DSC8006: REINFORCEMENT LEARNING

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Reinforcement Learning

Subject Code
DSC - Data Science
Course Number
8006

Academic Unit
Data Science (DS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SDSC8006 Reinforcement Learning

Exclusive Courses
Nil

Additional Information
Nil

Part II Course Details

Abstract

The goal of this course is to provide a clear account of the key concepts and solution algorithms of reinforcement learning. Topics include optimal control, dynamic programming (including policy iteration and value iteration) Markov decision processes, temporal-difference learning value approximation, policy approximation Q-learning and various reinforcement learning algorithms. Emphasis will be placed on trade-off between exploitation and exploration and the trade-off between the sub-optimality and tractability. We will learn how to formulate, analyze and solve various reinforcement learning problems. Applications in various fields will be also discussed.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the basic ideas, concepts and principles of dynamic programming and reinforcement learning	10	x	x	
2	Explain the theories and solution methodologies for optimal control, dynamic programming and reinforcement learning	60	x	x	x
3	Formulate various problems to be reinforcement learning problems and implement the correct solvers to solve them	15		x	
4	Model the applications of reinforcement learning in real world	15	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will engage in lectures that introduce key knowledge points of dynamic programming and reinforcement learning methods covered in this course	1, 2, 3, 4	29 hours/sem

2	Tutorial Sessions	Students will participate in tutorial sessions that have more explanation and exercises to familiarize themselves with the methods learnt during the lectures. Students will develop the ability of implementing dynamic programming and reinforcement learning algorithms.	1, 2, 3, 4	10 hours/sem

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments Students are required to explain knowledge and apply methodologies learned from the course in solving some problems.	1, 2, 3, 4	20	-	Yes
2	Midterm Students will be assessed via the examination in their ability to explain the concepts and apply methodologies and technologies in solving dynamic optimization problems and reinforcement learning problems learned in class.	1, 2, 3, 4	20	-	No

3	Course project(s) Students will be assessed via course projects in demonstrating their ability in solving reinforcement learning problems. Students will present their projects to their peers, and they will write feedbacks for others' presentations. Students will also write a report on their project. Possible topics include state-of-the-art reinforcement learning algorithms and theories, as well as advanced topics in reinforcement learning that are not covered in lectures.	1, 2, 3, 4	30	-	Yes

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Assignments (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Based on submitted written work to evaluate the ability to explain the knowledge of reinforcement learning learned in class

Excellent

A+, A, A-

Good

B+, B

Marginal

B-, C+, C

Failure

F

Assessment Task

Midterm (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Based on submitted written work and programming code to evaluate their ability to explain core concepts of reinforcement learning, as well as the ability of applying different reinforcement learning algorithms.

Excellent

A+, A, A-

Good

B+, B

Marginal

B-, C, C-

Failure

F

Assessment Task

Course project(s) (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Based on submitted written work and oral presentation to evaluate students' synthesis ability and clarity, their knowledge of reinforcement learning, and their ability to extend their knowledge in reinforcement learning

Excellent

A+, A, A-

Good

B+, B

Marginal

B-, C, C-

Failure

F

Assessment Task

Examination (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Ability to solve problems of reinforcement learning and Markov decision process with fundamental methods.

Excellent

A+, A, A-

Good

B+, B

Marginal

B-, C, C-

Failure

F

Assessment Task

Assignments (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Based on submitted written work to evaluate of the ability to explain the knowledge of reinforcement learning learned in class.

Excellent

A+, A, A-

Good

B+, B, B-

Fair

C+, C, C-

Marginal

D

Failure

F

Assessment Task

Midterm (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Based on submitted written work and programming code to evaluate their ability to explain core concepts of reinforcement learning, as well as the ability of applying different reinforcement learning algorithms.

Excellent

A+, A, A-

Good

B+, B, B-

Fair

C+, C, C-

Marginal
D

Failure
F

Assessment Task
Course project(s) (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Based on submitted written work and oral presentation to evaluate students' synthesis ability and clarity, their knowledge of reinforcement learning, and their ability to extend their knowledge in reinforcement learning

Excellent
A+, A, A-

Good
B+, B, B-

Fair
C+, C, C-

Marginal
D

Failure
F

Assessment Task
Examination (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Ability to solve problems of reinforcement learning and Markov decision process with fundamental methods

Excellent
A+, A, A-

Good
B+, B, B-

Fair
C+, C, C-

Marginal
D

Failure
F

Part III Other Information

Keyword Syllabus

Dynamic programming, Markov decision processes, temporal-difference learning, value approximation, policy approximation, Q learning, bandit problems

Reading List

Compulsory Readings

	Title
1	Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction
2	Lecture Notes and Slides

Additional Readings

	Title
1	Dimitris Bertsimas. Dynamic Programming and Optimal Control
2	Csaba Czepesvári, Algorithms for Reinforcement Learning
3	Dimitris Bertsimas. Reinforcement Learning and Optimal Control