Course outline:

Course learning objectives:

- Study the fundamental theories and algorithms for reinforcement learning, including Q-learning and policy-gradient algorithms.
- Develop in-depth understanding of the practical use of deep reinforcement learning algorithms, including the Deep Q-Network, Soft-Actor-Critic algorithm, and Proximal Policy Optimization algorithm. Understand the real-life performance of these algorithms, subject to different hyper-parameter settings.
- Propose a new deep reinforcement learning algorithm to enhance the performance of a state-of-the-art algorithm such as the Soft-Actor-Critic algorithm or the Proximal Policy Optimization algorithm. Conduct comprehensive experimental evaluation of the proposed new algorithm on multiple benchmark problem instances to understand its effectiveness.
- Write detailed technical reports to systematically summarize the research works conducted during the individual study.

Assessments:

- A technical report to summarize the fundamental theories and algorithms for reinforcement learning. The report should provide detailed introduction to the reinforcement learning problem and multiple recently developed reinforcement learning algorithms, including the Deep Q-Network, Soft-Actor-Critic algorithm, and Proximal Policy Optimization algorithm.
    - Weighting: 20%
    - Page limit: 8 pages
    - Due date: end of week 4
- A technical report to report the empirical evaluation of multiple recently developed reinforcement learning algorithms, including the Deep Q-Network, Soft-Actor-Critic algorithm, and Proximal Policy Optimization algorithm. The experiments should be conducted on six benchmark problem instances (e.g., robotics control problems). Detailed statistical analysis should be performed in the report to understand the performance differences across different reinforcement learning algorithms. Special attention will also be paid to understand the impact of critical hyper-parameters on the performance of these algorithms.
    - Weighting: 30%
    - Page limit: 15 pages

    - Due date: end of week 7
- A technical report (including the source code for the new algorithm implemented) to develop a new reinforcement learning algorithm to enhance the performance of a state-of-the-art algorithm such as the Soft-Actor-Critic algorithm or the Proximal Policy Optimization algorithm. Conduct comprehensive experimental evaluation of the proposed new algorithm on multiple benchmark problem instances to understand its effectiveness.
    - Weighting: 50%
    - Page limit: 25 pages
    - Due date: last week of the assessment period