Module Aims & Learning Outcomes

Module Aims/Objectives

Deep Reinforcement Learning (RL) has made significant advances in theory and practice over the last decade. For example, frameworks that learns to play Atari games from scratch and improves itself to a superhuman level. Likewise for the games of Go and poker which the Deep RL frameworks now play competitively at world championship level. The objective of this module is to equip students with the fundamental knowledge and techniques necessary to understand/develop/use Deep Reinforcement Learning. Emphasis will be placed on applications of Deep Reinforcement Learning.

Learning Outcomes

Cognitive (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis)

At the end of this module students will be able to:
- Formalize problems as Markov Decision Processes
- Demonstrate an understanding of dynamic programming and exploration / exploitation trade-off
- Know how to implement deep reinforcement learning as an efficient solution approach
- Learn new trends in deep reinforcement learning and apply deep reinforcement learning to problems.

Affective (Attitudes and Values)

At the end of this module students will be able to:
- Question and demonstrate whether a deep reinforcement learning based solution is effective, given a learning and planning problem

- Select the best deep reinforcement learning based solution to address a a given learning and planning problem

Syllabus (indicative content)

1. Foundations of Reinforcement Learning including Markov Decision Processes (MDPs), Bellman's Optimality equation, rewards, value functions and policies, and exploration versus exploitation.

2. 2. Classical tabular-based approaches such as Dynamic Programming, Monte Carlo, and Temporal Difference Methods (TD) with Eligibility Traces. TD methods such as Sarsa and Q-Learning will be discussed, as well as RL architectures such as Actor Critic.

3. 3. Gradient decent methods.

4. 4. RL for planning and learning.

5. 5. New Approaches such as Monte Carlo Tree Search (MCTS),Proximal Policy Optimisation, and others.

6. 6. Applied Deep RL, for example, using Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) for generalisation.