



A2I2
APPLIED ARTIFICIAL
INTELLIGENCE INSTITUTE



Higher Degree by Research Program

a2i2.deakin.edu.au





About A²I²

Deakin University's Applied Artificial Intelligence Institute (A²I²) was formed by merging two groups already established at Deakin University: PRaDA (Pattern Recognition and Data Analytics), recognised internationally for its ground-breaking work in machine learning and pattern recognition, and DSTIL (Deakin Software and Technology Innovation Laboratory), which has transformed complex ideas into user-friendly software systems, including mobile and web applications.

A²I² is located at Deakin's Waurin Ponds and Burwood campuses and has more than 100 staff and PhD students on board, including several who have been working in the field for more than 25 years, long before the current interest in AI. We aim to transform industries and improve lives by implementing safe, effective uses of cutting-edge AI tools and techniques. We cover all aspects of AI research and development from fundamental science to translation and commercialisation.

The multi-disciplinary expertise of A²I² makes us an ideal partner to help industry, government and community take full advantage of the benefits AI offers.

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A²I² at a glance



44
Scientists



30
Engineers



28
PhD students



10
Patents in data
analytics



5
Start-up companies and
commercialisation awards



775
Publications



Multiple papers
accepted at 1st rank
conferences



15
Best and Best runner-
up student awards



\$33+M
of funding



4
Laboratories
Purpose-built AI
computing infrastructure

“In the future, AI will become ubiquitous. With this vision, we aim to inspire you to build AI that is useful to society, reliable and aligned to our core human needs and values. Through your research, we encourage you to push the frontiers in optimisation, deep learning, and machine learning. We provide fantastic learning opportunities, a chance to work on high-impact real world problems, and generous support for infrastructure and work dissemination”

Svetha Venkatesh

Co-Director, A²I²

Alfred Deakin Professor,
Australian Laureate Fellow

“Our world is changing and AI presents some benefits, and certainly some challenges. If we focus on ‘Human in the Loop AI’ - which is our inspiration to build AI that is useful to society and aligns well with the values that our society has set - this will allow us to inspire many young people to come on the journey with us.”

Kon Mouzakis

Co-Director, A²I²

Professor

A²I² research and innovation themes

Deakin has invested almost \$33 million into A²I² to push the boundaries of possibilities between human interactions and AI and to train the next generation for the jobs of the future.

AI Frontiers stream

Bayesian optimisation

We believe the time is not far off when Bayesian optimisation will make its mark by accelerating the discovery of a new alloy with outstanding mechanical properties, or a new synthetic fabric with amazing properties, or a new optimised printing process of stem cells for the large-scale adoption of regenerative medicine. Motivated by real-world demands, we have invented new Bayesian optimisation techniques that scale into high-dimension, make many objective optimisation problems feasible, extend solutions to unbounded search space and enable integration of complex prior information. However, integrating scientific knowledge and human level reasoning are the major open problems.

Deep learning and beyond

We study new ways for brain-inspired machine learning with minimal human supervision. Our research areas include representation learning, deep reinforcement learning, generative models, modelling of graphs and relations, designing memory and attention mechanisms, continual learning, learning to reason, and knowledge-based inference. We apply deep learning to solve important real-world problems where data is abundant. The problem space spans across living sciences (health, drug design and genomics), physical sciences (molecules and materials), and digital domains (computer vision, NLP, cybersecurity, software and recommender systems). We invite AI practitioners and theorists to join forces with us in our far-reaching pursuit for Artificial General Intelligence (AGI).

Algorithmic assurance

Algorithms are already being used for making important life decisions, like short-listing resumes,

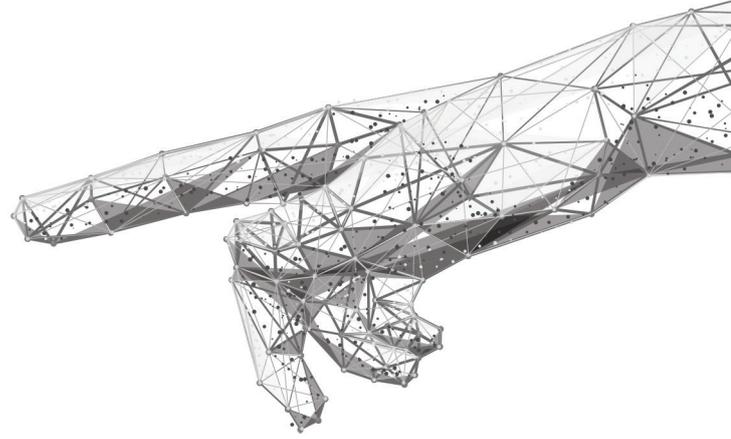
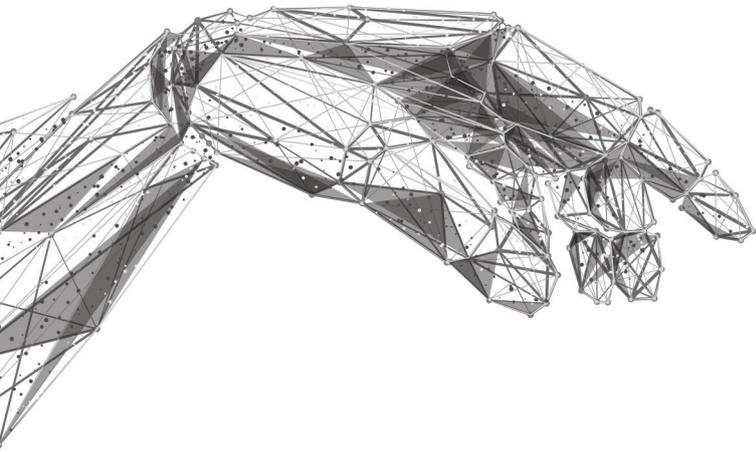
loan approval and even for granting parole. In those cases, bias in the training data presents a formidable challenge for model building. Additionally, modern machine learning algorithms are known to be fragile and are at the risk of adversarial manipulation. That's why it's so important to ensure the decisions made by algorithms are as desired in a given context. We call it Algorithmic Assurance and consider it an important area of research. Open research problems include assuring algorithms in the presence of multiple complex objectives, e.g. fairness, adversarial robustness etc.

AI for biology and health

Technological advances have made it possible to collect an enormous amount of biomedical data, ranging from genomes to drugs to medical records. Our research aims to step away from the one-size-fits-all approach to healthcare, and instead develop methods that tailor disease diagnosis and treatment to individuals. We design AI algorithms and systems to accelerate living sciences. We also aim to advance AI capability for learning, reasoning and communicating about medicine, thereby pushing the boundaries of medical arts, precision and efficiency. Example topics include biomarker discovery, drug design, multi-view health data integration, NLP, and explainable AI.

Value-based AI

We envision a future where AI will co-live with humans as our digital companions. AI will augment our senses, amplify our capability and share our ethical values. We aim to invent new machine learning algorithms that teach machines to align values with humans, be sensible to what others think and need, act morally, and maintain social norms and stability, just as when we pass our legacy to younger generations.



Software Engineering for AI stream

Over the past few decades, software engineering research has invented, re-invented, discovered and refined practices/methods/tools for productively constructing high quality conventional software. This work encapsulates knowledge derived empirically, conceptually, mathematically, and experientially. However, the unique nature of AI software requires that we refine and extend existing software engineering knowledge.

Software engineering for AI is the application of a systematic, disciplined, quantifiable approach to the specification, design, construction, testing, deployment, operation, and maintenance of systems that have one or more AI components, and the study of these approaches. We invite applicants to push forward innovations in human-machine co-operation and engineering AI-enabled processes.

Improving engineering productivity

We investigate AI projects to understand where effort is wasted, or effort results in sub-optimal outcomes. We then investigate methods to reduce this and deliver the outcomes as tools that can be embedded into engineering workflows.

Competency-aware AI

Using data and machine learning techniques promises new opportunities. To ensure broad acceptance, we need to know what the machines are learning and the limits to this knowledge. Their competency must be captured, verified and properly communicated. We study methods to help us build more robust systems that are aware of both their ability and limitations.

Engineering methodologies, management and governance

Data driven systems have a different profile or risks and need engineering approaches that address the fact that data is acting as a requirements specification. Our work in this theme is focused on refining existing software development methodologies to consider the probabilistic and data driven behaviour of these AI components. This theme spans project management methods and human factors as well as governance issues.

Our research team regularly publish their findings in prestigious journals and conferences, and we open source publications to assist others in pushing the boundaries of possibility.

Find out more about our publications at

a2i2.deakin.edu.au/publications/



Selection criteria and how to apply

A²I² offers scholarships for prospective PhD students through the Deakin University Higher Degree by Research program. We also consider self-funded PhD applicants.

All applications go through a rigorous assessment process and shortlisted applicants will be interviewed. Successful applicants will have their University tuition fees waived, and will receive a stipend and medical insurance.

Selection criteria

- Graduate of Electrical Engineering, Computer Science, or similar disciplines
- Completed a four-year undergraduate degree and a research thesis. Postgraduate degree is a plus
- Having any of the following is advantageous: high GPA with first class honours, extensive research experience, and peer reviewed publications
- Have a strong background in some of the following subjects:
 - Machine learning
 - Linear algebra

- Probability and statistics
- Optimisation
- Software Engineering
- Good programming skills
- Curious to learn and self-motivated to push the boundaries of knowledge
- Oversea applicants need to meet English language requirements for postgraduate programs at Deakin. See deakin.edu.au/post-english for details.

How to apply

Interested applicants should visit a2i2.deakin.edu.au/study-with-us/ to submit their applications.

Learn more about our PhD program

Before you apply, it's worth visiting a2i2.deakin.edu.au for our views on machine learning and AI, and current and upcoming projects. If possible applicants should discuss potential projects with relevant A²I² staff.

As an A²I² PhD student, you will work alongside internationally recognised researchers in machine learning, artificial intelligence, computer vision and pattern recognition, and robustness of AI systems. You will have opportunities to share your research interests in our weekly reading groups with other PhD students, staff, and external researchers.

Students working in the AI Frontiers stream will be based at Deakin's Geelong Waurn Ponds campus in the largest regional city in Victoria, with affordable modern living and close to some of Australia's best surf beaches.

Students working in the Software Engineering for AI stream will be based at Deakin's Burwood Campus, in the capital city of Victoria, surrounded by impressive buildings and a vibrant cultural life.

Find out more about our locations at deakin.edu.au/locations and our accommodation by visiting deakin.edu.au/life-at-deakin/accommodation



“I was fortunate to be advised by A/ Prof Santu Rana, A/Prof Sunil Gupta and Prof Svetha Venkatesh. As a PhD student, I was encouraged to communicate my works to top conferences and journals. I was also given the opportunity to attend and present at international conferences. The best part of the journey was being able to see my work applied to solve real-world problems. A²I² has always tried to create a stimulating atmosphere within the group. There were social gatherings, paper reading sessions, and more”

Dr Tinu T.Joy

Machine learning scientist
Exabel, Norway



“I had a great experience during my time at A²I² Geelong. My principal supervisor, A/Prof Truyen Tran is a great scientist who has taught me valuable knowledge and research skills and instilled in me a professional work ethic. Thanks to his constant guidance and support, I was able to finish my PhD with a good outcome. It was also great to learn from Prof Svetha Venkatesh. As a successful woman in tech and research, she is one of my motivations to keep pursuing my career path.”

Dr Trang Pham

Software engineer
Google, Sydney



“What I like most about A²I² is the practicality of our research. My honours research helped shape automated photography software that was deployed in large-scale marathons, and I like to know my research has made an impact for business solutions. Doing a PhD here means I get lots of support from the A²I² team.”

Alex Cummaudo

PhD candidate and software engineer
Melbourne Burwood Campus, A²I²



Become an A²I² researcher

Want to know more
about studying with A²I²?

Contact

Our HDR team is more than
happy to answer your questions.

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