MONASH University

School of Mathematics

2024 / 2025 SUMMER VACATION RESEARCH PROJECTS

Summer Vacation Period **18 November 2024 - 21 February 2025**

Applications are open for the 2024 / 2025 AMSI and Monash summer vacation scholarships**.**

- Please contact the supervisor for more details, prerequisites and to obtain the ***required*** formal letter of support, ***before*** applying.

How to apply

What does this AMSI/Monash scholarships offer me?

- the chance to work on a real research project for six weeks
- travel and accommodation to attend the national *AMSICONNECT* student conference
- a six-week award of $500/week (total $3,000)

Eligibility

These scholarships are open to students who:

- are currently enrolled at an AMSI Member university
- are in their third year doing a major in the mathematical sciences (outstanding second year students with the support of their department may apply)
- have a strong academic record
- intend to go on to honours and/or postgraduate study in the mathematical sciences, this includes students doing joint degrees that include mathematics and statistics.

To apply visit: http:vrs.amsi.org.au/

Applications close: Friday 23 August (Monash) and 19 September 2024 (AMSI)

IMPORTANT application information for students applying through AMSI website

There are two (2) steps to this application process, namely that you are required to **submit *two applications*** for a scholarship:

1. First, apply to Monash University at https://www.monash.edu/students/scholarships/current/research-projects online from **Monday 5 August 2024** until **Friday 23rd August 2024 (5pm).**

2. Second, apply to AMSI at http:vrs.camsi.org.au/ by **Thursday 19th September 2024.**

AMSI and Monash summer vacation scholarship offers

Successful Monash scholarship applicants will receive an offer first from Monash and then a subsequent offer directly from AMSI, for the same project (not a second scholarship). **You must accept *both* offers.**

Note: If you did not apply for, and get, a Monash scholarship, you will not be offered an AMSI scholarship. Scholarships offered, by *both* AMSI and Monash, are administered by Monash University, including your weekly payments.

Projects

1. *Topics in discrete probability and statistical mechanics*

Project title: Topics in discrete probability and statistical mechanics
Supervisor/s: Prof Tim Garoni

Details: Please contact Tim Garoni for project details.

2. *Random walks in a random environment*

Project title: Random walks in a random environment
Supervisor/s: A/Prof Andrea Collevecchio & Prof Kais Hamza

Prerequisites: MTH2222 needed, MTH3241 preferred.

Details: We explore the behaviour of processes defined on random media. We focus on Manhattan Lattice walks and walks on dynamical percolation. Most of the project is about simulations to have a better understanding, but could also involve some theoretical results.

3. *Random walks (generic) and their applications*

Project title: Random walks (generic) and their applications
Supervisor/s: A/Prof Andrea Collevecchio & Prof Kais Hamza

Details: Study of random walks in one and more dimensions. Its connections with combinatorics, analysis. In particular, we focus on questions like: How fast does the range grow?
How many times each vertex is visited by the process given that is visited once?

4. *Topics in differential geometry and PDEs*

Project title: Topics in differential geometry and PDEs
Supervisor/s: Dr Yann Bernard

Details: Please contact Yann Bernard for project details

5. *Sound recognition with deep learning*

Project title: Sound recognition with deep learning
Supervisor/s: Dr Alina Donea

Prerequisites: Experience programming in Python, Linear Algebra and Fourier Series, Discrete Fourier Series, Audacity or any Audio/Spectrum Fourier Series Decomposition

Additional details: Only available after 1 Dec 2025.

Details: Various deep learning models can be utilised for audio classification. We want to perform an extensive survey of current deep learning models used for a variety of audio classification tasks. In particular, we focus on works published under five different deep neural network architectures, namely Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Autoencoders, Transformers and Hybrid Models (hybrid deep learning models and hybrid deep learning models with traditional classifiers). CNNs can be used to classify audio signals into different categories such as speech, music, and environmental sounds. They can also be used for speech recognition, speaker identification, and emotion recognition. RNNs are widely used for audio classification and audio segmentation. RNN models can capture temporal patterns of audio signals and be used to classify audio segments into different categories. Another approach is to use autoencoders for learning the features of audio signals and then classifying the signals into different categories. Transformers are also well-suited for audio classification.

The aim is to apply existing AI algorithms (coding needed to test algorithms) to identify, classify a large existing library of sounds

6. *Optimal Cloud Computing*

Project title: Optimal Cloud Computing
Supervisor/s: Prof Andreas Ernst

Prerequisites: Some knowledge of optimisation is highly desirable. At least basic programming skills (any language).

Details: This project will consider the issue faced by a large government agency that regularly uses cloud computing services to create statistical reports. Amazon and other cloud computing services provide a large number of options with different costs and limitations on storage and compute capacity. What is the most cost-effective way to allocate the computing requirements for a statistical publication to a collection of cloud computing resources? This project, motivated by a real-world case study, will look at mathematical models such as chance-constrained optimisation, to determine how to model and solve this problem. Some real-world data may be available.

……