with researchers from The Ohio State University to create real-time atmospheric monitoring systems. You'll learn to measure systematic differences between actual muon flux readings and weather model predictions, then integrate this novel data into operational forecasting systems to assess improvements in prediction accuracy. The project combines particle physics detection techniques with meteorological science, offering hands-on experience with detector construction, data analysis, and atmospheric modeling while contributing to groundbreaking Southern Hemisphere validation of this emerging forecasting technology.

Project Details

Supervisor(s): Dr Laura Manenti
Contact: laura.manenti@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- N/A

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28), Room 429-430

Attendance Mode:
On Campus
30 hours per week on campus, 5 hours per week remote

PHYS14: How does the brain compute? Distributed dynamical computation in neural circuits

Project Subject Area: Physics

One of the most fundamental questions about the brain is how it performs computation. To address this, we have developed the concept of distributed dynamical computation (DDC), in which neural computation and information processing arise from interactions among propagating wave packets. DDC bridges previously disconnected perspectives on brain dynamics and computation. Recently, we demonstrated that, within the DDC framework, wave packets can efficiently implement sampling-based probabilistic computation. This project will further develop the links between neural dynamics and computation, including an in-depth study of neural circuit models developed by our research group. The goal is to uncover the physical principles underlying key brain functions such as visual processing and attention, and to lay the foundation for brain-inspired artificial intelligence.

Project Details

Supervisor(s): Professor Pulin Gong
Contact: pulin.gong@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
– N/A

Student Preparation:
– N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS15: The physics of deep learning in artificial intelligence

Project Subject Area: Physics

Deep neural networks, widely used in artificial intelligence (AI), can be trained to solve a variety of real-world problems, including speech recognition, object detection, and drug discovery. However, our understanding of why they are so effective remains incomplete. Recently, we discovered that the learning process in deep neural networks exhibits complex anomalous diffusion dynamics, in contrast to the conventional assumption of normal diffusion (i.e., Brownian motion). These dynamics include intermittent large jumps that prevent the learning process from becoming trapped in local minima, thereby enabling the attainment of optimal solutions. This finding offers a new explanation for the effectiveness of deep neural networks. This project will investigate the physical mechanisms underlying these complex learning dynamics. Specifically, it will explore how the fractal, self-similar geometry of loss landscapes interacts with gradient descent to give rise to these behaviors. Students participating in this project will also learn essential AI models and algorithms.

Project Details

Supervisor(s): Professor Pulin Gong
Contact: pulin.gong@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- N/A

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS16: Disks around Be stars

Project Subject Area: Astronomy and Astrophysics

Be stars are hot, bright stars that show emission lines in their spectra from a disk of material that surrounds the star. Unlike the material in a standard accretion disk, where gas is spiralling towards the centre, the gas in a Be-star disk is moving outwards – a so-called "excretion disk". This project aims to identify similarities and differences between the two types of disks. This will involve understanding the theory of disks, to see how different heating processes change the temperature profile of the disk and then comparing these predictions with observations.

Project Details

Supervisor(s): Associate Professor Helen Johnston
Contact: h.johnston@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
– N/A

Student Preparation:
– N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
Hybrid
Regular on-campus meetings are required, though most of the project work can be completed online if preferred

PHYS17: Stability requirements for quantum hard drives for light

Project Subject Area: Physics

The concept of distributing quantum entanglement over long distances by sending light (photons) in free space or in an optical fibre is ubiquitous. But there is currently no solutions for sending light distances greater than 100 km with high (e.g. >90%) efficiency, which places stringent limits on the performance of networked quantum technologies. Our group investigates an alternative: using atoms in a crystal to absorb, store, transport, and reemit light. This project will contribute to our understanding of what the magnetic and pressure stability requirements on such a quantum hard drive are. The work will involve working with the Quantum Integration Lab team to measure and model magnetic and pressure shifts in crystals containing erbium using laser and microwave techniques. You will learn about atomic energy levels, laser spectroscopy, cryogenic measurements, running experiments in a quantum lab, and much more.

Project Details

Supervisor(s): Dr John Bartholomew
Contact: john.bartholomew@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- We are happy to tailor the project to different levels of study, experience, or preferences around theoretical or experimental strengths
- An interest in quantum mechanics and quantum technology will provide a strong starting point

Student Preparation:
- Participants must complete the required safety inductions before commencing the project. These include:
  (i) SNH Building Induction (can be completed online)
  (ii) Laser Safety Induction (can be completed online)
  (iii) QIL Lab Induction (requires on-site attendance and takes approximately 1–2 hours)

Project Location:
Sydney Nanoscience Hub (A31), 4th floor offices and 2nd floor labs (SNH2018 and SNH2020)

Attendance Mode:
On Campus and on-site
Ideally, the student would be available to attend on-site five days a week; however, we are open to discussing alternative arrangements if needed

PHYS18: Construction of an advanced laser system for quantum information experiments with trapped ions

Project Subject Area: Physics

At the Quantum Control Laboratory, we develop cutting-edge trapped-ion quantum technologies. This project will give students hands-on experience in optics by building a new laser setup, which will play a crucial role in precision control of our ion systems. The student will learn practical skills in optical alignment, laser characterisation, and working with advanced photonics equipment, while contributing to an active research environment at the forefront of quantum science.

Project Details

Supervisor(s): Dr Cameron McGarry
Contact: cameron.mcgarry@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Familiarity with optics experiments is desirable but not required

Student Preparation:
- N/A

Project Location:
Sydney Nanoscience Hub (A31), Quantum Control Laboratory

Attendance Mode:
On Campus

PHYS19: Identifying galaxies that have gone through past mergers, and those that haven't

Project Subject Area: Astronomy and Astrophysics

Our picture of galaxy formation is hierarchical, with small galaxies forming early and merging to build larger galaxies over time. But galaxies in the early Universe did not look the same as galaxies now. For example, galaxies were much more compact in the early Universe, even when compared to galaxies in the local Universe of the same mass. This evolution in size seems to be driven by galaxy merging. However, merging is random, so a small fraction of galaxies undergo few or no mergers. These relic galaxies are structurally the same as galaxies in the distant Universe. In this project you will use simulations to test how effectively we can predict the merger history of local galaxies, using machine learning techniques. We will then apply the approach to recent data sets such as the Sydney led SAMI and Hector galaxy surveys.

Project Details

Supervisor(s): Professor Scott Croom
Contact: scott.croom@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of 2000-level Physics
- Experience of scientific use of Python language
- Some experience using Python to analyse astronomical data, or application of machine learning would be an advantage, but not required

Student Preparation:
- N/A

Project Location:
School of Physics, Brennan Maccallum Building (A28)

Attendance Mode:
On Campus

PHYS20: Vortices and caustics

Project Subject Area: Physics

Quantum caustics are lower-dimensional regions of a wavefunction where interference leads to focused intensity patterns, and which regions are classified by catastrophe theory. These structures may lead to phase singularities (quantum vortices), where the wavefunction amplitude vanishes and its phase winds around a core, linking geometry to topological features in quantum fields. The project will involve coding (e.g., Matlab or python) and it aims to quantify some properties of vortices in different geometries.

Project Details

Supervisor(s): Dr Daniel Schumayer
Contact: daniel.schumayer@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- The project is computational hence previous exposure to numerical physics would be highly advantageous. While may use built-in software packages, the aptitude to do programming in some high-level languages would be necessary.

Student Preparation:
- Ideally, a meeting with the candidate and supervisor would take place before Christmas to discuss the timeline and aims

Project Location:
School of Physics, Brennan Maccallum Building (A28)
The project can be undertaken in hybrid mode. We plan to begin with some face-to-face meetings, after which you may work from home. Online meetings can be arranged as the project progresses.

Attendance Mode:
Hybrid
40% on campus and 60% online

PHYS21: Quantifying asymmetry in time series

Project Subject Area: Data Science

Repeated measurement of some system through time, forming time-series data, is how we learn about the dynamics of the world around us. Many such data streams exhibit marked asymmetries, for example, in the probability of increases versus decreases, or the statistics of the process above or below the mean. These are statistical indicators of deviations from the typically studied linear Gaussian processes in time-series textbooks. This project will explore a new method for quantifying asymmetry by considering a time series as a sequence of rigid physical 'stick-like' objects that can rotate about an axis and quantifying the properties of the set of allowed rotation angles of these objects. The student will be expected to develop the associated theory and validate it using simulations of reversible and irreversible processes.

Project Details

Supervisor(s): Associate Professor Ben Fulcher
Contact: ben.fulcher@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- The student should have a quantitative background (physics/computer science/data science/statistics/mathematics) and be interested in dynamics

Student Preparation:
- N/A

Project Location:
This is a project involving numerical and theoretical work. It will be undertaken in Madsen Building (F09), Level 4

Attendance Mode:
On Campus
Some flexibility for online work is allowable

School of Life and Environmental Sciences

SOLE01: Optimising growth performance: Re-evaluate energy systems for poultry

Project Subject Area: Agriculture and Food

This computer-based research project focuses on evaluating various dietary energy systems in poultry nutrition, with regular catch-up meetings held at the Camden campus or online. Dietary energy is the most critical nutrient influencing feed intake, growth performance, and overall feed cost in poultry production. The core objective of this project is to develop a publishable manuscript based on meta-analyses of existing data. This includes calculating energy values using different systems and correlating them with in vivo growth performance from studies conducted over the past five years in our lab. The findings will offer insights into the advantages and limitations of each energy system and assess the feasibility of transitioning toward the Net Energy system in commercial poultry nutrition.

Project Details

Supervisor(s): Associate Professor Sonia Liu
Contact: sonia.liu@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- N/A

Student Preparation:
- N/A

Project Location:
Camden Campus (C01)

Attendance Mode:
Hybrid

Hours Per Week:
50% on campus and 50% online

SOLE02: De novo generation of novel analgesics

Project Subject Area: Biology

This project leverages novel protein folding models to design peptides that can block receptors. The student will learn to use bioinformatic tools to design these new peptides.

Project Details

Supervisor(s): Dr Lipin Loo
Contact: lipin.loo@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Interest in de novo synthesis and drug development
- Familiarity with Python and R

Student Preparation:
- N/A

Project Location:
Online and Charles Perkins Centre (D17)

Attendance Mode:
Online (100%)

SOLE03: Developing novel lead molecules to fight antibiotic resistance

Project Subject Area: Molecules, Cells & Organisms

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. One reason for this is there have been few new classes of antibiotics introduced. Our project aims to alleviate this issue by developing novel classes of antibiotics against important biomolecular interactions that have not been targeted previously.

Project Details

Supervisor(s): Associate Professor Ann Kwan
Contact: ann.kwan@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
Completion of BIOL1997 or BCMB2/3XXX unit

Student Preparation:
- Both online and on-site laboratory inductions (1 day total) must be completed at least three working days prior to the project start date to allow sufficient time for access requests to be processed

Project Location:
- Most of the research will be conducted in the Molecular Bioscience Building (G08) but depending on the experiments, visits to other buildings located in the Camperdown campus are likely.

Attendance Mode:
On Campus
Some data analysis can be performed remotely

SOLE04: Engineering protein coats for biotech applications

Project Subject Area: Molecules, Cells & Organisms

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 biocompatibility of surfaces. You will investigate the production and characterisation of modified hydrophobins including their ability to coat different materials, including 3D-printed scaffolds and drug delivery vehicles.

Project Details

Supervisor(s): Associate Professor Ann Kwan
Contact: ann.kwan@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of BIOL1997 or at least one BCMB2/3XXX unit

Student Preparation:

- Both online and on-site laboratory inductions (1 day total) must be completed at least three working days prior to the project start date to allow sufficient time for access requests to be processed

Project Location:
Mostly in the Molecular Bioscience Building (G08) but depending on the experiments, visits to other buildings on campus are likely.

Attendance Mode:
On Campus
Some data analysis that can be performed remotely.

SOLE05: The spatial ecology of corals in tropical and subtropical regions

Project Subject Area: Ecology, Evolution, & Conservation

Subtropical reefs are home to corals at their poleward distributional limits and are already experiencing the effects of climate change. You will work with underwater photographs from reef areas in subtropical regions in Japan and Australia to determine spatial dynamics of corals on the seafloor. You will learn to identify corals and use specialised software to annotate corals on large-area underwater photographic maps of the seafloor (orthomosaics) to determine size-based patterns for different species, and the incidence of coral bleaching in response to heat stress. This will help understand the ecology of these dynamic systems that are already being transformed by warming and associated changes in species distributions and interactions.

Project Details

Supervisor(s): Dr Brigitte Sommer
Contact: brigitte.sommer@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- No prerequisite experience is needed as tasks will be explained at the start of the project with ongoing help available.
- An interest in marine ecology is helpful but not critical.

Student Preparation:
- Students should be comfortable with computers and learning to use new software and technology

Project Location:
Edgeworth David Building (A11)

Photo annotations are done on state-of-the art Wacom creative pen display tablets and specialised software available on workstations in the marine ecology lab in Edgeworth David Building (A11), Camperdown.

Attendance Mode:
On Campus (100%)

SOLE06: Structure-based AI-guided discovery of small-molecule drug leads

Project Subject Area: Molecules, Cells & Organisms

Drug discovery is a long and expensive process costing on average USD 1 billion and 15 years to bring a new drug to the market. Artificial Intelligence (AI) is offering new opportunities to screen large numbers of chemical structures to significantly lower the costs and time to find potential drugs. Our project aims at leveraging the power of AI to find potential modulators of significant protein targets. In this project, you will learn a range of computational techniques in structural biology and drug discovery such as structural modeling, molecular docking, molecular dynamics simulation, and the basics of machine learning.

Project Details

Supervisor(s): Associate Professor Ann Kwan
Contact: ann.kwan@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of BIOL1997 and/or BCMB2/3XXX
- Some programming experience and/or strong interest in AI

Student Preparation:
- N/A

Project Location:
Molecular Bioscience Building (G08), Level 6

Attendance Mode:
Hybrid
Remote work is possible once you have mastered the techniques and are able to run the programs independently

SOLE07: Developing a pipeline to reprogram seekRNA

Project Subject Area: Other

seekRNA is an emerging RNA-based platform with potential applications in gene editing and programmable cargo insertion. This project will focus on designing a computational pipeline to reprogram seekRNA molecules for targeted sequence recognition and structural optimization. Students will learn to retrieve guide sequences, manipulate target regions, and integrate them into a modular RNA scaffold. The pipeline will include RNA structure prediction and comparative analysis to assess the impact of reprogramming on folding and stability. This project offers hands-on experience in synthetic biology and bioinformatics, with potential implications for next-generation RNA therapeutics.

Project Details

Supervisor(s): Dr Sandro F Ataide & Rezwan Siddiqquee
Contact: sandro.ataide@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Familiarity with R and bioinformatics

Student Preparation:
- Molecular Bioscience Building (G08) orientation

Project Location:
Molecular Bioscience Building (G08), Room 672 and 383

Attendance Mode:
Hybrid
30% on campus and 70% online

SOLE08: Estimating soil moisture using a statistical machine learning approach

Project Subject Area: Agriculture and Food

This project utilises machine learning methods (e.g., random forest), to estimate soil moisture at multiple depths in a monitored agricultural area. The students will learn the entire process of developing machine learning models, including data preparation, feature selection, hyperparameter tuning, model training, and testing. The students will also learn common model validation methods and metrics, as well as how to visualize them.

Project Details

Supervisor(s): Dr Yuxi Zhang
Contact: yuxi.zhang@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Proficiency with computers and statistical analysis
- Familiarity with Python (packages: NumPy, Pandas) and ArcGIS
- Interest in machine learning

Student Preparation:
- N/A

Project Location:
This project does not require on-site attendance

Attendance Mode:
Online (100%)

SOLE11: Antioxidant bioactivity of isolated phycobiliproteins

Project Subject Area: Biology

Phycobiliproteins are colored hydrophilic pigment proteins in red algae and cyanobacteria. Phycobiliproteins consist of phycobilin (chromophore) and apoprotein by covalent bond. There are three subclasses of phycobiliproteins according to their colours (maximal absorption): phycoerythrin, phycocyanin, and allophycocyanin. Typical phycobiliproteins demonstrated multiple biological activities, including antioxidant and antibacterial activities. This project aims to evaluate the antioxidant activities of isolated phycobiliproteins, especially the unique allophycocyanin. You will learn the methods to isolate phycobiliprotein from different cyanobacteria, including Chl f-containing cyanobacterium and conduct assays for antioxidant activities.

Project Details

Supervisor(s): Professor Min Chen
Contact: min.chen@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Hands-on laboratory experiences

Student Preparation:
- WHS training and PC2 lab introduction

Project Location:
Life, Earth and Environmental Sciences (LEES) Building (F22), Level 5

Attendance Mode:
On Campus (100%)

School of Mathematics and Statistics

MATH01: Modelling sensory data from the Australian red meat industry

Project Subject Area: Statistics

The beef industry in Australia is worth $15 billion annually and the sheep meat industry is worth another $5 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 will focus on the statistical issues associated with analysing consumer sensory data to predict meat eating quality. Examples of projects include: robust multi-level and multi-class modelling of consumer sensory data which often contains many outliers; determining the relative importance of eating quality factors such as flavour, tenderness and juiciness for overall palatability and purchasing intention; evaluating the importance of "link product" as a common starting benchmark across consumers; developing methods and protocols to evaluate new objective grading technologies; and designing dashboards to help inform the decision making of processors and producers across Australia.

Project Details

Supervisor(s): Associate Professor Garth Tarr
Contact: garth.tarr@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of DATA2002 or DATA2902

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07)

Attendance Mode:
Hybrid
50% on campus and 50% online (with some flexibility)

MATH02: Inequalities in geometry and analysis

Project Subject Area: Mathematical Sciences

This project surveys fundamental inequalities in geometry and analysis, including the classical isoperimetric inequality, the Brunn-Minkowski inequality, the Sobolev inequality, the Brascamp-Lieb inequality, the Prékopa-Leindler inequality, and many others. The aim is to explore the connections among these inequalities, study their applications, and investigate new proofs.

Project Details

Supervisor(s): Associate Professor Jiakun Liu
Contact: jiakun.liu@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Multi-variable calculus, real analysis, and differential geometry

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07), Rooms 488, 535 or 727

Attendance Mode:
Hybrid
1-2 hours per week of on campus meetings each week. The remainder of the project can be completed either on campus or online

MATH03: Neural posterior learning for bayesian model choice

Project Subject Area: Statistics

Bayesian model choice provides a principled framework for comparing competing hypotheses on the data generating process, but its implementation remains challenging when likelihoods are intractable or when the model space is high-dimensional. This project proposes to harness neural networks as flexible, data-driven tools for Bayesian model choice. We will investigate neural architectures that learn low-dimensional, sufficient-like representations of the data for distinguishing between candidate models and estimating posterior model probabilities. The

outcomes will establish neural posterior learning as a scalable and robust strategy for Bayesian model choice.

Project Details

Supervisor(s): Associate Professor Clara Grazian
Contact: clara.grazian@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Some statistical/mathematical units

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07)

Attendance Mode:
Hybrid

MATH04: Modelling liver disease and risk factors

Project Subject Area: Mathematical Sciences

For people with fatty liver disease, routine monitoring to detect development of late-stage liver disease or cancer can lead to better health outcomes; however, for many this is not necessary as their risk is relatively low. For example, alcohol cessation and weight loss can quickly reduce risk of liver disease and cancer, meaning ongoing monitoring has limited benefits.

The goal of this project will be to analyse existing models of liver disease and adapt them to capture the impact of risk factor changes over time, such as weight gain/loss and alcohol use/cessation. This project would suit someone with experience in differential equations and coding/numerical analysis and an interest in epidemiology/public health..

Project Details

Supervisor(s): Professor Peter Kim
Contact: peter.kim@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Familiarity with ordinary differential equations (such as taught in MATH3063 Nonlinear ODEs with applications)
- Interest in applying mathematical modelling to biological problems, especially in public health
- A background in ODEs and maybe PDEs
- Ability to program or learn to program, e.g., Matlab, R, Python

Student Preparation:
- N/A

Project Location:
School of Mathematics and Statistics, Carslaw Building (F07), Room 621

Attendance Mode:
Hybrid
50% on campus and 50% online

MATH05: Data science approaches to biomarker translation in precision medicine

Project Subject Area: Data Science

In the age of precision medicine, molecular markers discovered through advanced multi-omics techniques hold great potential for improving clinical decision-making. However, their wider applicability is often limited and restricted because of their substantial drop in performance when applied beyond the original discovery datasets. Such differences may arise from differences in cohort composition or different diagnostic platforms. This project investigates machine learning and AI methods that ensure both the markers (features) and their associated models remain transferable incorporating translational constraints in health care.

Project Details

Supervisor(s): Professor Jean Yang
Contact: jean.yang@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of DATA2002 or DATA2902

Student Preparation:
– N/A

Project Location:
Carslaw Building (F07) or Charles Perkins Centre (D17)

Attendance Mode:
Hybrid
At least 40% onsite.

MATH06: Agent based tools for interactive exploration spatial omics data

Project Subject Area: Data Science

Spatially omics technologies map gene and protein expression at high resolution in situ, enabling new insight into tissue biology. This project will build an LLM-powered tool for spatial biology that can collect data, find patterns in tissues, and suggest the next steps for experiments or design. Students will implement a robust workflow that integrates multiple spatial omics datasets with downstream design objectives, applying critical thinking strategies at each stage. Depending on interest, students will focus either on the model layer (tool use, chain-of-thought auditing, benchmarking) or on interactive UX and visualisation. Deliverables include a containerised pipeline, cross-dataset benchmarks, or a working agent demo.

Project Details

Supervisor(s): Professor Jean Yang
Contact: jean.yang@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
– Proficiency with computers and data analysis, and an interest in bioinformatics

Student Preparation:
– N/A

Project Location:
Carslaw Building (F07) or Charles Perkins Centre (D17)

Attendance Mode:
Hybrid
At least 40% onsite

MATH07: Quantum Automorphisms of Trees and their Representations

Project Subject Area: Mathematical Sciences

Compact quantum groups are noncommutative analogues of compact groups. More formally, a compact quantum group is a unital C*-algebra and a coassociative comultiplication satisfying conditions that make commutative examples just function algebras on compact groups. An important class of examples are known as easy quantum groups, and their distinguishing feature is that their representation category is governed by combinatorial structures known as partition diagrams. In this project we will look at examples of quantum groups coming from quantum automorphisms of trees, and we will investigate whether their representations can be described using combinatorial information, as is the case for easy quantum groups.

Project Details

Supervisor(s): Associate Professor Nathan Brownlowe
Contact: nathan.brownlowe@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of MATH2X22 and MATH2X93

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07)

Attendance Mode:
Hybrid
Weekly meetings on campus, the rest of the project is flexible

MATH08: Post-quantum cryptography

Project Subject Area: Mathematical Sciences

The most widely used algorithms for public-key cryptography, a method of conveying protected information on open channels, rely on the difficulty of factorising large numbers. When sufficiently powerful quantum computers are available, large integers will be factorised quickly, and so we need new mathematical ideas that will be difficult

to decode, even for quantum computers. This project explores two mathematical directions: noncommutative groups and modular lattices for such ideas.

Project Details

Supervisor(s): Professor Nalini Joshi
Contact: nalini.joshi@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- 2000-level Mathematics units

Student Preparation:
- Reading material will be provided before the project starts
- A meeting in late November or mid-December will be arranged to outline the project

Project Location:
Carslaw Building (F07), Level 6, Room 629

Attendance Mode:
Hybrid
There will be a one-hour meeting on campus each week, the rest of the project can be completed remotely

MATH09: Fractals in dynamical systems

Project Subject Area: Mathematical Sciences

In this project you will learn how fractal objects appear naturally in non-linear dynamical systems. You'll learn computational methods to compute different types of fractal dimensions, generalizing the concepts of dimension in Euclidean geometry. The goal of the project is to completely characterize fractals in both the parameter- and phase-space of a simple chaotic system. You can expect a combination of mathematical and computational ideas, including beautiful figures of fractals.

Project Details

Supervisor(s): Professor Eduardo G. Altmann
Contact: eduardo.altmann@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Knowledge of a programming language (Python, Julia, C, etc.) and interest in computational work
- MATH2021/2921 or equivalent course in differential equations

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07)

Attendance Mode:
Hybrid
50% on campus and 50% online

MATH10: Robust fair machine learning

Project Subject Area: Data Science

This project aims to enhance fairness in machine learning by creating specialized algorithms for intricate performance measures, vital in domains like finance, healthcare, and criminal justice. It aims to develop robust complex fairness metrics (e.g., area under ROC/PRC curve fairness, Harmonic mean fairness) and to design scalable fairness-aware learning algorithms using mathematical optimisation. This project will also involve of python programming for testing the developed algorithms in real-life datasets.

Project Details

Supervisor(s): Professor Yiming Ying
Contact: yiming.ying@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Multivariable calculus and linear algebra
- Basic probability and statistics

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07), Room 492

Attendance Mode:
Hybrid
20% on campus and 80% online

MATH11: Triangulations of 3-dimensional spaces

Project Subject Area: Mathematical Sciences

Curves are familiar 1-dimensional objects and surfaces are familiar 2-dimensional objects. This project studies their generalisations to 3-dimensional spaces. A 3-dimensional space can be built up from tetrahedra, giving a triangulation of the space. The combinatorics of a triangulation often allows theoretical proofs and algorithmic computations, revealing key properties of the space. Students involved in this project will learn some 3-manifold theory and then analyse the so-called layered triangulations and surfaces in 3-dimensional spaces using a mix of theoretical arguments and computer experimentation using the software package Regina.

Project Details

Supervisor(s): Professor Stephan Tillmann & Associate Professor Jonathan Spreer
Contact: stephan.tillmann@sydney.edu.au

Maximum number of places available: 7
Final Assessment: Project report (1-2 pages)

Prerequisites:
As this is a group project, students may have complementary desirable skills.
- Essential:
    - Linear Algebra
- Desirable:
    - Discrete Mathematics
    - Proficiency in Python or C or C++ coding

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07) and The Quadrangle (A14)

Attendance Mode:
On Campus
It is expected that students learn background material and conduct research together, with a daily catch-up with the supervisors Professor Stephan Tillmann and Associate Professor Jonathan Spreer

MATH12: Tubes – their geometry and applications

Project Subject Area: Mathematical Sciences

The volume of a ball around a point in the three-dimensional space is well-known. What is the volume of a tube around a curve in the three-dimensional space? More generally, what about the volume of a tube around a submanifold of a Riemannian manifold? This project studies the geometry, especially the volume, of tubes and explores the applications of tubes in differential geometry.

Project Details

Supervisor(s): Dr Haotian Wu
Contact: haotian.wu@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Multivariable calculus and linear algebra
- A background in differential geometry of curves and surfaces is helpful but not necessary

Student Preparation:
- Students will be given preliminary reading in December

Project Location:
Carslaw Building (F07)

Attendance Mode:
On Campus
During the project, students are expected to meet with the supervisor weekly (1 hour meeting) and maintain a work journal on Overleaf.

MATH13: Pathway-Based Polygenic Risk Scores for Disease Subtype Prediction

Project Subject Area: Other

Polygenic risk scores (PRS) quantify genetic susceptibility to complex diseases, but conventional PRS aggregate genome-wide variants into a single score, ignoring biological heterogeneity. Pathway-based PRS address this limitation by grouping variants according to functional categories such as metabolic, immune, or mitochondrial pathways. This project will develop and evaluate pathway PRS methods for distinguishing disease subtypes. Students will implement and compare different model components, including the choice of gene sets, SNP-to-gene linking strategies and pathway-level aggregation. Model performance will be benchmarked across subtypes using discrimination and calibration metrics. This project aims to provide insights into both predictive accuracy and the biological mechanisms underlying complex diseases.

Project Details

Supervisor(s): Professor Jean Yee Hwa Yang
Contact: jean.yang@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Proficiency with computers and statistical analysis
- Familiarity with R and Genetics

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07) or Charles Perkins Centre (D17)

Attendance Mode:
Hybrid
At least 40% on campus

MATH14: Mathematical modelling of cancer evolution

Project Subject Area: Mathematical Sciences

The current paradigm of cancer evolution is that malignant tumours evolve through lineal evolution, meaning a single cell lineage acquires more mutations eventually leading to a malignant tumour. In contrast, experimental data from our collaborator Associate Professor Guy Lyons of the Sydney Medical School suggest an alternative process called interclonal cooperativity in which multiple cell lineages acquire different nonmalignant mutations and produce a collectively malignant population. Using mathematical modelling, students will simulate the dynamics of lineal evolution and interclonal cooperativity to determine which evolutionary pathway could be more feasible under different conditions and which could potentially lead to a more aggressive tumour.

Project Details

Supervisor(s): Professor Peter Kim
Contact: peter.kim@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Interest in learning about mathematical modelling and cancer biology
- Familiarity with ordinary differential equations and possibly partial differential equations, and an interest and ability to learn computer programming, e.g. in Matlab

Student Preparation:
N/A

Project Location:
School of Mathematics and Statistics, Carslaw Building (F07), Room 621

Attendance Mode:
Hybrid
50% on campus and 50% online

MATH15: Statistical stability estimation of matrix eigenvalues from data

Project Subject Area: Mathematical Sciences

It is possible, and increasingly popular, to estimate matrix transformations A through pairs of data points (x, Ax + \xi), where the \xi are mean zero. This happens, for example, in trying to study general dynamical systems by transforming them into linear systems. The eigenvalues of such matrices are important in studying the stability of a system, and finding slowly-decaying patterns in their dynamics.

In this project we will investigate a very new probabilistic method that uses the properties of positive-definite matrices to accurately quantify the reliability of the eigenvalues of estimates of A from data. By studying some simple examples of matrix estimation (e.g. estimating the transition matrix of a Markov chain), both with pen and paper and through computer simulation, we will give some explicit examples to understand the output of this new method, and assess its effectiveness.

Project Details

Supervisor(s): Dr Caroline Wormell
Contact: caroline.wormell@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Second year linear algebra
- Some statistics (ideally MATH2911)

Student Preparation:
- N/A

Project Location:
Carslaw Building (F07), Room 491

Attendance Mode:
Hybrid
25% meeting on campus and 75% online/self-work

Education Innovation

EDUC01: Analyzing Professional Development Engagement Patterns: A Quantitative Investigation of University Educator Participation

Project Subject Area: Teaching and Learning

This project examines university educator engagement with professional development through quantitative analysis of participation patterns in the Modular Professional Learning Framework (MPLF), the University of Sydney's flagship educator development programme. Students will conduct statistical analysis of anonymised longitudinal attendance data from 2019-2025, investigating participation trends across academic faculties, employment classifications, and temporal variables to understand factors influencing retention and sustained versus episodic engagement.

The research will generate evidence-based visualisations and institutional recommendations for optimising professional development programme design and delivery. Students will develop expertise in educational data analytics, statistical methodology, and the translation of empirical findings into strategic recommendations for higher education policy and practice. This project is ideal for students with confidence in data analytics and quantitative statistical methods who have an interest in educational research and institutional improvement.

Project Details

Supervisor(s): Professor Susan Rowland, Vice-Provost and Dr Eszter Kalman
Contact: eszter.kalman@sydney.edu.au

Maximum number of places available: 1
Final Assessment: Project report (1-2 pages)

Prerequisites:
- The project would suit students with experience and interest in statistics, data analysis and data visualization
- Successful completion of at least first year statistics is required
- Your work will be shown, and have impact, at the University level and you will be working with senior members of the University. As such, we are looking for a student who is keen to show professionalism and produce high-quality work in collaboration with our team. You will not be expected to work alone, or unsupervised

- You will be expected to show initiative, ask questions when you are unsure, have attention to detail, take direction, be collegial, and learn as you work.
- Your supervisory team has extensive experience with supervising and supporting undergraduate researchers

Student Preparation:
- N/A

Project Location:
Fisher Library (F03), with the Educational Innovation Team.

Attendance Mode:
Hybrid
20% on campus (in Fisher Library (F03)) and 80% online (this is flexible and more time on campus can be accommodated)

School of Psychology

PSYC01: Investigating gender based violence using legal psychology: From memory to psychological wellbeing and everything in between!

Project Subject Area: Psychology

Gender-based violence, such as sexual, domestic, and family violence is a prominent issue in Australia and globally. Our legal system can be improved in how it deals with these cases. From how we collect the most accurate memory statements, to how we can protect the psychological wellbeing of those involved. From police interviews to court room testimonies. In this project you will assist with reviewing literature, data collection, coding, and interpretation. This project will help you develop skills and knowledge to tackle these real-life issues.

Project Details

Supervisor(s): Associate Professor Celine van Golde
Contact: celine.vangolde@sydney.edu.au

Maximum number of places available: 4
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Introductory Psychology units of study
- Comfortable with computers and basic statistics

Student Preparation:
- The student(s) will need to be added to the human research ethics application of the secondary project, which will involve a small amount of online paperwork. Successful applicants will be directed to contact the supervisor to arrange this.
- Research induction on the topic and the various tasks involved. As part of this induction student(s) will be assessed on how comfortable they are with the research topics, and together with the supervisor the student(s) will decide what topics they will be working on.
- Guidance regarding emotional responses to the topic will be provided, and there are various distress protocols in place if needed.

Project Location:
School of Psychology - Brennan MacCallum (A18) and Griffith Taylor (A19).

Attendance Mode:
Hybrid

The student(s) will be expected to be on campus at least 3 days a week, as the project requires testing participants for this study.

PSYC02: Building evidence-based digital tools for gambling harm reduction

Project Subject Area: Psychology

Online sports betting is rapidly expanding, driven by targeted digital marketing and social media influencers. In this project, students will collaborate with researchers and clinicians to design and test digital harm minimisation tools — such as educational games, interactive resources, and social media campaigns — aimed at reducing gambling-related risks. Students will gain hands-on experience in digital content creation, coding, and evaluation, contributing to innovative solutions at the intersection of psychology, technology, and public health.

Project Details

Supervisor(s): Professor Sally Gainsbury
Contact: sally.gainsbury@sydney.edu.au

Maximum number of places available: 5
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- This project will suit students with experience using digital tools to design and produce content, such as Scratch, Canva, or video editing software, as well as social media platforms for content creation
- Skills in coding, graphic design, or multimedia production will be highly valued, and students with an interest in applying creative technologies to real-world health challenges are especially encouraged to apply

Student Preparation:
- Pre-reading will be made available for students in early January

Project Location:
Gambling Treatment and Research Clinic (M02F, Level 2).
Students will be based at the world-renowned Brain and Mind Centre, a multidisciplinary research and clinical centre, when they are on campus.

Attendance Mode:
Hybrid
At least 60% on campus (3 days per week) and 40% online (2 days per week, using Teams for collaboration)

PSYC03: Remembering repeated events: Investigating eyewitness memory in criminal investigations

Project Subject Area: Psychology

This project offers students the opportunity to engage in research focused on memory for repeated events, particularly in the context of criminal investigations involving repeated abuse (e.g., domestic violence, child sexual abuse, workplace bullying). Students will gain hands-on experience in a range of research activities, which may include conducting literature reviews, assisting with ethics applications, coding qualitative data, and analysing inter-rater reliability. The research aims to uncover important implications for understanding memory in these contexts and improving justice processes for victims of repeated abuse. This is a valuable opportunity to contribute to ongoing research while gaining a variety of research skills

Project Details

Supervisor(s): Associate Professor Helen Paterson
Contact: helen.paterson@sydney.edu.au

Maximum number of places available: 4
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of PSYC1001 and PSYC1002

Student Preparation:
- N/A

Project Location:
Brennan MacCallum Building (A18)

Attendance Mode:
Hybrid
60% on campus and 40% online

PSYC04: Can psychology journals improve research transparency?

Project Subject Area: Psychology

In response to psychology's 'replication crisis' there have been calls to increase adoption of transparent research practices, like data sharing and preregistration. Psychology journals may be able to improve research transparency by introducing

policies that require higher transparency standards; however, we don't currently know how many journals have transparency policies and how strict those policies are. In this meta-research (research-on-research) project, you will extract and classify information from the websites of psychology journals in order to identify strengths and weaknesses in their policies. This information will eventually be used to encourage journals to adopt stronger policies that raise transparency standards in psychology research.

Project Details

Supervisor(s): Dr Tom Hardwicke
Contact: tom.hardwicke@sydney.edu.au

Maximum number of places available: 4
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Conscientious, organised, and attention to detail

Student Preparation:
- Recommended reading:

Hardwicke, T. E., Thibault, R. T., Clarke, B., Moodie, N., Crüwell, S., Schiavone, S. R., Handcock, S. A., Nghiem, K. A., Mody, F., Erole, T., & Vazire, S. (2024). Prevalence of transparent research practices in psychology: A cross-sectional study of empirical articles published in 2022. Advances in Methods and Practices in Psychological Science, 7(4). https://doi.org/10.1177/25152459241283477

Project Location:
School of Psychology, Brennan Maccallum Building (A18)

Attendance Mode:
Hybrid
Some face-to-face meetings are preferred, but the majority of the data extraction work can be done remotely as the student prefers.

PSYC05: Cognition in the digital age

Project Subject Area: Psychology

This research project looks at how thinking is shaped by our digital and physical environments. This includes thinking online (such as in social media forums), and how digital technology changes how we think in offline "irl" spaces. This project involves both analysis of online content, as well as working with cognitive science experimental methods.

Project Details

Supervisor(s): Associate Professor Micah Goldwater
Contact: micah.goldwater@sydney.edu.au

Maximum number of places available: 3
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Some form of online research skills necessary, particularly computational and/or statistical. This can be experience with natural language processing tools to help do analyze online text, statistical programming such as R or Python, or familiarity with javascript to help build online experiments

Student Preparation:
- Please be in touch with the supervisor in advance to discuss digital research skills to advise what to potentially get a head start on where applicable

Project Location:
Griffith Taylor Building (A19) & Brennan MacCallum Building (A18)

Attendance Mode:
Hybrid
Approximately 50% on campus and 50% online

PSYC06: Perception and attention in young and old

Project Subject Area: Psychology

We rely on the visual part of our brains to parse the world into meaningful objects and to keep track of them, particularly in busy scenes such as when driving a car or crossing the street. Certain aspects of our abilities remain mysterious, especially since the discovery that the two cerebral hemispheres (left and right) have independent abilities to keep track of moving objects (here is a short book on the topic: https://tracking.whatanimalssee.com/). One behavioral index of the two hemispheres' tracking ability has been reported to decline precipitously with age. In this project we are testing both young adults and seniors in the task. Using our psychophysical experiment design, eye tracker, and Bayesian data analysis on the supercomputer, we will gain insights into how the ability to keep rapid events distinguished from each other declines with age.

Project Details

Supervisor(s): Professor Alex Holcombe
Contact: alex.holcombe@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
– N/A

Student Preparation:
– N/A

Project Location:
Griffith Taylor Building (A19)

Attendance Mode:
On Campus

PSYC07: Exploring individual differences in learning-guided control

Project Subject Area: Psychology

Cognitive control is the mental ability to adjust our behaviour to achieve our current goals. An example might be choosing healthy options at the supermarket while resisting the impulse to be drawn to tasty but unhealthy snacks. Problems with cognitive control are linked to mental health issues like anxiety and behavioural disorders. Cognitive control changes with experience and current expectations, and this "learning-guided control" is what we are most interested in studying. We do this using conflict tasks where distracting information is presented at the same time as a target stimulus, and the distracting stimuli are either congruent or incongruent with the target, affecting performance to different degrees. This project will use these tasks in conjunction with measures of individual differences to help understand which factors are most important for learning-guided control. It will involve in-lab experimentation and literature review.

Project Details

Supervisor(s): Professor Evan Livesey
Contact: evan.livesey@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
– Completion of 1000-level Psychology
– Interest in cognitive psychology
– Completing a major in Psychology and/or Neuroscience is helpful but not necessary

Student Preparation:
- Two initial meetings with the research team, approx. one hour each (time and date to be determined)

Project Location:
Top South Badham Building (A16) & Griffith Taylor Building (A19)

Attendance Mode:
Hybrid
Minimum three days per week on campus

PSYC08: A qualitative study exploring the experiences of long-term users of PARP inhibitors in advanced ovarian cancer

Project Subject Area: Psychology

People living with cancer sometimes face complex decisions about whether to continue or stop treatment. This can involve weighing up whether the clinical benefits of treatment outweigh the impact on their quality of life. This project aims to explore how people with advanced recurrent ovarian cancer approach decisions about whether to continue or stop long-term treatment. Students will gain valuable skills in qualitative analysis and content knowledge.

Project Details

Supervisor(s): Dr Rachel Campbell
Contact: r.campbell@sydney.edu.au

Maximum number of places available:
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- There are no pre-requisite skills, however interest in experiences of living with cancer and qualitative data analysis would be beneficial

Student Preparation:
- N/A

Project Location:
Griffith Taylor Building (A19), Level 3, Room 310

Attendance Mode:
Hybrid
40% on campus and 60% online

PSYC09: Social support and well-being

Project Subject Area: Psychology

Helping others and receiving support from others are common parts of our social lives. But what are the benefits (and costs) of these forms of support? The primary aim of this project is to explore how providing and receiving social support relates to health and well-being, as well as potential cultural differences. Your primary tasks will be to work with large, publicly available datasets to address these research questions, including data cleaning, statistical analysis, and writing up results. The secondary tasks will include assisting with fieldwork for an ongoing couple study in the lab, such as recruiting participants and running an experiment with video recordings.

Project Details

Supervisor(s): Dr Yue Li
Contact: yue.li@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of stats units (PSYC2012 — Statistics and Research Methods for Psychology)
- Familiarity with R and/or SPSS
- Be comfortable with interacting with strangers in public settings since the secondary task of the project involves interacting with participants

Student Preparation:
- The student(s) will need to be added to the human research ethics application, which will involve a small amount of online training and paperwork. Successful applicants will be directed to contact the supervisor to arrange this.

Project Location:
Brennan MacCallum Building (A18), Room 447

Attendance Mode:
On Campus

PSYC10: Emotion regulation and relationship wellbeing among people with and without neurodivergent conditions

Project Subject Area: Psychology

People with neurodivergent conditions (e.g., ADHD, autism) tend to experience difficulties in emotion regulation and interpersonal relationships, but few studies have examined neurodivergent symptoms, emotion dysregulation, and relationship wellbeing (e.g., relationship satisfaction, perpetration and victimization) simultaneously. This research aims to understand the inter-relationships between them, which can potentially improve the wellbeing of people with neurodivergence. Students in this project will be involved in activities such as meta-analysis, systematic review, and/or designing studies, preparing ethics applications, and designing questionnaires.

Students will also be involved in a secondary project that is led by Dr Rebecca Pinkus and Prof Carolyn MacCann. This experimental study aims to understand how partners regulate each other's emotions when one member of the couple faces a challenge. This study takes place mainly onsite as it involves videotaping couples' interaction. Students may help with recruitment of couples and data collection.

Project Details

Supervisor(s): Dr Iana Wong
Contact: iana.wong@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Interest in the research topics mentioned above
- Familiarity with R
- Completion of PSYC2012 Statistics and Research Methods for Psychology
- Good interpersonal skills (comfortable interacting with the public and working in small groups, for the secondary project)

Student Preparation:
- The student(s) will need to be added to the human research ethics application of the secondary project, which will involve a small amount of online paperwork. Successful applicants will be directed to contact the supervisor to arrange this.

Project Location:
In-lab or at-home work (primary project): You will work on tasks related to meta-analysis/systematic review (e.g., screening of abstracts and full-text papers, study quality appraisal) and report writing, which you can do either in a shared working space in the school of psychology (likely in Brennan MacCallum Building (A18), Room 447) or remotely.

In-lab (secondary project): You will help collect data from couples onsite (likely in Brennan MacCallum Building (A18). You will be involved in greeting the couples, running the experiment following the study protocol, providing instructions to couples, and debriefing them. The frequency will depend on the participation of couples.

Fieldwork (secondary project): You will help recruit members of the public (couples) from public places like parks and markets and will work in pairs or groups with other students to do this. This would likely be 1-2 days per week, and much of it will be unsupervised. You will also need to practice and prepare for this with your team members (in person, in labs at the Camperdown campus).

Attendance Mode:
Hybrid
3 days per week on campus and 2 days per week from home

PSYC11: Researching emotion regulation strategies in romantic couples

Project Subject Area: Psychology

In this project you will work in pairs or small groups recruiting couples in public settings (e.g., parks) to take part in an experiment. You will help to run the experiment where one member of the couple faces a challenge, and the other is instructed to help them. We are interested in how partners regulate each other's emotions in this situation. This study will involve fieldwork (working off-campus) and interacting with the public. You will be jointly supervised by both Dr Rebecca Pinkus and Prof Carolyn MacCann.

As a secondary focus, this project may involve coding video footage from prior studies, preparing ethics applications, conducting literature reviews or assisting with systematic review and meta-analysis projects.

Project Details

Supervisor(s): Professor Carolyn MacCann
Contact: carolyn.maccann@sydney.edu.au

Maximum number of places available: 4
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Good interpersonal skills (comfortable interacting with the public and working in small groups)

Student Preparation:

- The student(s) will need to be added to the human research ethics application of the secondary project, which will involve a small amount of online paperwork. Successful applicants will be directed to contact the supervisor to arrange this.

Project Location:
Brennan MacCallum Building (A18) and onsite in fieldwork.
You will need to be recruiting members of the public (couples) from public places like parks and markets and will work in pairs or groups with other students to do this. This would likely be 2 days per week, and much of it will be unsupervised. You will also need to practice and prepare for this with your team members (in person, in labs at the Camperdown campus).

You will also work on background writing and reports, which you can do either in a shared working space in the school of psychology (likely Brennan MacCallum building) or remotely. There is scope for flexibility around short (~ 1 week) holiday plans as it is understood that families often plan holidays during this time.

Attendance Mode:
Hybrid
30% online, 40% fieldwork, and 30% on campus

PSYC12: Investigating biases in judgements

Project Subject Area: Psychology

Our current research examines the cognitive processes that shape how people make judgements. We focus on investigating why individuals sometimes misjudge their knowledge or perceive patterns that are not there. Using behavioural experiments, we aim to identify the conditions that amplify or reduce these biases. The project will involve literature review and/or in-lab experimentation.

Project Details

Supervisor(s): Dr Hilary Don
Contact: hilary.don@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project report (1-2 pages)

Prerequisites:
- Completion of first year Psychology
- Interest in Cognitive Psychology

Student Preparation:
- An initial one-hour meeting with the research team on campus (date and time is to be determined)

Project Location:
Top South Badham Building (A16), Griffith Taylor Building (A19), & Brennan MacCallum Building (A18)

Attendance Mode:
On Campus
Flexible, either 100% on campus or up to 40% online.

PSYC13: Interpersonal dynamics in romantic couples

Project Subject Area: Psychology

This hybrid project investigates how romantic partners regulate each other's emotions and respond to social comparisons within their relationship. Students will work in pairs or small groups to recruit couples and run an experiment where one partner faces a challenge while the other regulates their emotions. Students will be actively involved in running the experiment (co-supervised by Professor Carolyn MacCann), gaining hands-on experience in behavioural research. A complementary study explores how individuals react when they outperform or are outperformed by their partner, using video analysis to examine behavioural responses from couples who have already participated in an experiment. Students may also contribute to literature reviews, ethics applications, and potentially systematic review or meta-analysis tasks.

Project Details

Supervisor(s): Dr Rebecca Pinkus
Contact: rebecca.pinkus@sydney.edu.au

Maximum number of places available: 4
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Strong interpersonal skills, being comfortable interacting with the public and working in small groups
- Interest in learning behavioural coding and video analysis techniques
- Completion of Introductory Psychology courses and preferably Social Psychology courses

Student Preparation:
- The student(s) will need to be added to the human research application in November/December, which involves a small amount of online paperwork. Because a large portion of the project involves recruiting couples from public places (largely unsupervised), you will need to practice and prepare for this with your team members (in person, in labs at the Camperdown campus) in the first

week of the program, and you will need to liaise with team members about the recruitment and testing schedule. All recruitment and testing is done in pairs.

Project Location:
Griffith Taylor Building Room (A19), Room 463 and onsite fieldwork.
The emotion regulation study will be conducted in the field (e.g., public settings such as University campuses, parks, and markets within Sydney). Travel to these locations will be required.

The social comparison experiment's videos will be coded in Room 463 of the Griffith Taylor Building (A19).

Literature reviews and other similar tasks can be conducted remotely.

Attendance Mode:
Hybrid
45% fieldwork, 45% on campus, and 10% remote

PSYC14: A systematic review and meta-analysis of the relationship between death anxiety and pain

Project Subject Area: Psychology

This project is a systematic review and meta-analysis of the relationship between death anxiety and pain (e.g. chronic pain, pain sensitivity, pain catastrophising, etc). Students will be assisting with screening papers for eligibility for the review, summarising the main results, and assisting with manuscript preparation. Students will learn the process of a systematic review and build content knowledge on the topics of death anxiety and pain.

Project Details

Supervisor(s): Dr Rachel Menzies
Contact: rachel.menzies@sydney.edu.au

Maximum number of places available: 2
Final Assessment: Project presentation (5-10 minutes)

Prerequisites:
- Completion of 1000-level Psychology units
- Interest in health psychology or death anxiety/existential psychology

Student Preparation:
- N/A

Project Location:
All research can be undertaken online, with options to meet on campus (Brennan MacCallum Building (A18).

Attendance Mode:
Online (100%) or hybrid

Contact

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