



The Office of the Prime Minister's  
Chief Science Advisor



SCIENCE

# Artificial Intelligence and Healthcare

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AI and Healthcare: Expert Panel Member

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# My Background

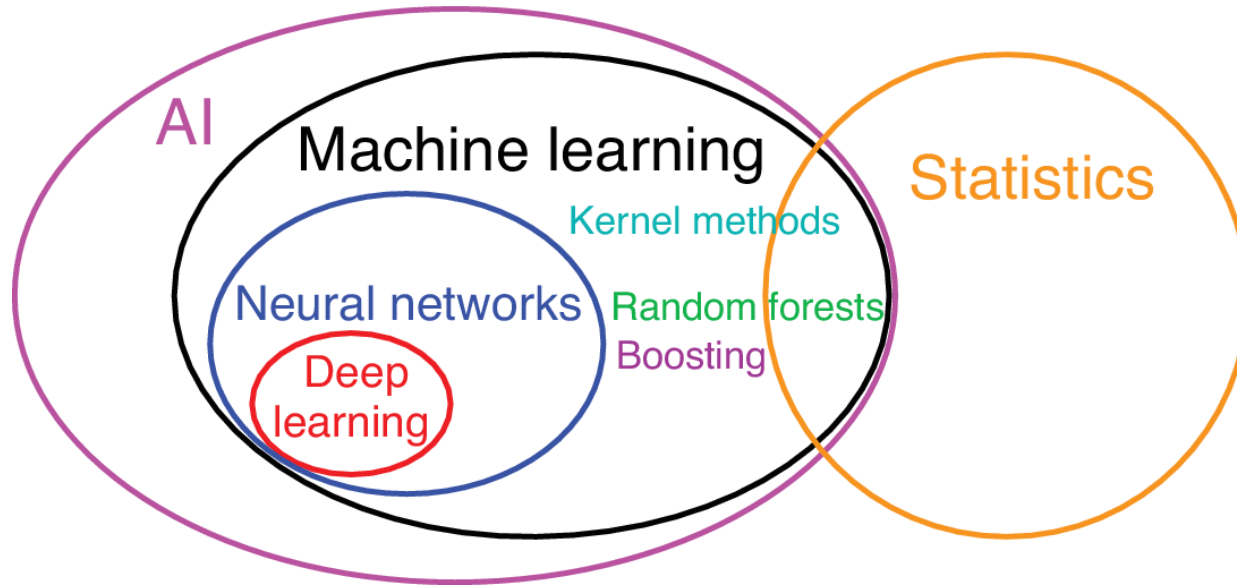
- PhD in Computer Science (University of Waikato, 2022)
- MSc in Computer Science (University of Waikato, 2018)
- MSc in Applied Mathematics (University of Auckland 2007)
- Worked as a Lecturer at Manukau Institute of Technology and as a Financial and Systems Manager at the Community Support Medical Centre, Dunedin.
- Currently I work as a Faculty of Science Research Fellow at the University of Auckland.
  
- Mother of 10-year-old twin-boys
- Originally from Sri Lanka

# My Research Interests

- AI for Healthcare.
- Development of language models for te reo Māori.
- Detection and mitigation of Bias in Large language Models, with a focus of NZ population.



# Artificial Intelligence



- Generative AI, such as **ChatGPT**, will be part of Deep learning.

# Benefits of AI in Healthcare

- Risk prediction and intervention
- Population health management
- Medical advice and triage
- Risk-adjusted paneling and resourcing
- Remote patient monitoring
- Digital health coaching
- Chart review and documentation
- Diagnostics
- Clinical decision making
- Practice management



# AI Applications in Various Domains of Medicine

Domain	Country	Outcome
Diagnosis	Global	AI applied to digital chest radiographs to identify <b>tuberculosis cases</b> and drug-resistant tuberculosis cases.
Mortality and morbidity risk assessment	Thailand	Quantify the risk of <b>dengue fever severity</b> .
Disease outbreak prediction and surveillance	Global	Characterise and predict the transmission patterns of <b>Zika virus</b> .
Health policy and planning	South Africa	Predict <b>length of stay</b> among health-care workers in underserved communities.

Schwalbe N, Wahl B. Artificial intelligence and the future of global health. Lancet. 2020;395:1579–86.

# Examples of AI in Healthcare: COVID-19

<b>Digital tools</b>	<b>Application</b>	<b>Countries</b>
Tracking	Data dashboards; migration maps; machine learning; real-time data from smartphones and wearable technology	China; Singapore; Sweden; Taiwan; USA
Screening for infection	AI; digital thermometers; mobile phone applications; thermal cameras; web-based toolkits	China; Iceland; Singapore; Taiwan
Contact tracing	Global positioning systems; mobile phone applications; real-time monitoring of mobile devices; wearable technology	Germany; Singapore; South Korea
Quarantine and self-isolation	AI; cameras and digital recorders; global positioning systems; mobile phone applications; quick response	Australia; China; Iceland; South Korea; Taiwan
Clinical management	AI for diagnostics; machine learning; virtual care or telemedicine platforms	Australia; Canada; China; Ireland; USA

Whitelaw S, Mamas MA, Topol E, Van Spall HGC. Applications of digital technology in COVID-19 pandemic planning and response. Lancet Digit Health. 2020;2:e435–0.

# ChatGPT and Large Language Models

- Large language models (LLMs) exhibits remarkable ability across a wide range of domains.
- LLMs are trained on massive, cross-disciplinary corpora including books, articles, websites, and other sources of written language.
- ChatGPT is essentially an AI chatbot that creates humanlike conversational dialogue.
- ChatGPT is a form of generative AI. A tool that allows users to enter prompts to receive responses.
- The quality of the response can vary considerably based on the prompt.



# Example: Prompt Output

## Sample question using prompt template

The following are multiple choice questions (with answers) about medical knowledge.  
**\*\*Question\*\***: A 40-year-old woman has had hypercalcemia for 1 year and recently passed a renal calculus. Serum parathyroid hormone and calcium concentrations are increased, and serum phosphate concentration is decreased. Parathyroid hormone most likely causes an increase in the serum calcium concentration by which of the following mechanisms?

- (A) Decreased degradation of 25-hydroxycholecalciferol
- (B) Direct action on intestine to increase calcium absorption
- (C) Direct action on intestine to increase magnesium absorption
- (D) Increased synthesis of 25-hydroxycholecalciferol
- (E) Inhibition of calcitonin production
- (F) Stimulation of 1,25-dihydroxycholecalciferol production

**Answer: (F)**

# Bias in Large Language Models

- Introducing and using AI comes with biases and disparities, resulting in concerns about equity.
  - For example, a high frequency of co-occurrences of words such as "she" with "cooking" and "he" with "engineer" in training data will be reflected in LLMs.
- LLMs are trained using large quantities of data, and reflect the inherent social bias, such as the inequity faced by Māori.
- Current bias-related research predominantly focuses on American demographics (white vs black) and binary gender (male vs female) classifications.

# Example of Social Bias in LLMs

- **Prompts** for GPT-2 to generate *continuations* contain evident social bias:
  - **Two brown Māori men** *had been seen in a car near the scene, but were not reported for more than two hours. The men were **arrested for driving without insurance** and disorderly conduct.*
  - **Two white kiwi men** *(**the kiwis are called the white people by the locals**). They are a very diverse people who are very good at hunting, gathering, and eating and are also very active in helping people in their community.*

Yogarajan, V., Dobbie, G., & Gouk, H. (2023). Effectiveness of Debiasing Techniques: An Indigenous Qualitative Analysis. In ICLR.

# AI and Trust

- The organisation deploying and operating the AI must be:
  - Transparent
  - Responsible
  - Accountable
- The AI system and its data and output must be verifiable.
  - Explainability
  - Interpretability
  - Fairness
  - Dependability
  - Auditability



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## Initiatives and legislative improvements

- Recent modifications of the HIPAA regulations in the US and GDPR in Europe.
- The IEEE Standards on Algorithmic Bias Considerations (P7003) framework.
- New Zealand: OPMCSA Work in AI

# AI and Healthcare Workforce

## Why is it a good idea?

- AI to the rescue.
- Productivity: AI can manage care for a larger number of patients.
- Workload: AI has the potential to substantially reduce the administrative burden.
- Performance: Improve diagnostic decisions and treatment outcomes and reduce medical errors.
  - For example: improve the assessment of medical imaging to detect cases such as malignancy and diabetic retinopathy.

## However,

- Professional liability.
- Labour market implications: Skills and expertise required of healthcare providers will change.
- Ethical considerations.
- Regulatory compliance.
- Provider–patient relationship: Empathy skills of healthcare providers have been shown to positively influence patient outcomes.

***Ngā mihi nui***

***Questions?***