Responsible AI
Your questions answered
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This collection of short papers developed by the Australian Academy of Technological Sciences and Engineering (ATSE) and the Australian Institute for Machine Learning (AIML) at The University of Adelaide offers an insight into the world of responsible artificial intelligence and the opportunities this presents to Australia.
SECTION 1
INTRODUCTION

What is responsible AI anyway?

Professor Jon Whittle
Director, CSIRO’s Data61

Responsible AI is the practice of developing and using AI systems in a way that provides benefits to individuals, groups and the wider society while minimising the risk of negative consequences.

There are many benefits arising from AI. CSIRO’s Everyday AI podcast presents many examples where AI is benefiting society. Tennis Australia is using AI to assist blind spectators to watch tennis more easily; CSIRO and Data61 partners to provide real-time testing of an AI product so that the system doesn’t rely on AI alone, but also has redundant systems so that a critical system fails in its path. An AI-driven movie recommendation system can’t always recommend the movie you want to see right now. Of course, AI systems don’t need to be 100% accurate to be useful. However, some AI systems need higher degrees of accuracy than others. In the ChatGPT world, these factual inaccuracies have been called hallucinations. Examples range from making up fake citations in academic papers, to providing wrong answers to simple math puzzles, and failing people’s bias. So are AI systems that hallucinate irresponsible? Again, it depends on what the AI system is used for. Context matters when it comes to responsible AI.

Risks in AI development

Responsible AI isn’t only about the end product. It’s also about the way the product is designed and developed. Indeed, one clear principle behind responsible AI is that responsibility must be considered at all stages of a product’s lifecycle — from initial concept, all the way through design and implementation, to adoption and use. Responsible AI is like a chain — a weak link means the whole system fails the responsibility test.

In our forthcoming book, we think about this issue in the context of three dimensions: governance, process and product. Each of these characteristics of an AI system is developed, and the care and rigor applied in each dimension will affect the extent to which the system can be considered responsible.

Product

For an AI system to be considered responsible, it must be developed and its many benefits, two of the well-known issues with ChatGPT are bias and hallucinations.

Bias

It’s been known for years that AI systems can suffer from bias. One of the earliest public examples of this was the COMPAS system in the US, which was used to predict recidiver rates at parole boards but was found to discriminate against black people. In the case of ChatGPT, because it is trained on a large proportion of the text available on the internet, and because a lot of that text is biased and discriminatory, ChatGPT can also be biased and discriminatory. In recent times, significant effort has been put towards trying to reduce bias in AI systems — for example, there are guardrails in place to avoid any ethical mistakes. So one might ask, is ChatGPT an example of responsible AI? It’s hard to say — the time and effort put into developing guardrails is evidence of a responsible approach.

On the other hand, ChatGPT still suffers from some bias issues, which doesn’t look like responsible AI. This example illustrates that responsibility in relation to AI isn’t necessarily based on a binary between entirely responsible and irresponsible. Rather, responsibility lies on a spectrum, much like AI itself.

Factual inaccuracies (or hallucinations)

AI systems are never 100% accurate. This is the nature of the technology. Data-driven AI, in particular, applies statistics to look for patterns in data. But statistics, by definition, are not 100% accurate — it’s all about probability. So a self-driving car will never perfectly identify obstacles in its path. And an AI-driven movie recommendation system can’t always recommend the movie you want to see right now. Of course, AI systems don’t need to be 100% accurate to be useful. However, some AI systems need higher degrees of accuracy than others.

Goverance

If you are an organisation developing or using AI, what governance do you have in place to ensure the AI is responsible? Governance in AI is a huge topic, which can’t be fully covered here. But some of the questions organisations should be asking are: Where is AI used in my organisation? What data is used to train the AI and do we have the right in place to use that data? Has the data been properly curated to ensure it isn’t inherently biased? Have we considered what can go wrong and put in place mitigation strategies, or have we just assumed the AI will work as intended and everything will be okay?

Process

The best governance framework in the world won’t save you unless your organisation has rigorous processes in place to monitor whether things are being done responsibly. Are the right kind of people involved in the development of your AI system (i.e., end-users, and any relevant external stakeholders)? Have you defined what ‘responsible AI’ means in your particular context, and is this definition specific enough to be falsifiable? Have you, for example, ever encountered training for your workforce? Does your culture support responsible AI? Is there a truly responsible approach to AI development and deployment. This will involve a rigorous attempt to understand not just the AI system’s risks but also the risks arising from how the AI system is used in a broader environmental and social context.

Broader societal risks

Our first two categories of responsible AI are concerned with AI systems and how they need to be managed at an organisational level. Arguably more important than this, however, is to understand the broader societal impacts of an AI system and whether there are unknown, unexpected or unintended negative system-level consequences. As a good example, even if ChatGPT were implemented without any biases or hallucinations, the computing machinery needed to train and run ChatGPT for millions of users can have significant negative environmental impacts.

Another example of negative consequences concerns the critical minerals that need to be dug out of the ground to build the data centres and mobile phones required to run AI. A third example is the use of low-paid workers in Africa to train ChatGPT, who were asked to label text containing violent, sexist and racist remarks so that ChatGPT could avoid generating such text.

Broader societal risks are the hardest risks to manage. They are often hidden and not talked about. Systems thinking in one way to help understand and manage these hidden risks. Another way is to engage with experts outside the technology disciplines, such as lawyers, social scientists and anthropologists. These experts will typically bring a different lens that can enable hard questions to be asked that otherwise might go unrecognised.

While it is difficult, if not impossible, to guard against all negative unintended consequences, a truly responsible approach to AI development and deployment will involve a rigorous attempt to understand not just the AI system’s risks but also the risks arising from how that AI system is used in a broader environmental and social context.
10 examples of AI that are here now and have been embraced by the general public

Stella Solar
Director, National Artificial Intelligence Centre, CSIRO

IN THE RAPIDLY evolving landscape of technology, artificial intelligence (AI) has quietly become an integral part of our daily lives. Once considered a futuristic technology, AI has been embedded into our daily routines for years, seamlessly enhancing accessibility and experiences.

Beyond everyday conveniences, AI is playing a crucial role in solving some of the greatest challenges facing Australia. This includes adapting to a changing climate, protecting unique ecosystems, accelerating drug design, and helping cities and towns run as efficiently as possible.

Before we delve into these inspiring examples of everyday AI, let us remember that AI’s potential to improve outcomes for business and society can only be realised through responsible and thoughtful design, development and application. It is the mission of the National Artificial Intelligence Centre (NAC) to work with industry, government and civil society to guide the creation and adoption of AI towards safe and responsible outcomes.

Below are some of the many ways AI has been embraced by Australians.

1. AI in your pocket
When we unlock our phones using facial recognition or fingerprint scanning, that’s AI in action. These technologies use sophisticated algorithms to identify and authenticate users.

And it doesn’t stop there – AI enables virtual assistants like Siri and Alexa to answer our questions and set reminders, navigation apps to plan the most efficient routes, and social media platforms to curate personalised content feeds based on what we like or dislike.

2. Let’s talk chatbots
Chatbots are powered by AI technologies that allow them to engage in conversations with users. By leveraging natural language processing (NLP) and machine learning, these AI-powered assistants understand user inquiries and respond accordingly.

They can answer common questions, are available 24/7, and provide personalised recommendations and solutions.

According to CSIRO’s Australia’s Artificial Intelligence report, Australian businesses that deploy customer service bot experience an average incremental revenue benefit of $500,000 per project.

3. Streamlined streaming
Video-streaming platforms are a great example of how AI can create a seamless and intuitive experience.

Streaming platforms use machine learning algorithms to analyse vast datasets, identify patterns, make predictions, and continually refine their understanding of user preferences for personalised content suggestions.

Some streaming services even use NLP algorithms to understand users’ reactions to content to identify preferences.

By identifying which genres, themes and formats resonate with specific segments, AI also enables studios and production houses to make data-driven decisions when developing new content.

4. Next-gen empowerment
Generative AI technologies have sparked our imagination and engaged people at a scale never before seen with AI. The surge of new products and services underpinned by this technology is a testament to what human creativity can achieve in a short amount of time with new tools and technologies.

 Australians are using generative AI to write content, create reports, analyse trends, build websites, generate ideas and create code. For sole traders and small businesses, generative AI is a revolutionary technology that can scale customer engagement and operations and transform time-intensive tasks into quick actions.

5. Game-changing
From testing AI-powered predictive analytics platform on a handful of vending machines in Newcastle to counting Coca-Cola, Walmart and Red Bull as clients, HIVE has successfully harnessed the power of AI.

Founded in 2015, this Sydney-based startup’s AI solution generates insights from huge datasets to optimise product management and merchandising, empowering retailers to increase their brand’s footprint.

SAM, HIVE’s Sales and Marketing Manager, can develop a planogram at scale, allowing retailers to manipulate product trends.

The company’s world-leading technology facilitates swift medical intervention and helps ensure patients receive the best possible care.

6. Preventing potholes
LYRO Robotics, an Australian start-up, has developed an AI-powered solution to help farmers in regional Queensland sort and package fruits and vegetables.

The company’s world-leading pattern-packing robot can lift, de-stem and pack produce like avocados, sweet potatoes and pumpkins from conveyor belts and neatly pack them into boxes.

The robot can be fitted into existing operations and installed in less than an hour, helping farmers optimise operations, reduce food wastage, increase efficiency and mitigate labour shortages.

7. Keeping an eye out
Health in a Virtual Environment (HIVE) is a remote hospital patient monitoring system that has been assisting on-the-ground doctors and nurses since 2021. Powered by AI, HIVE continuously monitors patients who require close medical observation.

People’s vital signs are analysed, including heart rate, blood pressure and oxygen levels. This data is relayed to a team of clinicians at HIVE’s command centre at Royal Perth Hospital. If any anomalies arise, the HIVE team promptly alerts the attending healthcare staff to provide medical care, communicating through a two-way audio-visual unit.

This innovative use of AI technology facilitates swift medical intervention and helps ensure patients receive the best possible care.

8. Helping hands
LYRO Robotics, an Australian start-up, has developed an AI-powered solution to help farmers in regional Queensland sort and package fruits and vegetables.

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9. Caring for Country
In the wetlands of Kakadu, rangers are using AI and Indigenous Knowledge to care for Country. Ai Kakadu is one of the largest national parks in Australia, it can be challenging to monitor the environmental health of this precious ecosystem and the wildlife.

But using drones to perform aerial surveillance, take thousands of photos and speedily analyse the images is a game changer for rangers, who would normally perform healthy country maintenance in 40°C heat and 60 per cent humidity.

All the drone monitoring, data analysis and reporting happens through the Healthy Country Dashboard developed by CSIRO, Kakadu Rangers and Microsoft.

This combination of Indigenous Knowledge and AI has already generated positive results. In 2019, rangers reported thousands of magpie geese, who are the markers of healthy wetlands, returning to areas that were once choked by weeds.

10. That’s a wrap
Did you know AI is behind some of your favourite movie magic? In 2021, Adidas-based Rising Sun Pictures and the Australian Institute for Machine Learning (AIML) used AI to create visual effects for Marvel Studios’ Shang Chi and the Legend of the Ten Rings.

Using a ‘deepfake’ method, the team mapped stunt performers’ faces with ‘actor’ faces, training each character’s machine model with over 30,000 facial images of both stunt performers and actors. This enabled them to more efficiently swap the faces of the two, with 51 swaps needed for six key scenes.

Replacing the traditional use of 2D and 3D face ‘mapping tools, this new method saves time and money for high-intensity action scenes where stunt doubles are needed.

RESPONSIBLE AI: YOUR QUESTIONS ANSWERED
A responsible AI ecosystem is one where everyone — creators, regulators and end users — is accurately informed about the capabilities and limitations of the technology. A responsible AI ecosystem means decision-makers can take into account the informed opinion of all stakeholders and make the best decisions about developing, deploying or retracting AI-related technologies.

In a responsible AI ecosystem, stakeholders acknowledge and manage the tension between the huge benefits and possible harms of any transformative technology like AI. Responsible AI practitioners do as much due diligence as possible to pre-emptively prevent harm, but also acknowledge, and prepare for, the inevitable need to remediate the unexpected impacts and consequences of even approved AI deployments.

That underlying grand challenge is how to design a system that “knows when it doesn’t know.” To take a simple example, imagine an autonomous vehicle navigating a crowded pedestrian- and cyclist-filled city street. Part of its navigation system will rely on the vehicle understanding where it is located on that street: a process known as localisation in the research field, but what might more commonly be called positioning. The vehicle proceeds down the street safely until, at some critical juncture in time, perhaps when approaching a pedestrian crossing, the positioning system glitches and for a second or so, the vehicle imagines it is navigating a very different street, located on the other side of the city.

The vehicle makes some navigational decisions as if it were suddenly driving down that other street, chaos ensues and a group of pedestrians end up with serious injuries. Imagine instead that the algorithms and intelligence powering the positioning system had an introspection capability, so that the vehicle was able to analyse its performance and identify when it is not functioning properly, usually self-evident. The autonomous car hits a pedestrian, the autonomous flying system crashes into a mountain, the surgical robot cuts an artery. The problem of AI knowing when it doesn’t know how to respond has received relatively little attention in AI research to date, especially compared to the great deal of attention AI research has given to maximising performance scores on research benchmarks for tasks like object recognition, where research careers are made and million-dollar salaries are obtained.

This imbalance in attention is no doubt also a result of how these AI systems have largely been deployed: in operationally tolerant, human-supervised tasks like image, text or music generation, where a human sees the output and can refine and finalize with the AI system until it is satisfactory. If the huge potential of these AI systems is to drive a large-scale transition into the embodied intelligence domain — robots, autonomous vehicles and automation — the systems themselves will likely need to have much better introspection capabilities. This need is especially present in safety or operationally critical domains where constant, vigilant supervision of the system is not feasible, and intervening after an incident is far too late.

Australia performs well in fundamental research per capita in many areas but has a poor track record in translating fundamental research into deployed technologies.9 The scenario posed here relates to just one type of AI — positioning and navigation — but could just as easily apply to many other types of AI, such as the vehicle’s pedestrian recognition system. Embodied deployments of AI are particularly useful for thinking about these issues because the consequences of the system not knowing when it is not functioning properly are usually self-evident. The autonomous car hits a pedestrian; the autonomous flying system crashes into a mountain, the surgical robot cuts an artery. The problem of AI knowing when it doesn’t know how to respond has received relatively little attention in AI research to date, especially compared to the great deal of attention AI research has given to maximising performance scores on research benchmarks for tasks like object recognition, where research careers are made and million-dollar salaries are obtained.

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Responsible AI means keeping humans in the loop

What are other social implications of the mainstream adoption of this technology?

Associate Professor Carolyn Semmler and Lana Tikhomirov
School of Psychology, Faculty of Health and Medical Sciences, University of Adelaide

Responsible AI reflects the values, needs and goals of humans by augmenting human lives and respecting human rights.

Responsible AI is AI that is developed with the purpose and understanding of the human system it seeks to serve.

Lana Tikhomirov

IF AI is developed and implemented responsibly, it has the potential to be a positive force for Australians by reducing the strain caused by inefficiencies in our social systems. For instance, AI systems for health could minimise the millions of dollars lost yearly due to adverse events in the health system by allowing us to invest in better care in different areas. However, this can only be achieved if AI is recognised as being one part of a complex network of working parts, known as a socio-technical system. Although these principles can be generalised to many applications of AI, here we focus on health, which is the field that is currently most influenced by AI and a major focus of the tech industry.

Socio-technical systems
All technology exists in a socio-technical system. In the context of the health sector, this system is made up of doctors, nurses, other healthcare professionals, the technical infrastructure, and the community they serve. However, a poor understanding of how AI fits into this system, combined with poor implementation, is increasing the potential for harm and error. To illustrate how this looks in the healthcare system, we might consider the example of doctors taking advice from AI when it conflicts with clinical best practice (over-reliance) or doctors choosing not to use AI when it could encourage adherence to clinical best practice (under-reliance). Further, recent research by the Australian Institute for Machine Learning has demonstrated that bias against minority populations can be transferred through AI systems, which can then negatively impact certain patients.

Why there is no simple fit between AI and a complex socio-technical system like healthcare

Although doctors have specialised skills, they are privy to the same limitations as all humans, of which cognitive science can provide a basis for understanding. This begins by recognising how AI will never be a simple fit into a complex socio-technical system. First, the understanding of the tasks that AI can undertake is misguided. Too often, AI models are built without apprehension of the task that should be solved, and their development lacks input from the people who will use them, in this case, practitioners within the health system. Second, AI models have no ability to use context or meaning to inform their decisions. This is problematic because context critically determines the quality of outcomes for patients. For example, AI algorithms to detect sepsis have previously missed a large proportion of cases by being unaware of the population characteristics in which they were deployed. However, a doctor working in that same population will be able to draw on their knowledge (grounded in experience) of the different rates of sepsis among different populations to recognise the symptoms needed to accurately diagnose sepsis. Furthermore, the datasets used to train AI are often not kept up to date to reflect the diversity of the population or the diseases they are trying to classify, significantly limiting the technology’s adaptability and shelf life.

Designing AI to augment the human in the system

To overcome the problems we have identified, we need to take a radically different approach to the design of AI systems. This can be achieved by understanding how expert human decision-makers like doctors do their work, using the methods and knowledge of cognitive science. For example, cognitive scientists have developed a deep understanding of how radiologists can extract the features of a pathological condition from an image within milliseconds of seeing it. This understanding can help to guide when and where AI tools are needed to improve the skills and training of healthcare professionals. Doctors, unlike AI, have a responsibility to their patients and must maintain professional standards of care. Indeed, they are the pinnacle profession that needs to demonstrate responsibility. Therefore, ensuring the appropriate use of AI in their work represents a significant challenge. If AI is implemented poorly, it may add to their burden of responsibility and potentially expose doctors to the risk of poor decision-making. Alternatively, AI implemented with a responsible design informed by cognitive science will allow doctors to offload their cognitive tasks to the AI when appropriate and focus their attention on patients.

So what does this mean for Australians?

Responsible AI means giving all Australians, whose lives will be impacted by AI, information about its intention, data and decision-making processes. Further, responsible AI requires the development of legal frameworks to protect Australians from the potential harms arising from poorly developed AI and inappropriate deployment in socio-technical systems. Most importantly, Australians have the right to be informed about the limitations of AI to allow them to decide which aspects of their lives could benefit from it. AI could be a positive force, but only if our understanding of human cognition remains central to AI development.
AI is changing the way people work

How do we skill our future workforce to ensure these new jobs stay on shore?

Professor Katrina Falkner
Executive Dean of the Faculty of Sciences, Engineering and Technology
University of Adelaide

Responsible AI is the development and use of AI systems in a way that upholds ethical principles of fairness, transparency and privacy. It involves understanding how AI technologies may have a negative impact on members of our society, the risks that are involved in leveraging AI technologies, and how we might counter those through the application of ethical principles.

It involves being transparent about how and when AI is being used, transparency in the provenance and sharing of data, fairness and equity in accessibility and benefit, and accountability for outcomes. It must be aware of and embrace diversity and inclusion to not perpetuate bias or discrimination, and considerate of different cultural, social and demographic backgrounds.

WHILE WE DON’T KNOW what the future workplace is going to look like, we do know that artificial intelligence (AI) is already fundamentally changing it and the skills that our future workforce will need.

Enhancing disease diagnosis and predicting patient outcomes in our healthcare systems, creating personalised learning opportunities for students, freeing up human workers by taking on and automating repetitive tasks, and improving the safety of our workplaces through predictive maintenance and monitoring are just some of the examples of how AI can provide a significant opportunity for our society and workforce. But how do we set ourselves up to successfully engage with these changes, and to ensure that our workforce is prepared to lead in this space?

Key to our response is investment in STEM (science, technology, engineering and mathematics) education as a continued priority in schools and universities. We need to ensure we create the talent pool required to handle the challenges and opportunities presented by AI, starting with promoting core digital literacy and AI awareness from an early age, building a foundation of basic AI concepts, tools and platforms along with broader digital literacy skills and an awareness of ethical considerations and potential societal impacts to shape the development and deployment of AI in a responsible manner.

Our investment in STEM education must have an emphasis on AI education and training. There is a need to develop AI-focused educational programs and training initiatives to support our schools in building the fundamentals and our universities and other educational institutions in shaping the next generation of STEM and AI experts, as well as supporting a culture of rethinking and continuous learning in our workforce. Furthermore, AI is changing rapidly — so this is not a once-off education need but must be an ongoing process in line with the rapid pace of technological change.

This investment must come from both the education sector and industry. Industry needs to partner with educational institutions to invest in the retraining and upskilling of their teams, and to support workers transitioning from declining industries into AI-driven fields, mitigating job displacement and supporting economic growth.

How do we do this? Supporting our schools in STEM education, and our teachers, needs to be one of our highest priorities, ranging from offering ongoing, sustained teacher professional learning to allow our teachers to enhance their STEM expertise and build awareness of AI. This requires building dedicated AI-focused professional learning and curriculum, integrating real-world applications, and partnering with industry to align and reflect the latest industry trends and real-world examples of careers and impact. But we are not starting from nothing — we can continue to support the many existing STEM-focused professional learning programs that are currently supporting so many of our teachers.

We have some fantastic programs across Australia, including Early Learning STEM Australia, Education Services Australia’s Digital Technologies Hub, CSER STEM Professional Learning Program, and CSIRO’s STEM Professionals in Schools program, providing a direct link from industry to our schools. Beyond professional development, there is a wealth of STEM clubs and competitions calling out for industry and community support — encouraging students to actively participate in scientific experiments, engineering projects and coding exercises; fostering creativity, motivating students, and building a sense of community.

Assisting these communities to support AI-specific opportunities and working with industry will enable rich AI-focused educational experiences that are relevant to the needs of both industry and community.

We need to promote diversity and inclusion in our offerings. Encouraging our next STEM generation to see its place in the future STEM workforce will set us up as a nation ready to harness the diversity of thought needed for innovation and creativity, leading to robust and ground-breaking solutions that reflect the needs of our society. We also need to support and encourage representation of women and other minority groups in the future AI workforce.

As we grow to rely more and more on AI, we must be confident that our AI systems do not perpetuate bias or discrimination, and that our AI solutions are inclusive and considerate of diverse cultural, social and demographic backgrounds.

This is not intended to encourage all students to pursue a career in STEM. We also need to consider how students across all disciplines (and workforce) areas will build their knowledge of AI, and of how to leverage it, how to work with it and when to trust it. Learning about how AI is being applied across different fields, including healthcare, finance and customer service, will open up new opportunities and career pathways for all graduates, and help all of our industry sectors embrace what AI can offer.

To support our industries to engage successfully with the changing world of AI requires investment in relevant infrastructure, ensuring that the necessary technological infrastructure, such as high-speed internet and cloud computing services, is widely accessible and that the digital divide in our society is mitigated. Programs that support and promote AI entrepreneurship and innovation, encouraging start-ups and small businesses to engage with AI, will be critical to building a workforce ready to take on the challenge of AI, and to foster and keep our future generations of STEM graduates.
A precursor to responsible AI

Responsible data management

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Responsible AI is a broad term that is intended to encompass a number of guardrails to protect against potential risks and harms that may stem from the inappropriate use of powerful emerging AI technologies.

These risks include but are not limited to those related to consent, privacy, accountability, fairness and accessibility. Responsible AI design, development and deployment necessarily require qualified experts, trusted data and sustainable infrastructure. Without widespread use and adoption of responsibly developed AI, there is a risk of irresponsible AI tech-nologies infiltrating business and society.

RECENT ADVANCES IN AI are bringing about significant change with the advent of chatbots, recommender systems and traffic-aware navigation. However, the advancements that previous booms did not have access to are becoming increasingly important. In particular, large models like ChatGPT, which eventually become part of the model, introduce the right to be forgotten, which allows citizens to request that their data be erased from the web, including AI-produced products. Given the current lack of regulation in most jurisdictions of the world on the use of public data to train AI systems, its usage may be regarded as legally compliant, but it may also be considered ethically questionable. Another advantage of model distillation is the student model’s ability to assimilate a rich array of linguistic patterns from the teacher model, which may be trained on diverse, large and open-source data. The student model can then undergo further refinement via fine-tuning, specific proprietary data,facilitating a degree of model sovereignty.

Advancements in model distillation offer new promising avenues for AI research and development. However, the lack of widespread use and adoption of responsibly developed AI systems introduces significant challenges.

Modern AI applications like chatbots, recommender systems and traffic-aware navigation are increasingly becoming a part of our daily lives. However, the advancements that previous booms did not have access to are becoming increasingly important. In particular, large models like ChatGPT, which eventually become part of the model, introduce the right to be forgotten, which allows citizens to request that their data be erased from the web, including AI-produced products. Given the current lack of regulation in most jurisdictions of the world on the use of public data to train AI systems, its usage may be regarded as legally compliant, but it may also be considered ethically questionable. Another advantage of model distillation is the student model’s ability to assimilate a rich array of linguistic patterns from the teacher model, which may be trained on diverse, large and open-source data. The student model can then undergo further refinement via fine-tuning, specific proprietary data, facilitating a degree of model sovereignty.

Data management continues to be a critical aspect of responsible AI. The use of public data or data collected from individuals without their consent is not a new issue. It is important that the data used to train AI is either collected through informed consent processes and/or used in a way that provides a proportionate return for the content creators without putting them at risk. Modern AI applications like chatbots, recommender systems and traffic-aware navigation use and adopt from a wide variety of data, as inputs and provide predictions or suggestions. To reduce the reliance on real-time user data, an emerging line of research is around the use of AI to generate synthetic data points based on patterns extracted from real data. The application of synthetic data is already seen in several high-stake domains, such as medical analysis and financial fraud detection.

In the meantime, the computational cost of storing and analyzing large-scale data is escalating. For example, the state-of-the-art computer vision algorithms for object classification are all trained with the ImageNet dataset, whose full version contains over 14 million images and is 13 terabytes in size. Recent foundation models and in particular large language models like GPT-4 have further demonstrated the tremendous cost of data collection, curation and storage as well as the computational and environmental cost of model training.

Recent advancements that provide distribution-level summarisation of real data points with compression/condensation techniques offer promising solutions from both the data management and computational perspective, wherein large and noisy data points can be substituted with a small but quality samples (or aggregated samples), to provide a data-efficient paradigm for training AI algorithms.

Advancements in responsible AI model distillation (also known as knowledge distillation) offer another promising avenue to help deal with computational concerns. Model distillation involves training a smaller model [student] to reproduce the behaviour of a larger model [teacher], with the aim of creating a lighter, more efficient model to be executed in production, while maintaining a high level of effectiveness. This process is particularly useful for large language models that can have billions of parameters, making them computationally expensive to run. Distilling generic models, made available by third parties such as OpenAI’s Q-GPT-4 or Meta’s Llama, into smaller ones makes them more viable for real-world applications where substantial computing power is lacking. Another advantage of model distillation is the student model’s ability to assimilate a rich array of linguistic patterns from the teacher model, which may be trained on diverse, large and open-source data. The student model can then undergo further refinement via fine-tuning, specific proprietary data, facilitating a degree of model sovereignty.

Data management continues to underpin the development of AI technologies, and the responsibility with which we manage the data will determine whether we gain the benefits of these powerful technologies or instead face the risks they pose.
SECTION 2
WHAT DO WE NEED TO BE TALKING ABOUT?

Andrew Dettmer
Australian Manufacturing Workers Union

AI is a powerful tool. However, it must be limited— it is not simply a benign force for good. Humans are the only ones who should be able to make decisions about its creation and application.

We need to create a ‘social licence’ to ensure that those who AI would control have means of participation and recourse such that no system is applied without human beings at its centre. At all times, those who would benefit must be held to account for any of the decisions taken by AI systems. The safety of humans— mental, physical and social— must be incorporated into any AI system, and humans must be entitled to withdraw from any AI system and must be able to give informed consent to any limitation or control imposed by AI. Humans must retain, unimpeded, the right to our quiet enjoyment of life.

AMONG THE GREATEST fears we all have is a lack of control, of matters proceeding which involve us but over which we have no agency being a victim appeals to very few.

Australia has a belief in the ‘fair go’. However, this is tempered by the reality of the experience of many, in the workplace and the community. In workplaces, seemingly benign bosses can subscribe to the principles of ‘managerial prerogative’. At its worst, this entails bosses and supervisors conforming to the idea that they alone are the basis of all rational decision-making, with workers having the right to simply obey. In some ways, AI can be seen as an outgrowth of this prerogative, with even less human agency.

In Australia, rights in the workplace are governed by the awards of the Fair Work Commission (FWC). These instruments, having the force of statute, have been in existence for over a century. They form the basis of the rights and obligations enjoyed by workers. Formerly, awards were the result of a notional ‘industrial dispute’ between employers and unions. They were dynamic and responsive to the needs of workers and employers.

Since John Howard’s introduction of WorkChoices in 2006, however, they have been more akin to instruments of administrative law, such that unions and employers apply for variations to the FWC. The only effective rights to a consultation that most workers have (and a notional defence against the deprivations of AI in the workplace) are contained within the provisions known as the ‘Termination, Change and Redundancy’ Case of 1984. The ‘change’ element is the relevant consideration in this discussion.

As one would imagine, the rights to consultation envisaged under that decision reflect the state of technology in 1984. At the time, workers and employers were grappling with early computerisation. Instruments such as program logic controllers and computer numeric control systems were then novel. It is worthwhile recalling that the most popular home computer (and the first for many), the Commodore 64, had only been introduced in 1982.

The introduction of change requires consultation. In the Manufacturing Award (MWA) — an award that covers approximately 900,000 Australian workers — Clause 41 requires an employer who has made a ‘definite decision’ to introduce ‘major changes in production, program, organisation, structure or technology’ to consult with their workforce.32 In 1984, this was readily identifiable, and timeframes were created accordingly.

However, those rights appropriate to the time of the Commodore 64 are unlikely to provide significant rights where AI is concerned. When the notoriously anti-union Elon Musk complains about the scorching earth created by the unfettered application of AI, the rights of workers are at significant risk.

II is ‘artificial’ only because the artificial involved does not need to be initiated by a human. But the directions, the process and the outcome of an AI-generated command all originate with a human. AI is notorious for its capacity to descend into prejudice and abuse when an extended narrative is expected of it. But this, surely, is reflective of the prejudices of its originators and the data they provide. One of the many complaints about RoboKyle, aside from the fundamental illegality at its core, was the repeated experience of many recipients of the computer-generated letters of demand not being able to engender a response from Centrals. The mechanical assertion of debt and the virtually instantaneous garnishing of wages and bank accounts were a source of great stress.

HAL was the computer at the heart of Stanley Kubrick’s film, 2001: A Space Odyssey, which is based on the novel of the same title by Arthur C. Clarke. HAL was the killer of many astronauts, none of whom could control it. The most important scene occurs when astronaut Dave Bowman asks HAL to allow him to re-enter the spaceship. HAL refuses to cooperate. This is the great fear that is at the heart of every human interaction with AI — that it will not obey a human command.

At all times, those who would benefit must be held to account for any of the decisions taken by AI systems. The safety of humans — mental, physical and social — must be incorporated into any AI system, and humans must be entitled to withdraw from any AI system and must be able to give informed consent to any limitation or control imposed by AI. Humans must retain, unimpeded, the right to our quiet enjoyment of life.

Andrew Dettmer is the National President of the Australian Manufacturing Workers Union and is the ACTU’s representative to SafeWork Australia. Andrew sits on the boards of the Industry Capability Network, the Australian People for Health, Education and Training/Work, Education and Training/Test Laboratories stream of the AiG Industry Laboratories stream, the Australian People for Health, Education and Training/Test Laboratories stream of the AiG Industry Laboratories stream.
Innovation needs to create value

How do we tool universities to remain relevant to industry needs?

Professor Simon Lucey
Director, Australian Institute for Machine Learning, The University of Adelaide

For me, the term responsible AI represents the inflection point we’ve now reached with artificial intelligence. AI has transitioned from a laboratory curiosity into a deployable commodity for governments and companies to drive transformative change across industry and society. This means AI has reached a certain maturity level where we should start asking questions such as “How is this technology affecting our society?” and “How is it used in a responsible way?”

Australia really needs to be at the forefront of responsible AI, because if we can get ahead of the rest of the world, we can buy into the opportunities being created.

ARTIFICIAL INTELLIGENCE IS AT an interesting inflection point. The technology is now rapidly transitioning from a perception as a laboratory, theoretical curiosity, to something tangible that’s really transforming global business and making a big impact in people’s lives.

However, while we consider where we fit in an AI-enabled world, the Australian industry needs a bit of a wake-up call.

We enjoy an excellent standard of living, but for a country that pitches itself as an advanced economy, we have a dangerous lack of economic complexity, ranking 79th in the world — behind Chile and Kazakhstan. The world’s most economically complex countries are some of our closest allies and trading partners: Japan, Singapore, and the United States.

Our industries have incredible potential but have demonstrated a long-held aversion to risk and a lack of interest in serious research and development. The average Australian Securities Exchange (ASX) 200 company spends just 3 per cent of its revenue on research and development. Half of that of the Organisation for Economic Co-operation and Development (OECD) average and not nearly enough to spark significant innovation on our own soil.

Instead, Australia’s prosperity hinges on a dig and ship mentality, where our economy is propped up by exporting precious resources to the world, leaving us vulnerable to the volatility in commodity markets.

When it comes to the critical technology we need to complexify our economy and remain globally competitive, I’m genuinely concerned that Australia risks becoming too comfortable with becoming AI adopters, and not AI creators. Australian biggest companies cannot afford to sit tight and wait for AI technology to be developed abroad and buy it ‘off the shelf’ when they feel ready.

So how do we start to turn things around? Australia has impressive universities that are engines of innovation. They undertake about 40 per cent of our R&D, and the industry would be foolish to not leverage this wealth of knowledge on campuses across the country.

One of the greatest international examples is Stanford University, which has been an exemplar of successful university technology transfer and commercialisation for decades. Its industrial affiliates programs bring multiple companies together with faculty and students to explore research ideas in a pre-competitive environment. For a small membership fee, companies get direct contact with skilled researchers, industry-focused research presentations, and access to a student talent pool for internships and graduate recruitment. Where’s the interest, from Australia’s top companies for these kinds of opportunities?

Traditionally, universities have conducted low technology readiness level (TRL) research on initial ideas before they are spun out into stand-alone companies, where they then mature and climb the TRL ladder. But AI offers us — and requires us to develop — new kinds of university-industry partnerships for the future.

AI is a lightweight technology. It climbs the TRL ladder more rapidly because it doesn’t require heavy physical infrastructure, algorithms can be prototyped and tested rapidly and cloud-based services offer lower barriers to market entry. AI relies on datasets, making it ideal to roll out across existing industries, where it can be integrated into existing systems to dramatically augment capability.

Accompanying AI’s rapid development is a growing global demand for the main source of AI capability: talented people. Universities need strategies to ramp up and meet global demand. Hybrid appointments — where AI researchers split their time between academic research supervision and leading a company’s applied AI lab — are one way that Australian universities can form deeper engagements with local and global industry.

Increasingly common in the US but relatively new to Australian universities, hybrid roles are particularly useful in niche fields such as AI, where specialist skills are in high demand and top researchers command salaries that public universities can’t match.

Rather than headhunting research talent outright, tech companies understand the strategic value of building an ongoing connection with the latest research developments and drawing from a growing talent pool of PhDs and graduates.

Students benefit immensely from working on real-world problems with professors who are connected with the best graduate employers in their field.

The federal government also has a role to play in sparking innovation and helping our universities and industries work better together. While grants and piecemeal funding are beneficial, there needs to be fundamental change if we want to support the next era of innovation through start-ups, small- to medium enterprises, and broader industry.

We can also reimagine the government’s role as an AI customer and require governments — both state and federal — to purchase a certain percentage of their AI product requirements domestically. It’s a great way to build confidence in Australia’s tech ecosystem.

The idea is hardly new. In the early 1980s, the California state government implemented novel tax credit arrangements that saw Apple put computers into 9,000 public schools. This allowed them to get a strong foothold in the education market and revolutionise personal computing through the 1990s.

For startups, scaleups, and tech companies seeking to do new things, having the government as a customer is vital in building a brand and name recognition. After all, it’s these startups and small- to medium-sized tech companies that have been at the forefront of AI innovations through the past decade.

Australia has countless success stories in AI research, and we have many expats doing amazing things abroad, we just don’t often hear about them. High school students need to see role models in AI who are championing innovation if they’re to forge careers in STEM — kids might actually want to do their maths homework if they could see where it could lead them.

AI has arrived and very soon the idea of ‘AI and not AI’ is going to be outdated. When the internet first came to homes in the mid-1990s, it was only accessible via a dial-up modem attached to a desktop computer. Now it’s effortlessly connecting every aspect of our daily lives that we don’t really think about anymore.

In an age where AI is quickly becoming the facilitator of global innovation, Australia stands at a pivotal juncture. Our industries and government must harness the synergy that could fuel our growth in this new landscape. We should aim to be at the forefront of AI technology creation and implementation. By fostering a culture of research, risk-taking, and closer university-industry relationships, we can diversify our economy, bolster our global standing, and create a fertile ground for a new generation of Australian tech innovators.
An AI-literate community will be essential for the continuity of social democracy

Kylie Walker
Chief Executive Officer, Australian Academy of Technological Sciences and Engineering

In catalysing the industrial revolution, the steam engine fundamentally changed the way people lived, worked, defined and organised themselves. It brought widespread access to education, the rise of professional specialisation, cheaper goods, medical advances and longer life expectancy, and the promise of social mobility. It also brought exploitation of unknowned cities, climate change, unmanageable volumes of waste, social exclusion.

Al is the steam engine of today. It can and will fundamentally change the way we live, learn, care, play and work. And it will change the way we define being human: when machines can teach and learn, and those who work in every economic sector. In a word, we must prioritise AI literacy for everyone.

AI technologies replicate human-like intelligence, achieved by training machines and computer systems to do tasks that simulate some of what the human brain can do. They learn from and draw on large datasets that serve as their knowledge base and are trained to predict specific outcomes based on the patterns and structures found in these large collections of information.

It’s tempting to think of datasets as neutral sources of information, but they are not. The people and places from which they’re drawn, the questions they’re tasked with responding to, and the context in which they’re analysed all impact on the quality and focus of the information, and therefore drive the outcomes. For example, most large voice-based datasets are overwhelmingly male voices. As a result, voice-activated software responds much more readily to lower pitched (i.e., female) voices. These systems can improve over time, becoming more complex and accurate as they take in more information. Understanding this can help users to better grasp how, when and why these potent AI technologies are already being applied in deciding who gets a job interview or a mortgage, as well as which movie a streaming service recommends to individual users.

AI technologies are already being applied in deciding who gets a job interview or a mortgage, as well as which movie a streaming service recommends to individual users. An AI-related mistake or built-in bias in the first two instances has much more serious consequences than in the latter. Literacy for AI technologies could progress at the same pace as other areas of technology, resulting in a society in which these powerful new tools are perceived to be moral, reasonable and human-like: a society in which AI can be used by bad actors, and to create much more serious consequences than in the latter. Literacy for AI technologies is important for understanding the technology’s limitations, and hopefully a more equitable outcome.

AI literacy includes the ability to understand the basics of AI, how it works, and its potential impacts. It further requires a whole-of-life approach to learning for every member of the community. An AI-literate society is one in which everyone can exercise agency and discretion as we engage with AI technology. It’s a society in which we understand how to set the boundaries for this rapidly evolving technology and direct it towards an inclusive, kind, well, productive and happy society.

Responsive artificial intelligence (AI) requires an equitable, diverse and inclusive future, and has the potential to bring exploitation, overcrowded cities, climate change, unmanageable volumes of waste, dislocation and social exclusion.

The guiding principles for developing and using AI-powered technologies require a starting point to comprehensively address the use of these complex and rapidly evolving technologies.

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An AI-literate society is one in which these powerful new tools can be used for the benefit of all people.
What are the limits of current AI, and what opportunities does this create for Australian research?

Professor Anton van den Hengel
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THES LAST YEAR has seen incredible growth in public awareness of artificial intelligence, but perhaps not as much public understanding. Despite ChatGPT and a raft of other consumer AI software releases, the public perception of AI still hovers excitedly around visions of sentient physical beings: loyal and attentive robots at our side, diligently doing the jobs we humans find so annoying. The truth is far less Hollywood.

While related, AI and robots are not the same thing. The vast majority of what people call “AI” today is machine learning. It’s math and computer code. It’s software that’s able to analyse and interpret vast amounts of information, and make accurate predictions, far more efficiently than any human. And while AI is now driving a technological revolution and powering the world’s largest companies, it’s not about to cook you dinner and do the dishes.

The capabilities of even the most advanced contemporary robots are far more modest than the public imagines. The truth is the robot vacuum cleaner in your home is one of the smartest pieces of robotic technology you can buy. Most robots deployed in the industry today lack any form of true AI, rendering them essentially elaborate machines for the basic automation of repetitive tasks. They can’t deal with complexity, and they stop working if they encounter even the slightest unexpected change in their surrounding environment. They’re not intelligent, by the broadest possible definitions.

This prevailing public misconception tells us a lot about the kinds of opportunities Australian AI research could be well positioned to pursue. Right now, AI has trouble operating in the real world and interacting with the environment. Embodied AI tries to solve that problem.

Embodied AI operates inside smart devices like robots and drones and allows them to perceive, navigate and understand the real world in all its rich complexity. Perhaps the most publicly well-known example of robots with some basic attributes of embodied AI are iRobot’s Roomba range of vacuum cleaners; and they can trace part of their origins to Australian robotics and AI research.

Alongside two of his MIT students, Australian roboticist Professor Rodney Brooks founded the iRobot company in 1990. Thirty years and 30 million robot vacuum cleaners later, he’s internationally lauded for challenging the traditional AI approaches of the time and pioneering the commercially successful development of behavior-based robots. Modern Roombas are equipped with advanced visual navigation systems so they don’t get lost in your living room; and that is a downstream result of landmark research by The University of Adelaide’s Professor Ian Reid, who co-invented the computer vision AI technology that effectively transforms an inexpensive digital camera into a powerful geometric-sensing and mapping tool.

Embodied AI holds the potential to radically change our economy. Consider Australia’s vast landscape: we have plentiful land to cultivate and resources to manage, but manual labor at scale is both inefficient and expensive. Robots guided by advanced machine learning algorithms could potentially be deployed to perform some of these tasks autonomously, capturing significant economic value while doing the jobs Australians don’t want to do themselves. This technology could open the door to advanced manufacturing industries previously unavailable in Australia due to our high labor costs. Future robots will not be restricted to controlled factory conditions but will operate in open, dynamic environments, executing complex tasks.

The public dream of what AI technology should be—robots that listen to us and carry out our natural-language instructions—has been with us long before The Jetsons first appeared on TV screens sixty years ago; and while it’s still a way off, recent AI advances are encouraging.

ChatGPT’s great mainstream adoption is prompting people to now ask why they can’t have similar interactive experiences with other machines. Enter vision-and-language AI, a burgeoning field at the intersection of computer vision and natural language processing techniques. It’s an area where Australia has a very strong research talent, and an opportunity we should pursue.

The next generation of robots will possess natural language capabilities, allowing for more seamless human-machine interactions, while also interpreting and navigating the physical world in real time. Imagine asking your robot to “clean up that mess in the kitchen” and it not only understands you, but is able to effortlessly avoid obstacles, find the mess in the kitchen and maybe even empty the bin when it’s done.

So, what’s the broader implication? Australia is well positioned to be at the forefront of AI research in these emerging fields, but it requires investment. While the rest of the world is also accelerating in AI capabilities, Australia has a unique set of assets that make it viable for leadership in AI research.

The gap between current AI capabilities and the public’s expectation isn’t a drawback; it’s an opportunity for Australia to invest in building technology that will significantly alter our economic landscape and daily lives. The question remains: will Australia capitalize on this fertile ground for AI research, or will we let another opportunity slip through our fingers?
SECTION 3
WHAT ARE THE NEXT STEPS?

Australia’s unfair advantage in the new global wave of AI innovation

Professor Mary-Anne Williams
Professor Mary-Anne Williams is an international authority in artificial intelligence (AI) and human-robot interaction. Her research has changed the paradigm of intelligent systems and significantly advanced decision-making under risk and uncertainty in open, complex and dynamic environments. She has been adaptively industry, including IBM, Infosys, Boeing and Visual Dial, and leading international research groups at CNRS France, Stanford University, and Carnegie-Mellon University. Her high standing both in academia and industry is acknowledged through numerous awards, invitations, and distinguished appointments.

Responsible AI is the commitment to designing, developing, deploying and overseeing AI systems by aligning with ethical principles to prioritise the safety, rights, values, and interests of all stakeholders.

Responsible AI adheres to best practice guidelines, standards, regulations and laws and considers immediate and long-term ecological, social and economic impacts.

It aims to provide technical robustness, making AI systems reliable, secure, resilient and sustainable, and it mandates continuous monitoring, learning and adaptation, proactively addressing biases, adversarial threats and evolving societal needs.

AS ARTIFICIAL INTELLIGENCE (AI) shapes the future, nations worldwide are grappling with significant challenges in seeking to harness its potential and doing so safely and responsibly. Australia has been a leader in AI since the ‘expert system revolution’ in the 1980s, where banks started to invest in developing smarter financial computer systems. But as other countries have scaled their efforts, Australia has lacked leadership in both the public and private sectors and has fallen way behind.

The recent and continuous release of game-changing generative AI technologies by US companies highlights Australia’s lack of capability and capacity to contribute to a world dominated by these technologies. Without a game plan, Australia is at risk of being left even further behind.

Some have argued that Australia is currently in a do-or-die situation and that its lack of focus on the many challenges we need to face is wasting precious time and squandering future opportunities. Focusing on the translation of other nations’ AI technologies and ‘safe and responsible’ AI is not enough; it is critical that we also develop homegrown AI expertise and technologies.

Australia has been lagging in government policy and funding, university research and teaching, business innovation and investment, and industry adoption over the last two decades. This exposes us to problems that can impact our future prosperity making Australia uncompetitive in national and major international markets.

Even worse, Australia’s investment in digital transformation – a prerequisite to AI adoption – has paved the way for other countries with AI solutions ready for deployment to swoop in and reap significant rewards. This has been aided and abetted by a vacuum of enabling government policy for domestic AI research and innovation and a lack of university and industry collaboration and investment in deep AI research, innovation and training.

However, Australia is the lucky country; the game is not over, and we can still change our trajectory. Technology adoption takes time, and despite AI’s ‘magical’ powers, its widespread adoption will be no different, largely because of the significant risks AI brings to business, government, individuals and society (see Figure 1).

Australia needs a coordinated and integrated approach that leverages its unfair advantage.

As a nation, we have critically important unfair advantages in the AI space that we could leverage, and if we do it quickly, we can get back in the game and lead.

We need to rapidly identify the gaps in capability and capacity, consolidate our societal values, and develop an ambitious vision and strategies to translate into action. Australia’s unfair advantages relevant to building AI capability

Figure 1: Risks associated with AI tools and technology. Source: Mary-Anne Williams
Figure 2: Risks, challenges and strategies to put Australia at the forefront of developing and using AI tools and technology.
Source: Mary-Anne Williams

**SECTION 3
WHAT ARE THE NEXT STEPS?**

**STRATEGY 1**
Develop and enforce effective policy and governance for AI

**STRATEGY 2**
Ensure AI is not used to build and abuse power and provide equitable access to its benefits

**STRATEGY 3**
Design, develop and deploy responsible AI

**STRATEGY 4**
Build education programs and capability for an AI future

And capacity lie in our rule of law; laws and governance structures; democratic principles; fairness, equity and societal diversity and inclusion; rapidly growing innovation ecosystem; cultural inclination towards technology adoption; and investment and progress in change and digital transformation. These advantages mean that Australia is well-positioned to embrace and drive AI-led and enabled innovation. We need to develop integrated strategies that leverage our advantages to address all the risks and challenges simultaneously.

Australia’s strong democratic principles represent an unfair advantage when confronting the challenges of governance and policy in relation to AI. Democracies are fundamentally about balancing interests and providing everyone with a voice, making Australia’s democratic heritage a solid foundation for navigating policy debates around AI, including questions of privacy, equity and access. Unlike nations, where politics is extremely polarised, or policy may be awayed by a single entity or monopolistic businesses, the Australian approach embodies a wider set of societal perspectives, offering a model for inclusive AI regulation that reflects a broad consensus, which in turn enables rapid innovation.

Australia’s existing legal, economic and political infrastructure constitutes an unfair advantage. Australia enjoys a stable political environment and a strong rules-based legal system, both of which are crucial to enforcing AI regulations effectively and maintaining public trust. Our robust economic structure, characterised by a high level of digitalisation and a strong service sector, makes the economy resilient and adaptable to the integration of AI. This strong institutional framework can attract both domestic and international AI stakeholders, providing them with the security and predictability necessary to innovate and invest.

The cultural inclination of Australians towards technology adoption also serves as a critical unfair advantage. Australians are known for their openness to new technologies, with high levels of smartphone usage, internet penetration and digital services adoption. This readiness for technological adoption can speed up the integration of AI across different sectors, making Australia a potentially attractive testing ground for new AI applications. Furthermore, this cultural trait ensures that the development of AI in this country is driven by a population that is both understanding of AI’s potential and aware of its ethical implications.

Australia has an exceptional education system, which can be leveraged to develop a new generation of AI capabilities. Australian universities are breeding grounds for innovation, offering the potential to uplift the national workforce to embrace and exploit AI-led innovation. The existing strong ties between academia and industry further facilitate the practical application of AI research, turning theory and insights into tangible benefits. This relationship requires more investment to scale. There also needs to be more experimentation to learn how AI can be used to generate value for business and society.

Australia leads in critical industries where we expect AI to have the biggest impact, in particular, financial services, medicine and health. Australia’s rich diversity gives it an unfair advantage in the development of safe and inclusive AI. As one of the most multicultural and harmonious societies globally, Australia can ensure that AI algorithms are trained on diverse datasets, thereby reducing algorithmic bias and improving the fairness of AI systems.

Australia’s democratic principles, robust infrastructure, technological readiness, high-quality education system and multiculturalism are not just assets but provide us with significant ‘unfair’ advantages.

Leveraged effectively, these distinctive strengths can enable Australia to overcome the challenges related to AI, and to carve out a global leadership role in AI. This is a path that relies not on matching other countries’ stride for stride, but on leveraging Australia’s unique strengths to create its way in a world increasingly shaped and influenced by AI.

By leveraging its unfair advantages, Australia can not only gain a leadership position in AI but also hone and strengthen these advantages to create a continuous virtuous cycle that sustains our differentiation and competitiveness. For example, to help build a brighter future for all, Australia can improve the inclusion of more diverse societal groups like women, people with a disability and First Nations peoples. Similarly, there is considerable scope to improve our education system, not just in computing but also in many other disciplines. Since AI is a transformative technology, every industry will be affected and will require new workforce capabilities that enable people to utilise AI tools to create business and societal value and benefit.

Australia has distinctive strengths that position it uniquely to address the risks and challenges of AI and to lead in the pursuit of opportunity and national prosperity.
The $4 billion dollar question

What should Australia’s responsible AI future look like?

If Australia invested $4 billion in AI research and development, where should the money be spent and what impact would we see?

ARTIFICIAL INTELLIGENCE (AI) is now starting to impact every facet of human work and endeavour. AI will likely transform our world far more comprehensively and rapidly than digital technology predecessors like the internet.

Global AI investment is expected to contribute $157 billion to the world’s economy by 2025 and in Australia, CSIRO’s Dassault forecasts that we could boost our economy by $315 billion from digital technologies including AI, even by 2030.

Public investments in AI are expected to play a critical role in protecting and furthering Australia’s economic, defence, and infrastructure capabilities; natural resources and the environment; health; ageing; and disability sectors, cities, towns, and infrastructure.

But Australia, despite its high-quality AI research outputs and capabilities, has been both slow to invest in AI and has invested far less than countries of similar size and wealth. As part of the 2023-24 Budget, the Australian Government announced only around $100 million to support businesses to integrate quantum and AI technologies into their operations. In comparison, in 2021, Canada invested more than $500 million to support businesses to integrate quantum and AI technologies into their operations. The government of Singapore has invested about $565 million in artificial intelligence research and development over the last five years.

Given current strategic investments in AI abroad, it’s timely to investigate how a similar investment in Australia would look. If Australia invested $1 billion in AI research and development, where should the money be spent and what impact would we see?

A national initiative for Australian AI research and innovation

Australia has globally recognised AI research expertise in its universities, but despite this, the country lags behind the rest of the world in building a domestic AI capability. Many of our top AI researchers leave Australia because of the lack of research funding here. University funding is a catalyst for education and innovation excellence. Top researchers supervise numerous PhD students, and design and deliver high-quality curricula to educate thousands of undergraduate students who will form our future workforce. They build smart teams, connect with the body of the world, and do great ambitious things that benefit all of society.

Investment in Australian research is really an investment in people, and we already know it delivers economic results; for every $1 the Australian Research Council puts into research, it returns $3.60 in economic output back to the Australian community.

So, how do we turbocharge Australian AI research to deliver for the country?

We could start by funding a national AI initiative focused on unleashing the value of our university AI research and ensuring it supports Australia in capturing the benefits of the AI revolution. The cornerstone of this initiative would be a coordinated network of AI research and innovation centres across the country, co-located with our leading AI universities in:

- New South Wales / Australian Capital Territory – a centre would be integrated with the Australian National University (ANU), UNSW Sydney, and University of Technology Sydney.
- Victoria – with The University of Melbourne, Deakin University and Monash University.
- Queensland – with Griffith University, Queensland University of Technology, and University of Queensland.
- South Australia – with the Australian Institute for Machine Learning (AIML) at The University of Adelaide.
- Western Australia – with The University of Western Australia and Curtin University.
- Tasmania – with the Australian Research Council.
- Victoria – with the Australian Institute for Machine Learning (AIML) at The University of Melbourne.
- Queensland – with Griffith University, Queensland University of Technology, and University of Queensland.
- South Australia – with the Australian Institute for Machine Learning (AIML) at The University of Adelaide.
- Western Australia – with The University of Western Australia and Curtin University.
- Tasmania – with the Australian Research Council.

Creating partnerships and sovereign datasets for critical sectors

Australian AI is not in isolation from the world. As AI continues to mature, it is becoming a global story. Given the transformative power of AI, it is for governments to invest strongly and fund prime innovation systems. The best way to do this technology is for governments to invest strongly and make it as robust as possible. It’s what happened in Silicon Valley, Israel, and in other nations, but we’ve talked ourselves out of doing it here.

Australia’s AI venture capital market is smaller than that of other nations. Globally, billions of dollars in venture funding are pouring into AI startups and scaleups with the International Data Corporation expecting funding on AI technologies to increase to $110 billion per annum by 2024, double what it was in 2020.

In contrast, Australia has only a few AI-specialised venture funds whose offerings are typically significantly lower than those provided internationally. Creating ecosystems between university, startups, and industry will allow for AI innovation and help attract and retain the world’s most talented people. These ecosystems will enable leading AI researchers to pursue somewhat underresourced programs of talent recruitment and training, and to provide medium-term career development options or trajectories that would not be feasible in the current university system.

De-risking AI and developing Australia’s ecosystems

Universities are fundamental to innovation and business development in all high-tech sectors, with knowledge spillover being a vital element of innovation proceeds internationally. Many startup unicorns (companies that are valued at over $1 billion) have a campus origin.

To extract maximum value from our university research assets, Australia needs more AI entrepreneurs, but we have to de-risk funding tech innovation and create and fund prime innovation systems. Therefore, investment in AI, particularly in critical sectors such as health, defence, and other areas, is necessary to drive the ethical, trusted development of Australian AI in health, defence, and other priority areas.

Investing in education and public engagement

AI isn’t a discrete standalone technology restricted to a specialised workforce. It’s a general purpose technology that’s starting to roll out across all industries and sectors. Therefore, investment in education and AI literacy from the primary school to university levels is also key to creating the homegrown, innovative talent pool needed for Australia to keep up in an increasingly competitive, AI-impacted global economy.

But it’s not just formal education; there is also a need for extensions of continuing professional development programs so our existing workforce can maintain skill and remain occupationally nimble.

AI technology disrupts workplaces and industries system wide. We are certain that Australia will benefit the most when it is a nation of expert AI creators, not just consumers.

A broad, systematic campaign that targets every sector with in-depth for priority areas – such as government and primary/secondary education, and non-government, non-academic institutions – is needed.

Given AI’s transformative power to affect an endless array of sectors and global regions, Australia needs to be involved in the conversation around its growth and impact here in Australia.

The international community has been slow to act in developing sovereign AI talent pools. Australia’s AI venture capital market is smaller than that of other nations. Globally, billions of dollars in venture funding are pouring into AI startups and scaleups with the International Data Corporation expecting funding on AI technologies to increase to $110 billion per annum by 2024, double what it was in 2020.

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What are we doing to ensure that Australia is recognised as a global leader in responsible AI, and what else should we be doing now and into the future?

Dr Ian Opperman
NSW Government’s Chief Data Scientist, Department of Customer Service

Responsible AI, ethical AI or trustworthy AI refers to the design, development, deployment and use of artificial intelligence tools and systems such that they align with ethical principles and values, respect human rights, and ensure fairness, transparency, accountability and safety throughout the AI lifecycle. (A definition co-piloted by ChatGPT v3.5)

Thoughts on responsible AI

Large language models (LLMs) and generative artificial intelligence (AI) have redrawn the frontier of what we thought AI could do. Ask any current generation of AI tools to whip up a short biography of your favourite artist, and you will get a succinct summary. Ask it to write a song in the style of this same artist, and you will get a more detailed narrative. ASK it to translate a few pages of text, and you will get a factual response to your query, some results may refer to ‘real-world’ sources that simply do not exist. This unsupervised training occasionally leads to some surprises. While AI may provide a supposedly factual response to your query, some results may refer to ‘real-world’ sources that simply do not exist. Similarly, a request to generate an image from a verbal description may lead to something a little more Salvador Dali—like than you may have expected. This scaled-up version of the age-old adage of ‘garbage in, garbage out’ leads us to the modern twist of ‘garbage in, sometimes hallucination out’!

Nonetheless, the responses from the latest generation AI tools are pretty impressive, even if they need to be fact-checked. So, what does this mean for people thinking of regulating AI or putting AI policies in place?

AI is different from other technologies

Some of the concerns raised about AI are similar to those relevant to other technologies when first introduced. When addressing concerns with the use of AI, if you instead replaced ‘AI’ with ‘quantum’ levels ‘computer’ or even ‘calculator’, some of the same concerns arise about appropriate use, safeguards, fairness, and contestability. Yet AI is different in that it allows systems, processes and decisions to operate or occur much faster and on a much grander scale. AI is thus an accelerant and an amplifier; it can also ‘adapt’, meaning that what we design at the beginning is not how it will operate over time. These three characteristics are referred to as the three A’s.

Before developing new rules, existing regulation and policy should be tested to see if it stands up to the potential harms and challenges arising from those three A’s. If your AI also ‘generates’ ‘synthesises’ or ‘translates’, then a few more stress tests are needed as this goes well beyond what you can expect from your desktop calculator.

AI is no longer explainable

Except in the most trivial cases, the depth and complexity of the neural networks, (number of layers and number of weights), alongside the incommensurably larger training datasets, mean that we have little chance of describing and understanding how an output was derived, even if it were possible to unpack all of the layers and the impact of each training element. Any explanation would be largely meaningless.

For any decision that matters, there must always be an empowered, capable, responsible human in the loop ultimately making that decision. That human in the loop cannot just be a rubber stamp extension of the AI-driven process.

Any regulation must not refer to any technology. There have been numerous calls to ban, ‘pause’ or regulate the use of AI. ChatGPT, one of the first user-friendly AI-powered chatbots built on an LLM, hit the scene in November 2022, arriving in our lives with a bang, and with the accelerator planted to the floor. Every day new frontiers in AI capability seem to be announced. Buckle up for quantum supercomputers. The orders of magnitude difference between the pace at which technology moves and that at which regulation adapts means the closer regulation gets to the technology, the sooner it is out of date. Regulation must stay principles-based and outcome-focused. It must remain focused on preventing harm, enabling appropriate human-based judgement (even AI-assisted), dealing with contestability, and remediation.

Blanket bans will not work

Comprehensive banning of student use of generative AI has been announced by various departments of education around the world (including in Australia). The intention of these bans is to prevent students from using AI to generate responses to assignments or exams and then claiming it as their own work. Such bans are extremely unlikely to be effective simply because those who have not been banned from using AI have a potential advantage [real or perceived] by accessing powerful tools or networks. The popularity of AI platforms also means that workarounds are likely to be actively explored, including the use of these platforms in environments outside the restrictions. The bans arguably address symptoms rather than root causes. In the case of education, rethinking how learning is designed and implemented is needed.

We need to think long-term

AI is a technology that has been with us for a long time. It is suddenly renewed, and we are looking at it with little understanding of the long-term consequences. By analogy, electricity was the wonder of the 19th century. From an initial scientific curiosity, electricity is now embedded everywhere and has profoundly changed the world. AI is likely to have as profound an impact as electricity. As AI becomes embedded in devices, tools and systems, it becomes widespread and invisible to us. Our expectations of these devices, tools and systems are ‘smarter’ aligned to the tasks at hand, able to interpret what we mean rather than what we ask for, and able to improve over time. We do not expect to be manipulated or harmed by the tools we use.

The NSW AI Assurance Framework version 1.0

The NSW Government developed an AI strategy and AI Ethics policy in 2020. The state government has developed, tested, and mandated the use of an AI assurance framework.24 The framework is NSW’s attempt to connect the principles of its strategy and policy to the specific issues associated with the use of AI. The framework is a self-assessment tool supported by an expert AI review committee that is tasked to review AI projects with an estimated total cost of $5 million or those for which certain risk thresholds have been identified during the framework’s self-assessment process.

The framework assists project teams using AI to analyse and document a project’s specific AI risks. It also helps teams to implement risk mitigation strategies and establish clear governance and accountability arrangements. It was released with a boost with version 2.0 planned for release in late 2023.

Summing up

For AI to be used responsibly, much more is required than the application of a simple checklist that requires oversight and that we remain vigilant to the negative consequences of AI use, individually, for our society, and for sustainable development. Our focus must be on ensuring a safe and level playing field for users of AI as it continues to amplify, accelerate and adapt. That focus also has to stand the test of time.
### Acronyms & abbreviations

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<th>Acronym</th>
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<tr>
<td>AI</td>
<td>Artificial intelligence</td>
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<td>AIML</td>
<td>Australian Institute for Machine Learning</td>
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<td>ATSE</td>
<td>Australian Academy of Technological Sciences and Engineering</td>
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<td>FWC</td>
<td>Fair Work Commission</td>
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<td>STEM</td>
<td>Science, Technology, Engineering and Mathematics</td>
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<td>TRL</td>
<td>Technology Readiness Level</td>
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Endnotes


