SDSC3017: GAME THEORY AND ITS APPLICATION

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Game Theory and Its Application

Subject Code
SDSC - School of Data Science
Course Number
3017

Academic Unit
School of Data Science (DS)

College/School
School of Data Science (DS)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA1503 Linear Algebra with Applications or MA2503 Linear Algebra
and
MA2506 Probability and Statistics or MA2510 Probability and Statistics
and
MA2508 Multi-variable Calculus

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to introduce game theory with applications in artificial intelligence. Students will learn how to think and act strategically at a system level. Students will master the basic ideas of games including dominance, backward induction, Nash equilibrium, etc. At the end of this course, students will be able to use game theory to solve simple practical AI problems with course project. Students will be familiar with latest applications of game theory in various AI topics.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the basic concepts of game theory	20	x		
2	Model real world problems as games and multi-agent simulation models.	20	x	x	
3	Solve simple game problems in a real-world scenario with game theory	30	x	x	
4	Apply game theory to AI topics	30	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	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3	33 hours/semester
2	Tutorials	Learning through tutorials is primarily based on interactive problem solving and hand-on computer exercises allowing instant feedback.	2, 3, 4	6 hours/semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Hand-in assignments	2, 3, 4	30	The assignments enable students to demonstrate their skills and understanding of concepts and methods for game theory.
2	Course Project^	2, 3, 4	30	The course project provides students the chance to demonstrate their achievements on practical use of game theory methods learned in this course for practical problems.

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Note: To pass the course, apart from obtaining a minimum of 40% in the overall mark, a student must also obtain a minimum mark of 30% in both continuous assessment and examination components.

Assessment Rubrics (AR)

Assessment Task

Hand-in assignments

Criterion

1.1 Ability to learn the basic concepts of game theory, including static and dynamic games with complete and incomplete information.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task
Hand-in assignments

Criterion
1.2 Capability to apply game theory models to solve AI-related problems.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Course Project

Criterion
Ability to solve real-world AI problems using game theory models.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
Ability to explain the basic concepts of game theory Ability to solve simple game problems in a real-world scenario with game theory

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- What is a game? Why we need a theory about games? Introduction to a variety of real-world games.
- Thinking and acting strategically at the system level.
- Solving static games
  - Games with complete information, rationalizability and Nash equilibrium
  - Games with incomplete information, Bayesian Nash equilibrium
- Solving extensive-form games
  - Backwards induction, subgame perfection, bargaining, iterated conditional dominance
- Equilibrium for games with imperfect information
- Signal and forward induction
- Cooperative games
- Dynamic games
- Agent-based systems
- Intelligent agents and the emergence of intelligence from multi-agent systems
- Applications of game theory in AI

Reading List

Compulsory Readings

	Title
1	S Tadelis, Game Theory: An Introduction, Princeton University Press, ISBN: 9780691129082, https://press.princeton.edu/titles/10001.html

Additional Readings

	Title
1	AK Dixit and BJ Nalebuff, The Art of Strategy, W. W. Norton & Company, ISBN: 9780393062434, http://www.artofstrategy.net/