

Joint Submission - Pawsey Supercomputing Research Centre and Curtin Institute for Data Science

Senate Select Committee on Adopting AI

6th May 2024

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Overview

Pawsey Supercomputing Research Centre (Pawsey) is a world-class high-performance computing facility accelerating scientific discoveries for Australia's researchers. Pawsey operates Setonix, the greenest and most powerful research supercomputer in the Southern Hemisphere, and serves over 4,000 researchers achieving unprecedented results, in domains such as radio astronomy, energy and resources, engineering, bioinformatics and health sciences. Pawsey also leads the Australian Supercomputing Quantum Computing Hub pilot and is a founding partner of the Trillion Parameter Consortium, which is an initiative that brings together teams of researchers from around the world in creating large-scale generative AI models to address key challenges in advancing AI for science. Pawsey is supported by both the Western Australian Government and the Federal Government via the NCRIS program and is an unincorporated joint venture of CSIRO – Australia's national science agency, Curtin University, Murdoch University, the University of Western Australia (Core Members), and Edith Cowan University (Founding Associate Member).

Curtin University is a leading Western Australian University and a key user of Pawsey's infrastructure and services. The Curtin Institute for Data Science aims to apply data science and high performance computing to provide innovative solutions for real-world problems for government, industry and academia, and specialises in the development of machine learning models and other predictive analytics in a variety of domains.

Many countries have announced major investments in national AI programs in recent months. In order to maintain the international competitiveness of Australian research and industry it is essential the Australian government consider directly engaging in a similar manner.

Senate Select Committee – Terms of Reference A *(Recent trends and opportunities in the development and adoption of AI technologies in Australia and overseas, in particular regarding generative AI)*

The focus of the Trillion Parameter Consortium (of which Pawsey is a founding partner), is the creation of state-of-the-art, large-scale generative AI models aimed broadly at advancing progress on scientific and engineering problems by sharing methods, approaches, tools, insights, and workflows. The Consortium aims to address challenges, including developing scalable model architectures and training strategies, organizing, and curating scientific data for training models; optimizing AI libraries

for current and future exascale computing platforms; and developing deep evaluation platforms to assess progress on scientific task learning and reliability and trust. Training large language models with these many parameters requires exascale-class computing resources. There is an opportunity for Australia to continue investing in infrastructure to provide the intensive computational and storage resources needed for continued AI work and model development.

There is also an opportunity for Australia to develop the pipeline of skilled AI professionals to grow and sustain work in this space. Investment in training and education in school curriculums through to upskilling professionals will help to ensure Australia not only addresses the current shortage of skilled workers but also contributes to Australia's future as a desirable destination for technology and innovation.

The development of a national approach to AI requires a coordinated national investment. In 2023 the United Kingdom announced a £900 million investment in supercomputing infrastructure to support AI. Most recently the Canadian government announced a C\$2.4b funding package in infrastructure and systems to develop an AI industry and the Singaporean government announced a S1B investment over a 5-year period in AI for health in their 2024 budget. As countries invest nationally in these efforts, we can anticipate that they will nationalise the outcomes of these facilities. Australia is at risk of being left behind in this area. The relative level of investment in AI is small in Australia in comparison to these and other countries. Significant investment is needed to establish a sovereign AI capability to improve the pace of AI development in Australia and support the adoption of AI into practical applications within research and industry.

Senate Select Committee – Terms of Reference D (*Opportunities to adopt AI in ways that benefit citizens, the environment and/or economic growth, for example in health and climate management*)

Australia could consider promoting the adoption of AI technologies in Australia in domain areas that provide significant public benefit and ideally result in efficiency savings and other benefits that offset the necessary investment costs.

Through the infrastructure and services that our organisations provide Australian researchers are supported to undertake research that adopts and utilises AI to benefit people, the environment, and the economy. Examples of this research, demonstrating opportunities to adopt AI to achieve these benefits include:

- Transport - A team from Main Roads Western Australia, PATREC, and Pawsey have developed an AI model to enhance traffic management at intersections using drone footage. This innovative approach improves roundabout planning and could significantly reduce congestion and accidents. Validated against traditional methods, the model is now scaling to analyse more data, promising to revolutionize transport infrastructure in Western Australia and globally. (https://pawsey.org.au/case_studies/ai-makes-wa-roads-cheaper-and-safer/)

- Health - Australian researchers from WA Department of Health, Royal Perth Hospital, Alfred Hospital, and Royal Melbourne Hospital have developed an AI-driven algorithm to predict intracranial hypertension events with 90% accuracy. This is a critical area of medical science with tangible and far reaching impact on patient outcomes. (https://pawsey.org.au/case_studies/traumatic-brain-injury-predictions/)
- Space Science – A team from the Space Science and Technology Centre at Curtin University is using drones and AI to identify and collect fallen meteorites (<https://www.curtin.edu.au/news/media-release/drones-and-artificial-intelligence-aid-hunt-for-fallen-meteorite-in-outback-wa/>). This system is trained on data collected from previous meteorite searches and uses drone collected imagery at candidate site and AI trained algorithm running on computers in the field to help scientists find

There are many more applications of AI in domains of interest to the Australian public. Other applications in health, such as AI tools for protein folding, have immediate applications in drug discovery and clinical medicine. Australian investment in a sovereign AI capability will ensure that we have the skill base and fundamental infrastructure to deliver the benefits of this technology to the Australian public in a timely and affordable manner.

Senate Select Committee – Terms of Reference E (*Opportunities to foster a responsible AI industry in Australia*)

The uptake of AI technologies in Australia gives rise to the opportunity to establish and support a responsible AI industry in Australia through building a community of practise that crosses domains, organisations, and industries. Extending this internationally, Australia could look to collaborate with and learn from what is already being developed in other countries including for example, the development of standards and laws in the US and the European Union (EU) (https://www.weforum.org/agenda/2023/12/europe-landmark-ai-regulation-deal/?utm_source=NAIC&utm_medium=RAINresources&utm_campaign=RAINresources) (https://www.iso.org/standard/81230.html?utm_source=NAIC&utm_medium=RAINresources&utm_campaign=RAINresources).

To support responsible AI development, Australia could look to create large-scale AI hubs where academia, industry and Government can collaborate. These hubs can also encourage a multidisciplinary approach to ethical AI research and include technologists, ethicists, sociologists, and legal experts.

A responsible AI industry in Australia will also be enabled through developing and delivering a public campaign on AI risks and benefits; encouraging the disclosure of AI policies within the wider community; making AI training and education available from school curriculum through to tertiary curriculum and/or specialties and on to professional development; and promoting and recognising

those researchers and organisations within the Australian AI industry who make a significant contribution to ethical AI.

Senate Select Committee – Terms of Reference G (*Environmental impacts of AI technologies and opportunities for limiting and mitigating impacts*)

AI technologies have significant environmental impacts, primarily related to energy consumption, resource usage, and carbon emissions. AI models require substantial computational resources to train and deploy and this translates directly to high levels of energy consumption, particularly for the data centres where the computers are hosted.

We have identified opportunities to limit, reduce and mitigate these environmental impacts through various strategies that could have application to the uptake of AI technologies throughout Australia. The strategies employed by Pawsey and Curtin University include:

- Working closely with the research community to ensure code is efficient and researchers are leveraging optimised AI algorithms to reduce computational resource requirements. Opportunities in this area include model compression (compressing and pruning AI models to reduce size and computational complexity), transfer learning (leveraging pre-trained models and transfer learning techniques), and algorithmic innovation (supporting and advising on new algorithm development and techniques). Additionally ongoing research into more energy-efficient algorithms will further reduce the computational resources required for training and inference.
- Considering energy efficiency as a key factor in hardware selection and performing ongoing monitoring of technology improvements. This includes conducting lifecycle assessments of AI technologies to evaluate their environmental impacts and identify opportunities for improvement throughout their lifecycle.
- Investing in and developing training and education programs to raise awareness and skills among AI developers, researchers and users about the environmental impacts of AI technologies and promoting sustainable practices. Pawsey is currently working with CSIRO to link energy consumption of research directly to the energy source, which will allow researchers to be provided with a report on the carbon emissions from the work they have undertaken using Pawsey's systems.
- Given the environmental impacts of energy consumption, cooling requirements, and electronic waste generated by Pawsey's AI capable infrastructure, Pawsey has invested in infrastructure (e.g., efficient Ground Water Cooling system to cool Pawsey's supercomputer with the energy required to run the cooling system pumps offset by a solar array at Pawsey; data centre design optimisation; and a proof of concept thermal battery to move energy consumption to appropriate times and then leverage that cooling capacity during more appropriate times) and implemented processes (e.g., strategies for recycling electronic waste and reusing decommissioned hardware) to mitigate these impacts.

- Pawsey is also working closely with CSIRO to develop a digital twin of the Pawsey facility that will leverage AI capabilities to support improvements in systems to reduce the impact of the building operations.

Closing Statement

The sudden emergence of AI is a challenge for Governments around the world. There is difficulty in gauging the appropriate role and the magnitude of any Government led efforts. In the case of this disruptive technology, Australia could consider following the lead of countries such as Canada, Singapore and the United Kingdom. Government has an important role in ensuring this technology is deployed safely and can ensure that the potential benefits of this technology are fair and accessible. Australia can build on the existing skill base and technology investment to enhance and retain our skilled labour force and position Australia to capitalise on the potential efficiency gains possible in areas such as health.