

COURSE SPECIFICATION DOCUMENT

Academic School / Department:	Science, Innovation & Technology
Programme:	MSc Artificial Intelligence
FHEQ Level:	7
Course Title:	Reinforcement Learning
Course Code:	COMP 7104
Total Hours:	200 (Lev 7) (4 US Credits)
Timetabled Hours:	39
Guided Learning Hours	21
Independent Learning Hours:	140
Credit	20 UK CATS credits 10 ECTS credits 4 US credits

Course Description:

This module introduces reinforcement learning as a key paradigm within contemporary artificial intelligence. Students develop an understanding of how learning agents operate within interactive environments and how reinforcement learning techniques are applied to complex decision-making problems. The course blends theory and practice, enabling students to apply reinforcement learning approaches to realistic scenarios and to evaluate their effectiveness. Emphasis is placed on critical analysis of strengths and limitations, methodological rigour, and real-world considerations, supporting students in making informed judgements about the appropriate use of reinforcement learning in applied AI contexts.

Prerequisites:

None

Aims and Objectives:

The aim of this course is to equip students with practical and conceptual understanding of reinforcement learning. Students will learn how to design reinforcement learning problems, implement deep RL algorithms, evaluate agent performance, and apply RL methods to applied environments using free, open-source tools.

Programme Outcomes:

A2, A4, B2, B3, C1, C3, D3.

A detailed list of the programme outcomes are found in the Programme Specification. This is located at the archive maintained by Registry and found at:

<https://www.richmond.ac.uk/programme-and-course-specifications/>

Learning Outcomes:

By the end of this course, students will be able to:

1. Explain and critically analyse the principles of reinforcement learning, including MDPs, rewards, value functions and policies (A2);
2. Implement deep RL algorithms such as DQN, PPO or A2C using open-source frameworks (C1, B2);
3. Design RL environments and training pipelines with appropriate reward structures and evaluation metrics (A4, C3);
4. Critically evaluate RL agent performance including stability, convergence behaviour and sample efficiency (B3, D3); and
5. Apply RL methods to practical tasks using Gymnasium, Stable-Baselines3 and PyTorch, and communicate results clearly (D3, C1).

Indicative Content:

- Reinforcement learning fundamentals: agents, environments and returns
- Markov decision processes and value-based methods;
- Q-learning and deep Q-networks (DQN);
- Policy-gradient methods;
- Actor–critic algorithms: A2C, PPO and variants;
- Exploration, reward shaping and stability considerations;
- Practical pipelines with PyTorch, Gymnasium and Stable-Baselines3; and
- Applications in control, robotics, gaming and sequential decision-making.

Assessment:

This course conforms to the University Assessment Norms approved at Academic Board and located at: <https://www.richmond.ac.uk/university-policies/>

Teaching Methodology:

Teaching includes: lectures, coding labs, implementation workshops, model evaluation sessions and guided learning. Students will work exclusively with tools such as PyTorch, Gymnasium and Stable-Baselines3.

Indicative Text(s):

- Huang, S. (2024) *Practical Deep Reinforcement Learning*. New York: McGraw-Hill.
- Lapan, M. (2023). *Deep Reinforcement Learning with Python*. 2nd ed. Birmingham: Packt.
- Morales, M. (2020). *Grokking deep reinforcement learning*. Shelter Island: Manning.
- Xiao, Z. (2024). *Reinforcement learning: theory and python implementation*. 1st ed. 2024. Singapore: Springer Nature Singapore.

Journals

- *Journal of Machine Learning Research*.

- *Machine Learning Journal.*

Websites

- **Gymnasium Documentation**
Farama Foundation, *Gymnasium Documentation*, Gymnasium:
<https://gymnasium.farama.org>
- **Stable Baselines3 Documentation**
Stable Baselines3, *Stable-Baselines3 Docs: Reliable Reinforcement Learning Implementations*: <https://stable-baselines3.readthedocs.io>

See syllabus for complete reading list.

Change Log for this CSD:

Nature of Change	Date Approved & Approval Body (School or AB)	Change Actioned by Registry Services
Guided Learning Hours menu updated	October 2025	
Total Hours Updated	October 2025	