

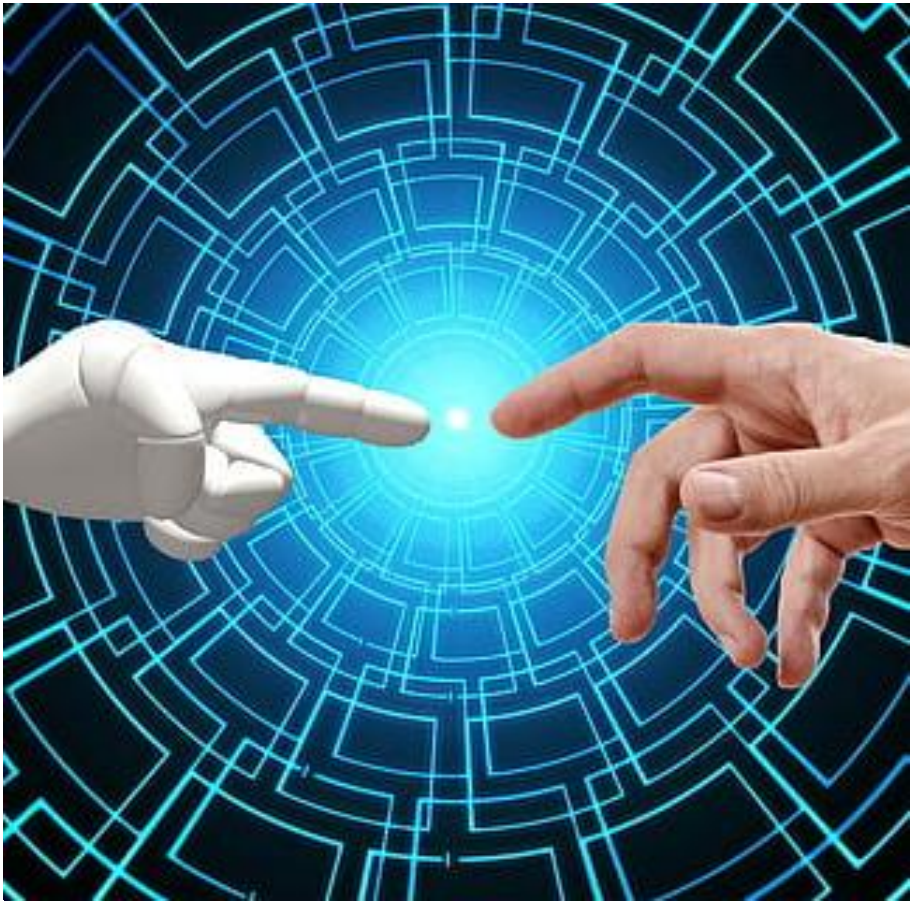
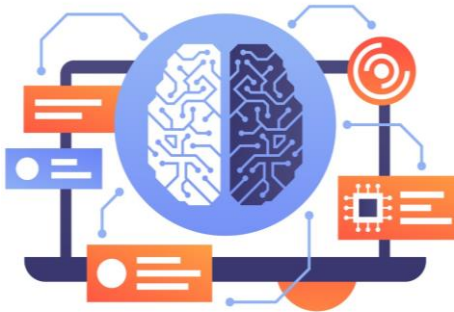
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Artificial Intelligence (AI) for Engineering

COS40007

Dr. Abdur Forkan
Senior Research Fellow, AI and Machine Learning
Digital Innovation Lab

Seminar 1: 31st July 2024

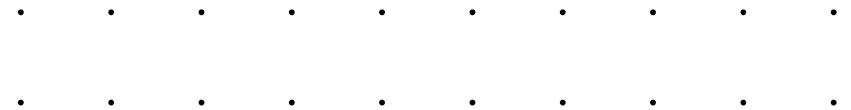
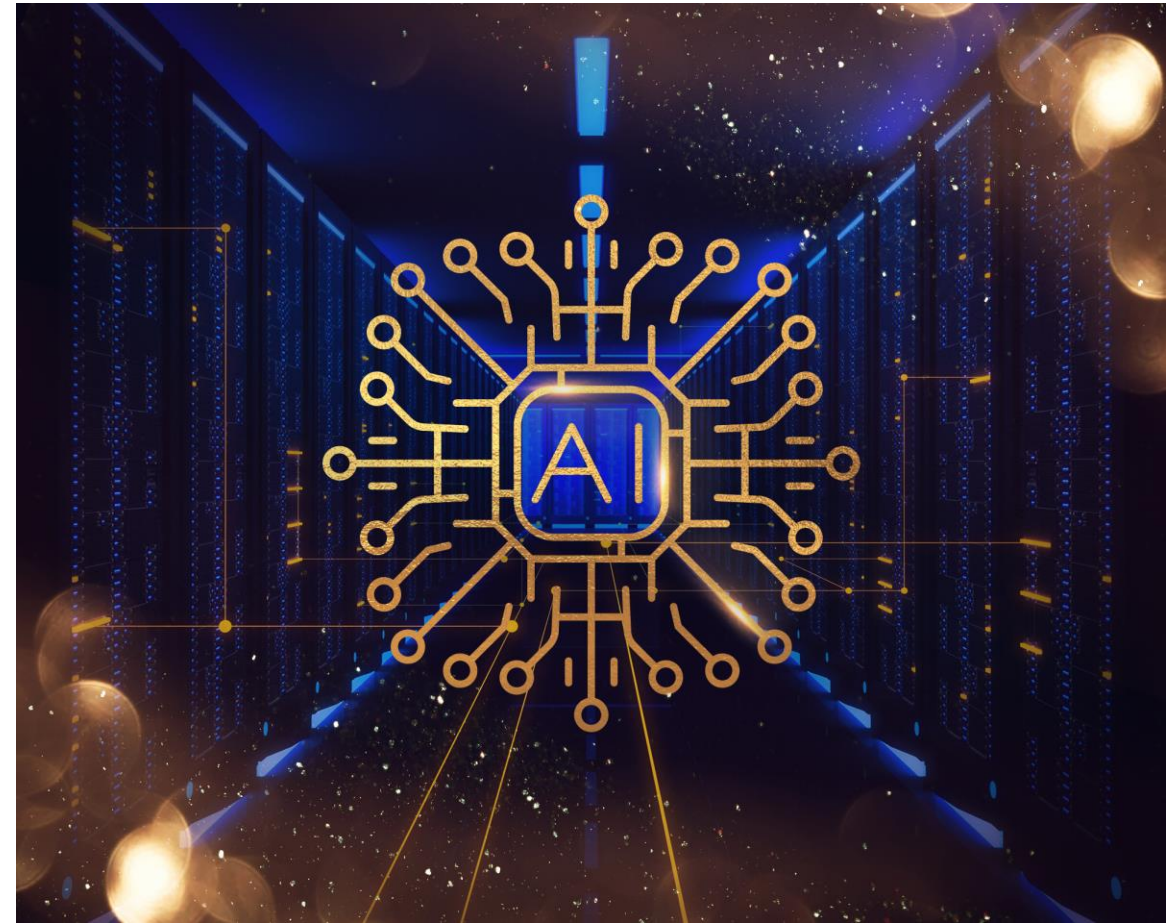


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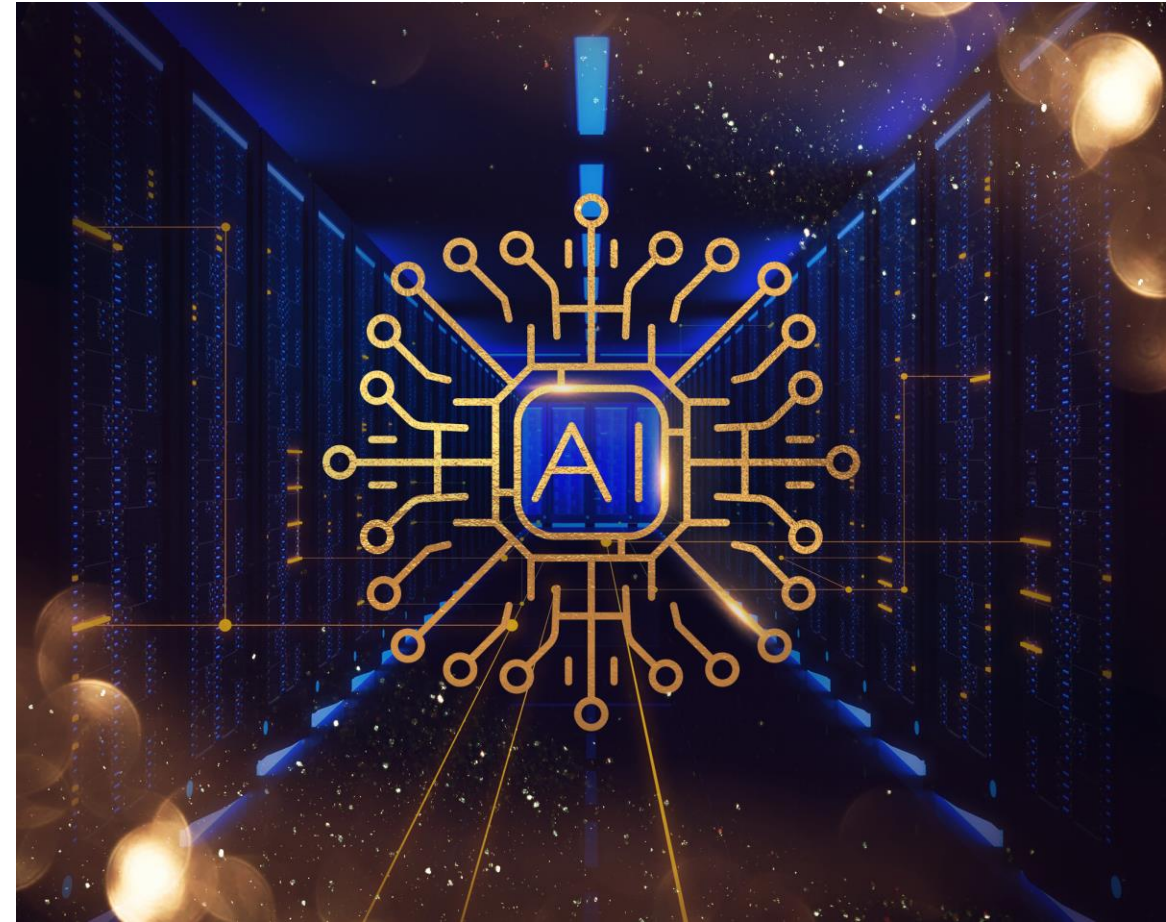
Introduction to Unit and Overview

- ❑ Staff contact
- ❑ Teaching Methods
- ❑ Assessments
- ❑ AI Overview
- ❑ AI in Engineering
- ❑ Applications of AI in Engineering



Required Reading

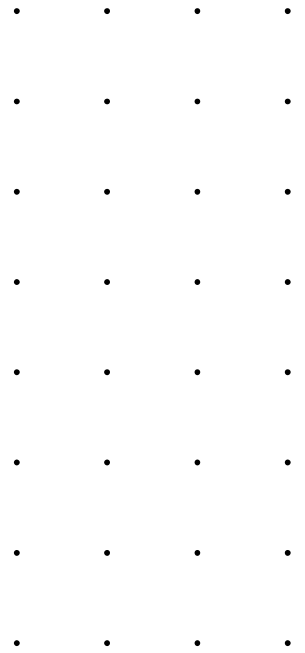
COS40007 Artificial Intelligence for
Engineering Unit outline in Canvas



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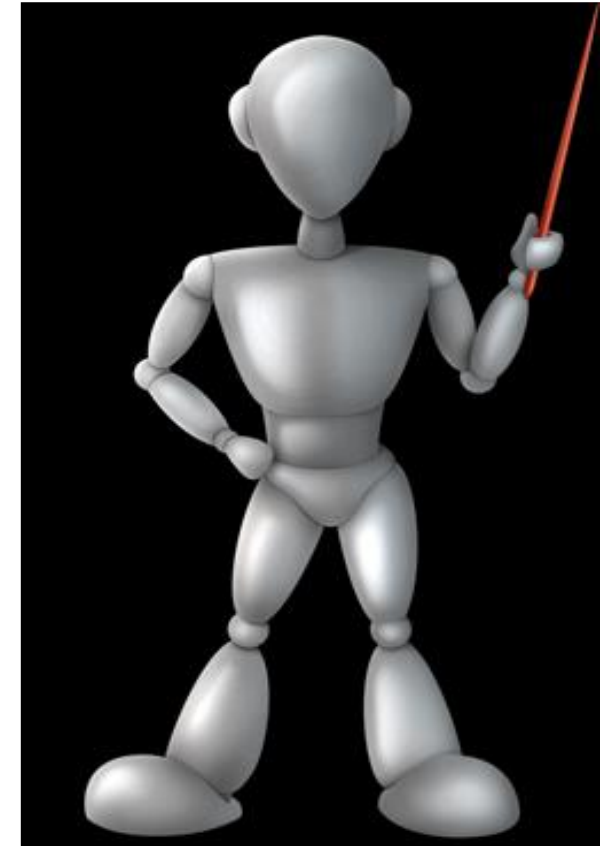
At the end of this you should be able to

- Name of your lecturer and know where to find staff contact details
- Summarise the intended learning outcomes for the unit
- List the assessment items for the unit.



Staff contacts

- Convenor: Dr. Abdur Forkan (fforkan@swin.edu.au), Senior Research Fellow, AI and Machine Learning
- Tutors:
 - Asif Ahmed Sardar
 - Shakthi Weerasinghe
 - Abyan Salam
- See canvas for contact details

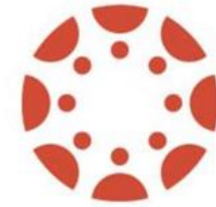


If you have an administrative question

- Read material supplied in unit outline and on Canvas (readings, seminar notes, studio notes)
- If you cannot find an answer, post your question on Canvas Discussion area
- Email questions/requests if they relate uniquely to your personal circumstance (e.g., sickness)

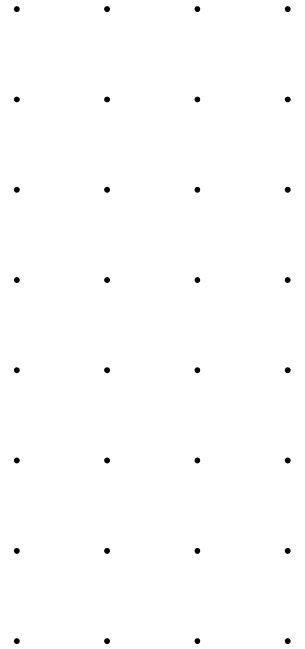


Learning management system



canvas

- Unit outlines
- Learning materials
- Assessment details and submission
- Contacts
- Discussion board



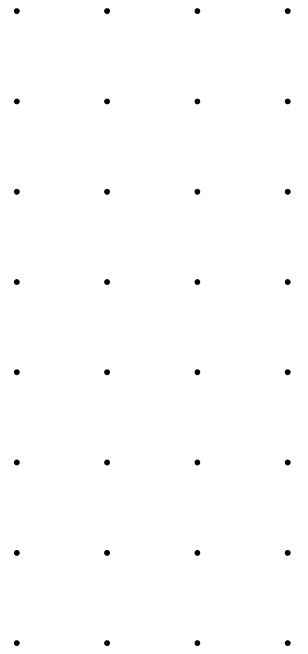
Intended Learning Outcomes

1. Design, build and train datasets using machine learning algorithms to solve multidisciplinary engineering problems
2. Demonstrate knowledge of a range of AI, machine learning and deep learning algorithms and their applications
3. Assess, appraise and justify appropriate AI techniques to solve computational engineering problems
4. Communicate effectively and succinctly through oral presentations and reports



Graduate Attributes

1. GA1 Communication - Verbal communication.
2. GA3 Teamwork - Collaboration and negotiation.
3. GA3 Digital Literacies– Technical literacy.
4. GA4 Ability to tackle unfamiliar problems.
5. GA5 Ability to work independently.



Teaching methods

➤ Seminar: 1 hour

- Will be delivered online using collaborative ultra
- Time: Wednesday 12:30-1:30 PM

➤ Studio: 2 hours

- Face to Face
- Exercises
- Portfolio Assignments and design project work

➤ Consultation: 1 hour

- Via MS teams/Collaborative Ultra

➤ Independent Learning

- 8-10 hours weekly -> take ownership of your learning



Resources

- Book

- Applied AI/ML foundations:

- Proise, Jeff. Applied machine learning and AI for engineers. " O'Reilly Media, Inc.", 2022.

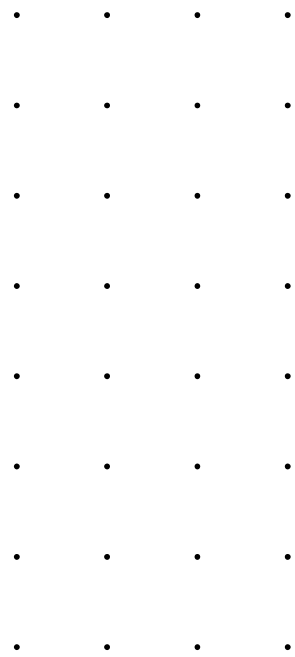
- Python for ML and DL

- Raschka, Sebastian, Yuxi Hayden Liu, and Vahid Mirjalili. Machine Learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with Python. Packt Publishing Ltd, 2022

- Kapoor, Amita, Antonio Gulli, Sujit Pal, and Francois Chollet. Deep Learning with TensorFlow and Keras: Build and deploy supervised, unsupervised, deep, and reinforcement learning models. Packt Publishing Ltd, 2022.

- Library: online Reserve, databases, catalogue, referencing workshop

- Web (look for electronic resources on Canvas and studio materials)



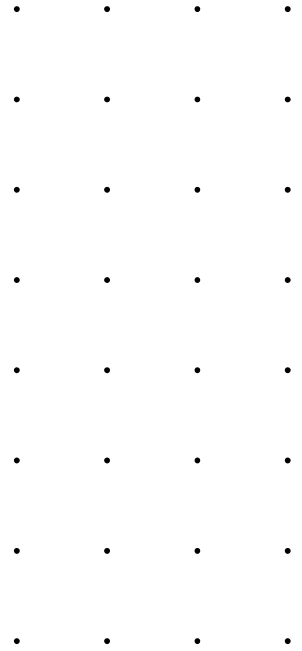
Prerequisites

➤ Technical Experience

- Introduction to Programming

➤ Willingness to learn more programming and software tools

- Python and related ML libraries



Assessments

➤ Portfolio: 50%

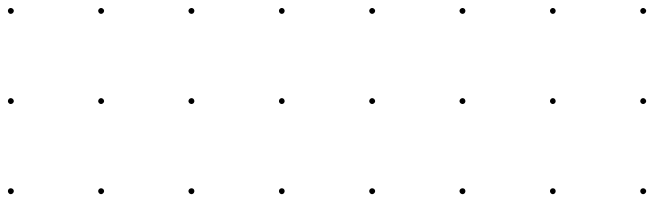
- 10% each from week 2 to 6.
- Submission due in the following week

➤ Design project: 50%

- Project brief: 5%
- Presentation: 5%
- Solution Design and Development: 30%
- Final report: 10%

Tutor will assess your work after due date. Portfolio work more than one week late will not be assessed





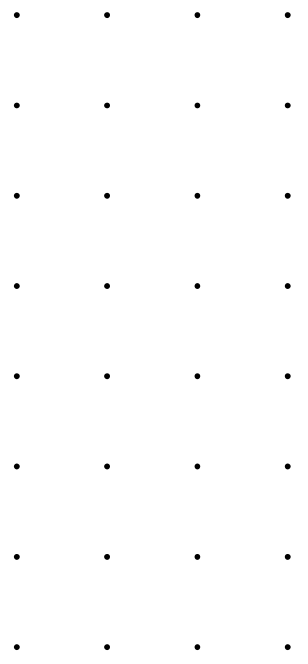
AI concepts



Concepts

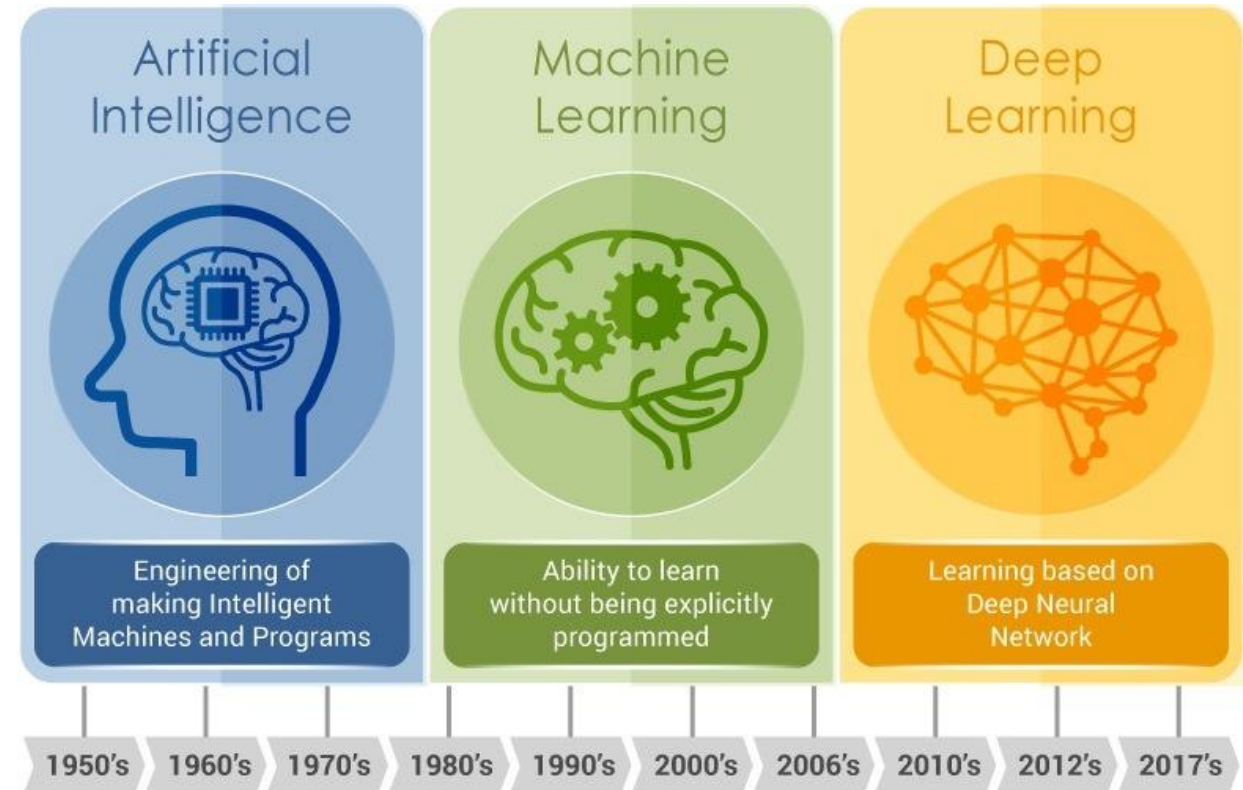
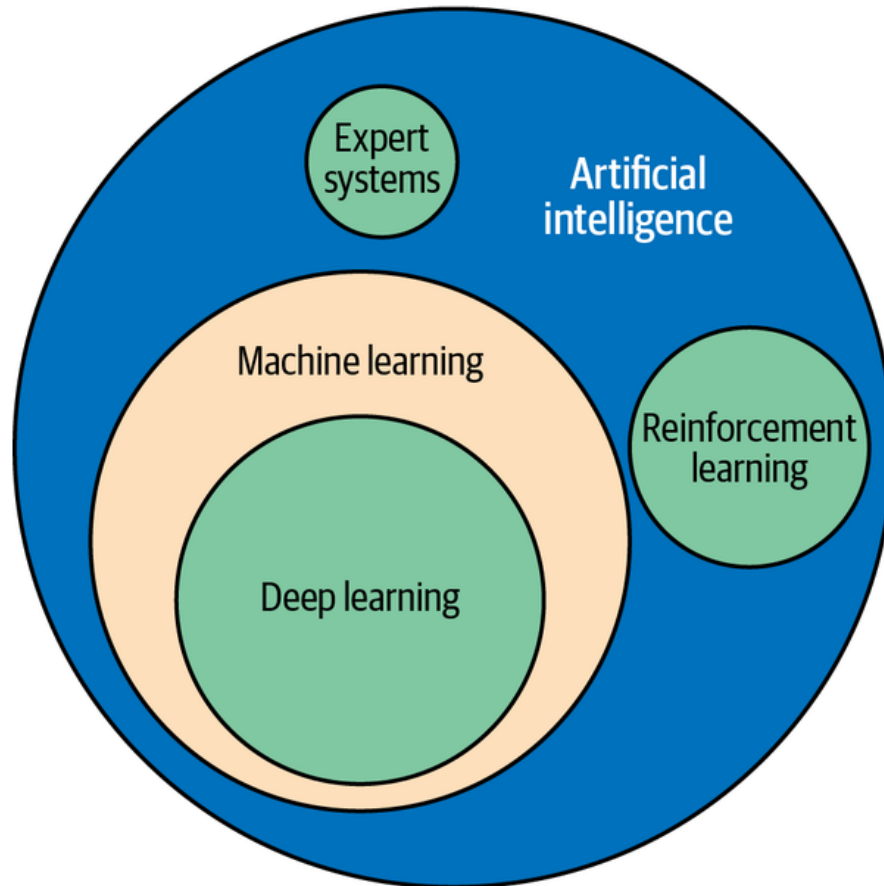
Artificial Intelligence (AI) plays many roles in Engineering. One of the most common subsets of AI is Machine Learning (ML)

Engineering process relies on AI to integrate data, analyse it, and produce the deep insights and predictions that help drive better decision-making. ML is the type of AI that requires big datasets to identify patterns and trends, then uses them to build models that predict future.



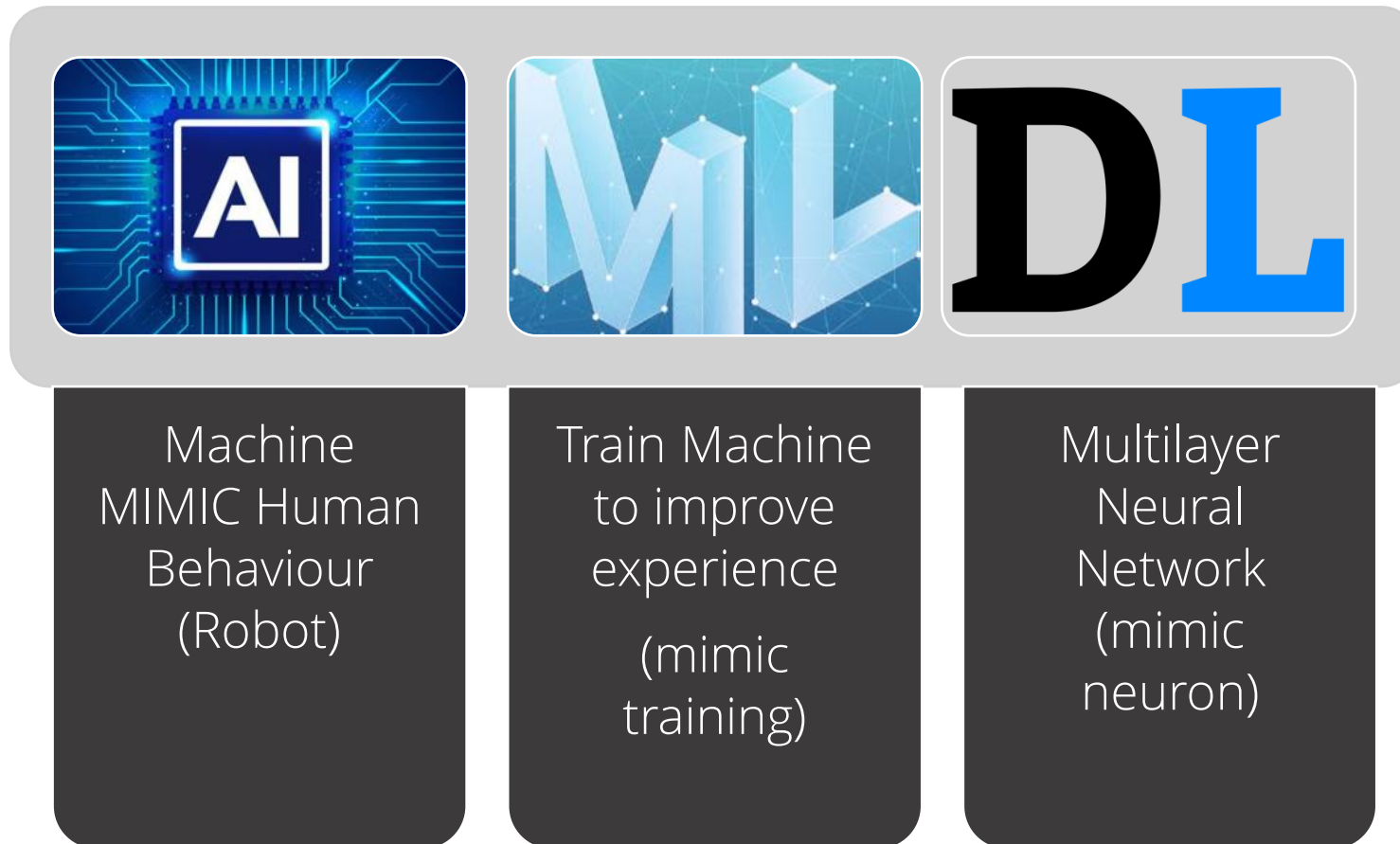
AI, ML and DL

- Machine Learning (ML) is a subset of Artificial Intelligence (AI)
- Deep Learning (DL) is a type of ML that use deep neural network
- Expert systems: Systems that makes decision based on defined rules
- Reinforcement learning: Learn behaviours by rewarding/penalising



AI, ML and DL

- Machine Learning (ML) is a subset of Artificial Intelligence (AI) technique
- Deep Learning (DL) is a type of ML that use deep neural network



AI in Engineering

- Machines with AI work alongside with Human make things better, quicker, and smarter.
- Human and Machines with AI capability work together, interact and collaborate
- Both Human and AI use their capability to have an impact on the Engineering system/process
- AI empowers humans to perform additional or enhanced activities and provide feedback (data, information, etc) to them
- Human also augment the AI by enhancing, informing, controlling or training it

AI offers insights from Data

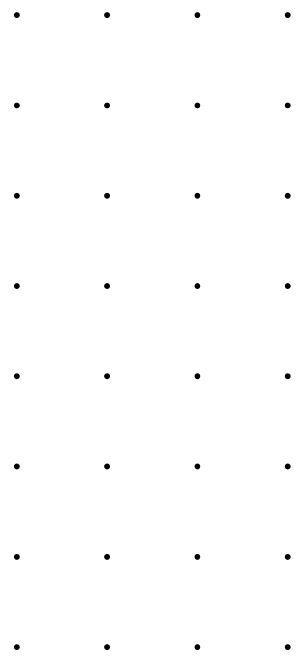
Human provide feedback
(labelling cases, controlling machine settings)

AI for Engineers

- Engineers' capabilities are influenced by AI. e.g., Engineer learn and make decision based on AI recommendations
- Engineers use AI to make better choices, improve processes, and even think of new ideas
- AI-enabled engineering systems/process can learn more efficiently or expand their knowledge range through their interaction with engineers

Impact of AI in Engineering

- Drive efficiency in production process
- Improve plant's productivity
- Enhance product consistency and quality
- Safer workplace
- Reduce unscheduled machine maintenance
- Optimise Inventory management
- Improve sustainability and energy consumption
- Reduce maintenance cost



AI applications: Civil Engineering

- AI helps engineers to design roads, bridges, and buildings more efficiently. E.g., Predict when a bridge needs fixing
- Road and Roadside infrastructure maintenance. E.g., automatically detect Road infrastructure issues
- Automate construction process (e.g., 3D printing)
- Monitor structural health of buildings



Example dataset for exercise: [cement manufacturing](#)

AI applications: Mechanical Engineering, Robotics

- Make machine intelligent to perform autonomous tasks. E.g., Robots, Autonomous cars
- Predictive maintenance: AI can look data from machines and predict next failure of a component or machine and alert engineers to perform maintenance to prevent such failure
- Product Quality: AI can check if products coming off an assembly line are perfect or if they have any defects, ensuring better quality.
- Process optimization: AI can find the best ways to manufacture things, making the process faster and cheaper.

Example dataset for exercise: [Fault diagnosis problem of electromechanical device](#)

AI applications: Electrical and Electronics Engineering

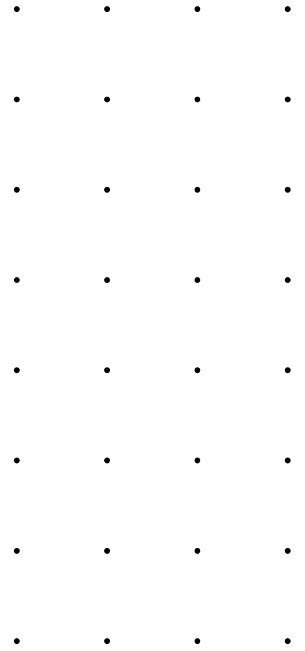
- AI-enhanced smart energy monitor makes electricity distribution more reliable and efficient.
- Smart Grid: Detect and react local changes in usage
- Predictive maintenance: Monitor data from electrical devices and predict failure
- Electronics manufacturing: AI algorithms assist in identifying and correcting manufacturing inefficiencies, reducing waste, and ensuring that each component meets the highest standards of quality and performance.
- Renewable Energy: AI algorithms analyse weather patterns, predict energy supply from renewable sources, and optimize their integration

Example dataset for exercise: [Combined cycle power plant](#)

AI applications: Biomedical Engineering

- Diagnose diseases more accurately
- Personalise treatment plan
- Predict disease outbreaks

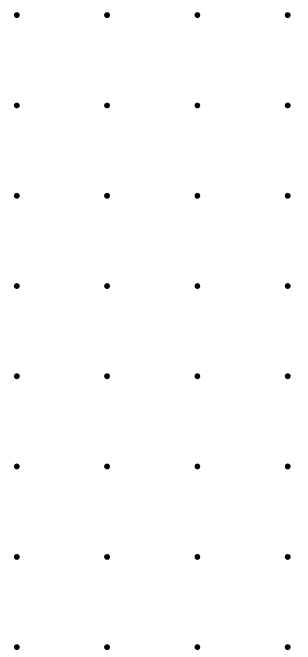
Example dataset for exercise: [Breast cancer diagnosis](#)



AI applications: Water Engineering

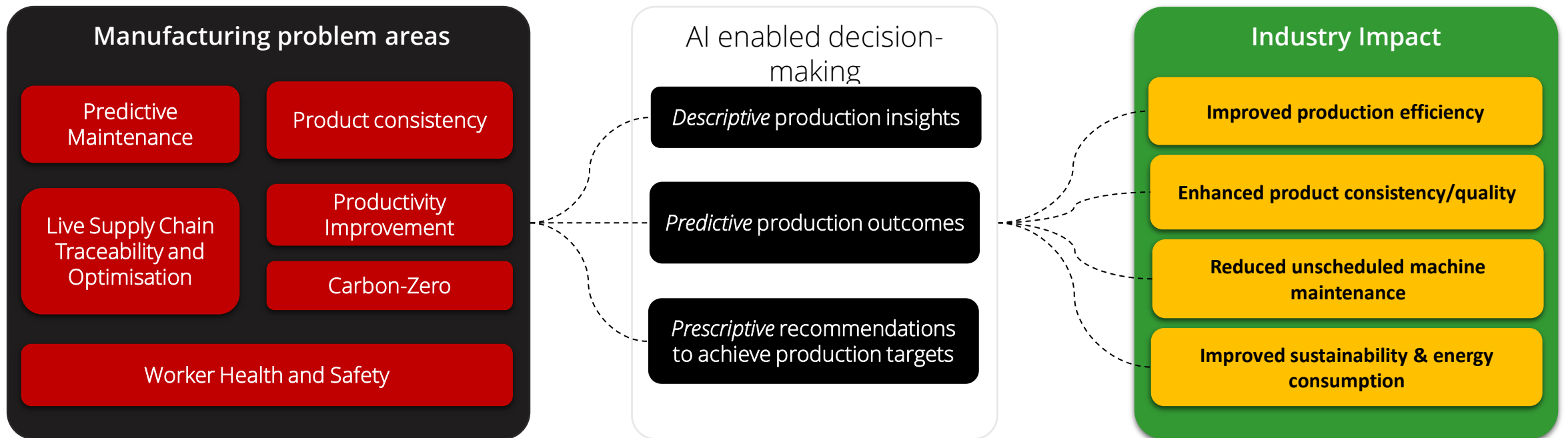
- Predicting and Managing Water Resources
- Water Demand Forecasting
- Smart Irrigation Systems
- Leak Detection and Prevention
- Wastewater Treatment

Example dataset for exercise: [Water Quality](#)



Digital Manufacturing in Product design

Digital Manufacturing – Bringing together machines, people, process and products underpinned by AI and IoT technologies to make our industry globally competitive



Learn, Practice and Enjoy the AI journey

