

# Australia's National Science and Research Priorities and National Science Statement

Submission by the **Kingston AI Group: Australian Professors of Artificial Intelligence**

6 April 2023

The Kingston AI Group comprises 14 leading professors from eight universities and the Chair of Robotics Australia Group. Eight are members of the learned academies and five are existing or previous laureate fellows. As well as driving Australia's artificial intelligence (AI) research, the group's members are working with companies to develop transformative commercial AI solutions.

The group agrees that the development of Australia's domestic AI research capability is of critical importance to the nation's future security and prosperity.

AI is a crucial part of the future of science, but while it features in many applications for grant funding, most are consumers of AI rather than creators of the technology. There are no current or recent dedicated research initiatives within the major Australian Research Council Centres of Excellence or Cooperative Research Centre schemes focusing on core AI research.

Australia must engage proactively with the AI revolution and commit to building fundamental AI research capability as a national priority. Without a strong capability in this critical area, Australia's position on the use and impact of AI will be irrelevant.

## **What are Australia's greatest challenges that science could help to address?**

Artificial intelligence (AI) is a disruptive technology that is impacting every sector of the global economy, helping solve previously intractable problems, and delivering dramatic improvements to productivity. The challenge for Australia is that our scientific efforts are in the application of AI, not in the development of our own capability. AI that can be downloaded from elsewhere is derivative, and provides no competitive advantage. Grant applications across every field explain how applying AI will revolutionise their science, but we spend little on developing our own capability in the area. A distinctive Australian capability in AI is critical to a distinctive capability in Australian science.

There are a number of specific challenges that Australia faces that research and development in AI can help solve. These include:

## Economic complexity

Australia performs poorly in measures of economic complexity and in the most recent country rankings (2020) reported by the Growth Lab at Harvard University's Atlas of Economic Complexity, Australia was ranked 91 in the world—between Kenya and Namibia—and the lowest in the OECD<sup>1</sup>. Economic complexity measures the number and diversity of products that countries export and is a predictor of the long-term future prosperity of nations<sup>2</sup>. One of the primary impacts of AI in industry is in improving productivity across the board. If Australia is to compete globally, in existing and new industry areas, a strong capability in AI will be essential. More than this, AI is enabling entirely new products, services, and industries. No other technology has a comparable capacity to assist Australian efforts to onshore, diversify, and value-add.

## Sovereign capability

A key feature of AI is that the first movers gain a distinct advantage as they control the technology and the data that drives it, creating an increasingly difficult barrier to entry for latecomers. Google's search engine, for instance, is trained on billions of search queries and website clicks—it uses our search behaviour to train its algorithms. Their lead in this area is now unassailable. Companies that control AI systems end up learning a lot about the people that use them. Google knows more about Australian online behaviour than we do ourselves. Uber knows more about our movements than we do. Our agricultural and mining industries are vulnerable to the same process. Forfeiting our health data will enable foreign medical companies to know more about our health than our own health system. In areas where national interests need to be protected, we must insist on Australian owned and developed AI for the core functioning of related digital systems and datasets. For these sectors, we need to be the early developers and adopters.

## Cybersecurity

AI is essential to protecting the information systems that run every aspect of our modern lives. It is already a critical part of cyber traffic filtering, and vulnerability testing but offensive cyber development continues at pace. Large language models offer a unique capability in phishing scams, for example, and the only counter is better AI. World-class AI is essential to a strong cyber defence, as the offensive cyber AI will be trained against existing technology. Recent high-profile cyberattacks have illustrated the immense costs of not effectively defending our digital assets and information. The potential impact of future cybersecurity attacks is still far worse than what we have seen so far.

## Biosecurity

The challenge of managing biosecurity risks is that rare, small incursions of invasive plants, animals or diseases can wreak billions of dollars of damage to the Australian economy. AI is ideally suited to be a persistent, round-the-clock guardian of Australia's borders against biosecurity threats.

## Democracy

The result of abdicating control of a nation's news media is visible in the impact Cambridge Analytica had using the data of millions Facebook users to influence the 2016 US presidential election and more than 100 other elections across 30 countries. Australia accepted the abdication of control over its own information to two US companies, but the rise of TikTok has illuminated the underlying problem.

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<sup>1</sup> The Growth Lab at Harvard University. [The Atlas of Economic Complexity](#). Accessed 20 March 2023

<sup>2</sup> Hidalgo, *et al.* (2009). [The building blocks of economic complexity](#). Proceedings of the National Academy of Sciences in the U.S.A. 106(26); 10570-10575

Australia must regain control over its information flow if it is to retain control of its democracy. TikTok, Google and Facebook are all AI companies. Australia needs a strong capability in AI if it is to compete.

### **National and regional defence**

AI is the key technology required to succeed in predicted forthcoming asymmetric warfare, and current information warfare. Australia must develop its own leading AI capabilities to support its national defence efforts and maintain its sovereignty. Such technology also gives us something to trade with our allies as we all seek to contribute to the maintenance of international peace. Moreover, AI is identified in the AUKUS security pact as an advanced capability that will provide critical enablers for future force capabilities<sup>3</sup>.

## **What are Australia's greatest opportunities we should seize?**

Australia ranks in the top five globally in many aspects of academic AI, but is slipping rapidly. Without investment we will continue to lose academics to better research opportunities overseas.

AI research and development brings enormous opportunities, particularly in the creation of new tools that can help solve previously stubborn problems and deliver productivity gains across Australia's industries to the economic and social benefit of the wider community. It will make some jobs redundant, and create many others, the challenge is that these new jobs may not be in the same place.

Countries like the United States and United Kingdom, but also China, Germany, France, Singapore, Canada and South Korea, are dramatically increasing their investment in AI research and development because they have recognised that their future prosperity depends on it. Australia has yet to recognise this opportunity.

First movers in AI technology gain a competitive advantage as they capture and control the data that drives the technology, creating an increasing barrier to entry for subsequent entrants into the market. This creates potential risks to Australia's sovereignty, as by falling behind in terms of AI technology creation we allow foreign AI technology created elsewhere to capture our data and markets in a way that is very difficult to reverse. The success of Uber in Australia, despite being illegal when it launched, exemplifies this challenge.

The rapid expansion of AI applications across the economy will proceed irrespective of our actions. The opportunity is to build Australian AI technology trained on and applied to our data in a way that addresses Australia's needs and is consistent with our values.

The Australian Government has indicated its strong desire to see advanced manufacturing in Australia grow, which will help create jobs for future generations and improve Australia's economic complexity. AI is driving a new wave of automation of systems and processes across the economy that rely on data and analysis of data. AI automation—which includes the essential role that technology plays in robotics—will continue to increase the productivity of manufacturing in Australia.

In the United States there is an active movement to leverage the benefits of automation to help re-balance American labour costs and reshore manufacturing. The US Reshoring Initiative 1H 2022 report estimates that 1.6 million jobs have returned to the country by reshoring and inward-bound foreign direct investment since 2010<sup>4</sup>. While the leading factors driving this activity since the Covid-19 pandemic have

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<sup>3</sup> [FACT SHEET: Implementation of the Australia – United Kingdom – United States Partnership \(AUKUS\)](#). PM Transcripts, Department of Prime Minister and Cabinet. 6 April 2022.

<sup>4</sup> Moser, H. & Kelley, M. (2022) [Reshoring Initiative 1H 2022 Data report](#). Reshoring Initiative.

been supply chain gaps and a growing need for greater self-sufficiency, automation-driven increases in domestic productivity have been among the leading factors every year since 2010. In Germany, manufacturers were found to deploy three times more robots than US companies, but still employ more people. Relative to the size of its economy, the German manufacturing workforce is twice that of the United States<sup>5</sup>.

There are a broad range of other areas where AI research can support Australia realise the opportunities for the coming decades. For example, AI can also play a significant role in helping Australia transform its energy systems, accelerate adaptation to the effects of climate change, and deliver improvements to food security and public health outcomes.

## **What are Australia's greatest strengths we should maintain or build?**

Australia has a history of strong academic AI, and can compete globally. Many nations are envious of our research capacity. Global AI giants like the United States and China have a lead in the area, but there is a lot of room to move. One of the primary opportunities is in developing a trusted brand in responsible AI that builds on our international reputation for strong liberal democratic institutions. Everyone knows that if Australian AI says it won't use your data for other purposes then it won't.

In March, Stanford University researchers announced a ChatGPT clone that they were able to train for only US\$600, demonstrating that working with large datasets, where they are available, is becoming more affordable<sup>6</sup>. However, Australia has an opportunity to develop a competitive advantage designing AI systems from small datasets where large datasets cannot be collected, or where the resources to build 'big AI' are not available. This type of AI is highly suited to solving Australian challenges and in building Australian security systems, where large datasets and resources are often not available.

Significant advances can be gained through research into mathematical underpinnings, more effective and efficient algorithms, and new trust-based learning paradigms. Progress in these fundamental areas will lead to breakthroughs in hugely important basic AI methods such as transfer learning, lifelong learning, human-machine interaction, autonomous control and sense-making, prior and expert knowledge and common-sense reasoning.

These types of AI learn faster, adapt faster and interact with humans far more powerfully and productively in the 'real world' than those systems built solely on data learning. It enables AI that needs fewer inefficient guardrails and cages to protect humans, and is more easily moulded and improved by human interaction to meet individual human needs. This is an area of development that has been recognised by the wider communities in collaborative intelligence companies such as Meta<sup>7</sup> and Salesforce<sup>8</sup>. Fortunately, Australia has leading talent in this research area, which is attracting the attention of the global tech community.

None of these important exemplar areas is predicated on the prevailing 'big data, big compute' paradigm of current AI; but all will require advances in fundamental AI research, not an expensive deployment of the existing paradigm.

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<sup>5</sup> Graetz, G. & Michaels, G. (2018) [Robots at work](#). The Review of Economics and Statistics. 100(5):753-768

<sup>6</sup> Buenconsejo, U. (2023) [Stanford Researchers Create ChatGPT Clone for Just \\$600: Introducing Alpaca AI](#). Tech Times

<sup>7</sup> Woodall, T. (2022) [Meta's AI chief publishes paper on creating 'autonomous' Artificial Intelligence](#). VICE.

<sup>8</sup> Savarese, S. (2022) [If you can say it, you can do it: The age of conversational AI](#). Salesforce AI Research.

## Does Australia have the capability and capacity needed to address these challenges, opportunities and strengths? If not, how could we build this??

If properly supported, Australia has the intellectual capability to enable expanded AI technology creation and increase the number of Australians with specialist AI skills.

In terms of AI research and development impact and output, Australia performs well internationally relative to its size. One Netherlands survey ranked Australia sixth in the world for most-cited papers<sup>9</sup>, and the AI index report published by Stanford University shows Australia is ranked 15<sup>th</sup> in the world in terms of total number of peer-reviewed AI publications<sup>10</sup>. While international private investment in AI has grown exponentially in recent years, private investment in Australia has only increased modestly; where we are now ranked ninth in the world in 2021, up from 11<sup>th</sup> for the period 2013 to 2021<sup>11</sup>. The risk is that with the dramatic increase in investment by many comparable nations, Australia will quickly fall behind. Various measures suggest that Australia continues to outperform internationally in fundamental AI research. However, we are already seeing a decline in our world standing as other nations invest much more heavily both through public and private sectors.

A key constraint on Australia's creation and deployment of AI technology is skilled people. CSIRO's data<sup>61</sup> estimates that Australia will need as many as 161,000 people with specialised AI skills by 2030<sup>12</sup>. University research and development is a key pathway for helping expand the talent pipeline for specialist skills in AI.

Australia has strengths in key fields of AI research including small data AI. These systems can be trained accurately and efficiently on smaller datasets that better reflect the datasets that actually exist in the real world. As a fundamental capability these tools would have the potential to bring about enormous opportunities across a wide range of challenges and industries, and potentially enable AI to be applied to problems where insufficient data currently exists to train big AI.

In the last six years a large number of comparable nations have released national AI strategies supported by significant increases in funding, including Canada, the United Kingdom, Germany, France, South Korea and Singapore. But critically, and unlike Australia to date, they have all invested substantially in funding fundamental AI *research*, recognising that their nations will benefit most from advances in the technology created locally rather than simply relying on the diffusion of technology created elsewhere.

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<sup>9</sup> Castella, S. (2023) [Must read: the 100 most cited AI papers in 2022](#). Zeta Alpha blog post. Accessed 6 March.

<sup>10</sup> Zhang, D. *et al.*, (2021) "[The AI Index 2021 Annual Report](#)," AI Index Steering Committee, Human-Centered AI Institute, Stanford University, Stanford

<sup>11</sup> Zhang, D. *et al.* (2022) "[The AI Index 2022 Annual Report](#)," AI Index Steering Committee, Human-Centered AI Institute, Stanford University, Stanford

<sup>12</sup> Hajkowicz S.A., *et al.*, (2019) [Artificial intelligence: Solving problems, growing the economy and improving our quality of life](#). CSIRO Data61, Australia

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