Australian Academy of Science

# Is Australian science ready for AI?

## AI and science

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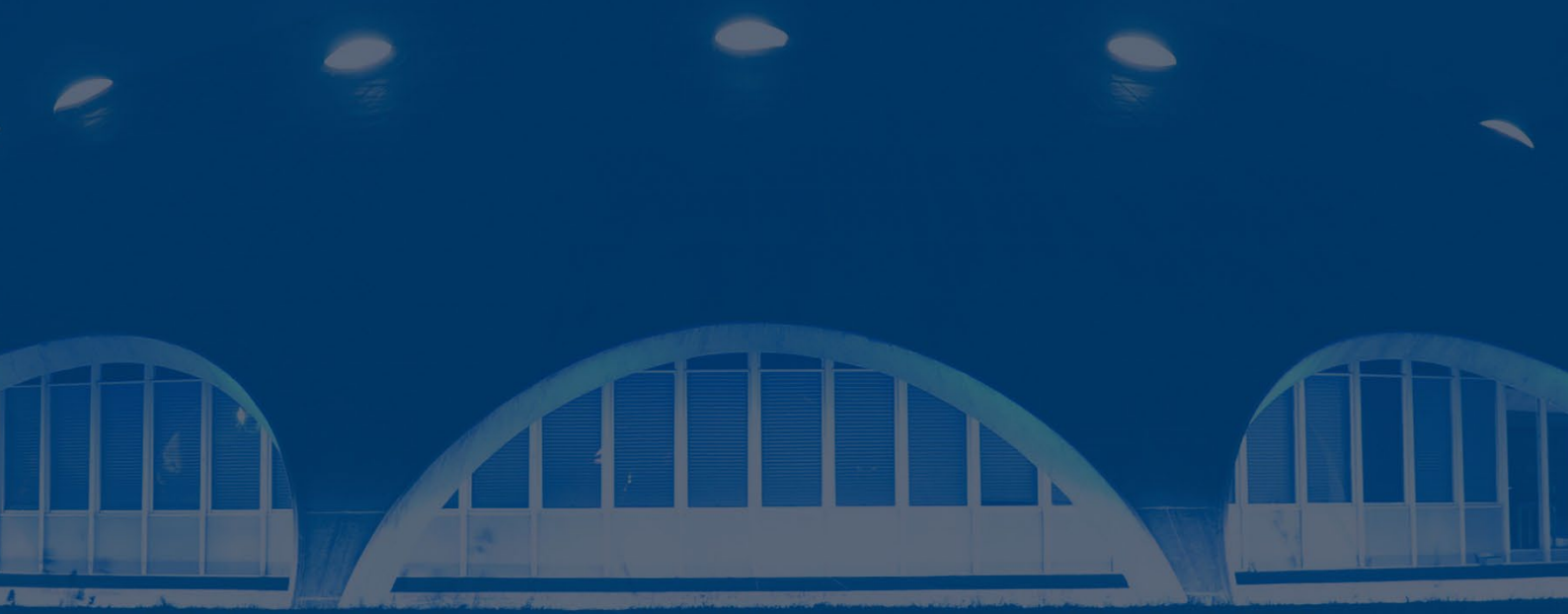

**'Is Australian science ready for AI?' is a series of discussion papers that explore the preparedness of the Australian science sector for AI advances.**

# How is AI being used to support science?

AI is changing the way scientific disciplines approach research. It has applications in fundamental, applied and clinical research, from the generation of new research hypotheses to automated data acquisition and faster data processing.[1] Some of these methods will drive a fundamental shift from traditional research to more data-centric approaches while enhancing efficiency and productivity in scientific research. As a result, there is a growing need to equip researchers with AI skills, suggesting the value of integrating these capabilities into research training programs.

AI is already used in science to analyse large datasets, improve predictive modelling in fields such as chemistry and epidemiology, and automate select laboratory procedures, speeding up research and supporting new discoveries. It also allows scientific data to be examined at a scale and complexity beyond human capability, changing how knowledge is generated and understood in data-driven science.

## To solve the problems of today, we do not have the luxury of time

In light of pressing global challenges, it is imperative to expedite scientific discovery. Issues such as increasing antibiotic resistance, climate change and the emergence of infectious diseases necessitate prompt and effective responses.

For instance, the identification of novel antibiotics has traditionally been a labour-intensive endeavour, often requiring more than 10 years. However, AI is now expediting this process. By analysing datasets encompassing chemical compounds and protein structures, AI facilitates the identification of targets for prospective antibiotic candidates, while also predicting bacterial structures and their potential development of resistance.

## How Australian science is using AI to tackle urgent issues

AI is being used to improve the efficiency and productivity of scientific research across many scientific disciplines.

AI technology underpins data-driven insights in smart farming, agricultural methods, environmental science and conservation. AI tools can drive new and personalised insights based on historical data and climate forecasting. SwarmFarm Robotics is an example of Australian innovation in this sector, using AI to automate tasks such as precision spraying and crop monitoring through an autonomous farming platform.

On the Great Barrier Reef, meta-genomic and image data (camera and remote sensing data) analysis is being used for identification, interaction, phenotyping and biomonitoring studies of organisms ranging from bacteria and lichens to coral reefs.[2]

Deep learning tools have been used in conservation efforts to identify and count endangered species using aerial surveillance, saving 8.4 years in human labour.[3] Deep learning systems can also help predict air pollution

via smart monitoring techniques.[4] With a warming planet, AI can help us adapt to climate change's environmental and physical impacts.[5]

AI systems assist in detecting patterns and proving mathematical theorems by exploring logical paths for complex mathematical problems. This enhances human capacities regarding efficiency and speed, dealing with complexity and unlocking new potential for discoveries.

In medicine, AI systems can diagnose diseases and predict virus evolution by analysing existing medical data, potentially helping predict future COVID-19, flu and HIV mutations.[6] AI tools can also analyse a patient's medical data to personalise vaccines and treatments. Australian company Harrison.ai is contributing to this space, developing AI-driven clinical support tools to improve diagnostic accuracy and healthcare delivery.

AI is a key driver of precision health technologies, transforming clinical care through AI-powered analysis of community-wide health data to detect and tailor interventions for chronic disease.

## How will AI affect the methods and practice of science?

### AI and task augmentation

AI can be used to automate tasks and alter ways of working, impacting employment patterns in science and the wider economy.

Already, AI can predict high-impact research[7] and augment and automate tasks such as literature reviews, data analysis and bibliometric analyses. In doing so, AI automates research tasks traditionally carried out by scientists, which could yield a better use of scientists' time.[8]

The shift to adopting AI tools for certain tasks may require scientists to broaden their existing skills. Specific skill sets that may be needed include understanding the fundamentals of AI development and deployment, current AI applications in research processes, effective prompt generation, responsible data stewardship processes and procedures, ability to critique and assess the accuracy of outputs, and the ethical use of AI.

If AI tools will change the tasks traditionally performed by scientists, careful forethought and planning will be required to determine which roles should remain human-led, how AI tools can perform and support research tasks, and which tasks can be handled by AI systems either independently or with minimal human intervention.

This shift could also challenge perceptions of what scientific tasks need to be closely supervised by scientific experts. There are also concerns about the long-term systemic impacts if this task augmentation results in a reduction in critical thinking ability.

### An AI-enabled science team?

The development of AI 'scientists' or assistants capable of operating under the direction of human researchers is on the horizon, indicating a transformative shift in the landscape of scientific inquiry. The concept of AI 'scientist' laboratories, where a single human scientist is supported by multiple AI counterparts – each able to respond to carefully designed prompts as accurately as the average human with a PhD level of research training while capable of working around the clock – could soon emerge as reality.[9]

This evolution presents an opportunity to accelerate research processes, enabling breakthroughs at an unprecedented pace and redefining the future of scientific exploration and innovation. However, caution must be exercised wherever human judgement and contextual knowledge are needed in producing and interpreting research, to prevent AI tools from 'supercharging' the spread of poor or inaccurate findings.

Therefore, there is an urgent need to consider the future of science both in Australia and globally, with a focus on human-centric design and implementation to ensure beneficial rather than detrimental outcomes.

## Ethics and the use of AI in the scientific process

Integrating AI into research processes necessitates a nuanced and forward-thinking approach to uphold the principles of research integrity, including transparency, rigour and accountability.

While AI presents itself as a labour-saving tool in tasks such as grant writing and assessment, it introduces complex ethical considerations.

There is a critical need for clear, evidence-informed guidelines that address both the benefits and ethical issues AI brings to research.

Blanket bans or uninformed policies could hinder the productive use of AI; a thoughtful examination of AI's implications, conducted in advance, will ensure that its integration into research methods enhances rather than compromises the integrity of science.

## Scientific integrity

While AI tools could help detect data manipulation, plagiarism or image manipulation, they could also help scientists game the system or commit fraud.[10]

Potential risks from the present generation of AI tools include:

- facilitating misconduct, such as inappropriate use to 'hallucinate' (a failed or misleading attempt to produce a suitable response to a prompt), mimicking genuine research, using large language models to produce research papers or theses, and fraudulently presenting outputs as the author's work
- facilitating data manipulation – generative AI can create realistic texts, images and data but often lacks factual accuracy. This tendency to 'hallucinate' risks spreading false findings and creating convincing-looking data that have been falsely produced
- facilitating pollution of scientific research – malicious users may misuse AI to fabricate datasets or entire research papers, flooding the literature with unverified information. Such actions threaten peer-reviewed research integrity and undermine scientific reproducibility
- algorithmic bias and transparency – AI models are trained on historical data that may contain inherent biases. When integrated into research methodologies, these biases can lead to skewed results and erroneous conclusions, particularly in fields that rely on large-scale data analysis
- threats to authorship and originality – automated writing can produce seemingly novel text from recycled patterns, risking plagiarism and diluting original thought. Unclear documentation of AI-assisted methods complicates peer review, making it hard for reviewers to discern AI's role in research output. This gap may compromise study reproducibility, which is essential for scientific progress
- threat of model collapse, which occurs when generative models are trained on data that contain their own outputs, resulting in the loss of the diversity and quality

of the original data distribution. This can pose a serious challenge for the future of large language models that rely on web-scraped data.[11]

### AI to detect scientific misconduct

AI can also assist in detecting scientific misconduct, including through the development of advanced detection tools and digital watermarking.[12] These tools can identify when figures and data have been artificially generated, reused from other authors or misrepresented.

AI can also be used to identify particular trends in citations and other publication metrics, which can help to identify areas for further investigation into potential predatory journals or citation cartels.

AI plays a vital role in verifying the reproducibility of studies, thereby improving transparency. These technologies help identify integrity issues and create strong validation protocols that support ethical research practices and encourage public confidence in scientific results.

In addition to using AI tools themselves to mitigate against deliberate or accidental misuse, measures can be taken such as:

- practising open science
- strengthening peer review
- developing and strengthening ethical guidelines and education.

As AI continues to advance, its integration into scientific research and teams will reshape the landscape of science in Australia and globally. New AI-driven opportunities and challenges will require careful consideration, training, ethical frameworks and guidelines, and collaboration to ensure they benefit both science and society.

## Reviewers

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## References


1. Hajkowicz, S. *et al. Artificial intelligence for science – Adoption trends and future development pathways*. (2022).
2. CSIRO. Everyday AI: How artificial intelligence is helping conservation. CSIRO (2023). Available at: https://www.csiro.au/en/news/all/articles/2023/february/how-ai-is-helping-conservation
3. Norouzzadeh, M. S. *et al.* Automatically identifying, counting, and describing wild animals in camera-trap images with deep learning. *Proc Natl Acad Sci U S A* **115**, E5716–E5725 (2018).
4. Bekkar, A., Hssina, B., Douzi, S. & Douzi, K. Air-pollution prediction in smart city, deep learning approach. *J Big Data* **8**, (2021).
5. Naughtin, C. *et al. Our future world: global megatrends impacting the way we live over coming decades*. (2022).
6. Prater, E. Scientists are using AI to forecast the future of COVID. Fortune Well. (2023). Available at: https://fortune.com/well/2023/10/13/scientists-use-artifical-intelligence-predict-next-big-covid-variants-pandemic-hiv-flu-lassa-nipah-virus/
7. Weis, J. W. & Jacobson, J. M. Learning on knowledge graph dynamics provides an early warning of impactful research. *Nature Biotechnology 2021 39:10* **39**, 1300–1307 (2021).
8. Prillaman, M. Is ChatGPT making scientists hyper-productive? The highs and lows of using AI. *Nature* **627**, 16–17 (2024).
9. Stevens, R. Testimony of Rick Stevens before the Senate Energy & Natural Resource Committee Hearing to examine recent advances in artificial intelligence and the Department of Energy's role in ensuring U.S. competitiveness and security in emerging technologies. (2023).
10. CSIRO. AI can be a powerful tool for scientists. But it can also fuel research misconduct. (2025) doi:10.5555/3692070.3693262.
11. Shumailov, I. *et al.* The curse of recursion: training on generated data makes models forget. (2023).
12. Gerhard, D. Detection or deception: the double-edged sword of AI in research misconduct. *The Scientist* (2024).