SDSC3017: GAME THEORY AND ITS APPLICATION

Effective Term

Semester A 2022/23

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 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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3	39 hours/semester
2	Take-home assignments	Learning through take-home assignments is primarily based on interactive problem solving and hand-on computer exercises allowing instant feedback.	2, 3, 4	after class

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

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

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/