

**City University of Hong Kong  
Course Syllabus**

**offered by School of Data Science  
with effect from Semester A 2020/21**

---

---

**Part I Course Overview**

**Course Title:** Game Theory and Its Application

**Course Code:** SDSC3017

**Course Duration:** One Semester

**Credit Units:** 3

**Level:** B3

- Arts and Humanities  
 Study of Societies, Social and Business Organisations  
 Science and Technology

**Proposed Area:**  
*(for GE courses only)*

**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  
*(Course Code and Title)*

**Precursors:** Nil  
*(Course Code and Title)*

**Equivalent Courses:** Nil  
*(Course Code and Title)*

**Exclusive Courses:** Nil  
*(Course Code and Title)*

## Part II Course Details

### 1. Abstract

(A 150-word description about the course)

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.

### 2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

| No. | CILOs <sup>#</sup>  | Weighting*<br>(if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) |    |    |
|-----|---|-------------------------------|---|----|----|
|     |   |                               | A1  | A2 | A3 |
| 1.  | Explain the basic concepts of game theory                             | 20%                           | √   |    |    |
| 2.  | Model real world problems as games and multi-agent simulation models. | 20%                           | √   | √  |    |
| 3.  | Solve simple game problems in a real-world scenario with game theory  | 30%                           | √   | √  |    |
| 4.  | Apply game theory to AI topics  | 30%                           | √   | √  | √  |
|     |   | 100%                          |   |    |    |

\* If weighting is assigned to CILOs, they should add up to 100%.

<sup>#</sup> Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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.

### 3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

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

### 4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

| Assessment Tasks/Activities                 | CILO No. |   |   |   | Weighting* | Remarks  |
|---|----------|---|---|---|------------|--|
|   | 1        | 2 | 3 | 4 |            |  |
| Continuous Assessment: <u>60%</u>           |          |   |   |   |            |  |
| Hand-in assignments                         |          | √ | √ | √ | 30%        | The assignments enable students to demonstrate their skills and understanding of concepts and methods for game theory.   |
| Course Project <sup>^</sup>                 |          | √ | √ | √ | 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. |
| Examination: <u>40%</u> (duration: 2 hours) |          |   |   |   |            |  |
| Examination                                 | √        | √ | √ | √ | 40%        |  |
|   |          |   |   |   | 100%       |  |

\*The weightings should add up to 100%.

<sup>^</sup>For a student to pass the course, at least 30% of the maximum mark for course project must be obtained.

## 5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

| Assessment Task        | Criterion  | Excellent<br>(A+, A, A-) | Good<br>(B+, B, B-) | Fair<br>(C+, C, C-) | Marginal<br>(D) | Failure<br>(F)                    |
|------------------------|--|--------------------------|---------------------|---------------------|-----------------|-----------------------------------|
| 1. Hand-in assignments | 1.1 Ability to learn the basic concepts of game theory, including static and dynamic games with complete and incomplete information. | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |
|                        | 1.2 Capability to apply game theory models to solve AI-related problems.   | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |
| 2. Course Project      | Ability to solve real-world AI problems using game theory models.  | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |

**Part III Other Information** (more details can be provided separately in the teaching plan)

**1. Keyword Syllabus**

*(An indication of the key topics of the course.)*

- 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

**2. Reading List**

**2.1. Compulsory Readings**

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

|    |   |
|----|---|
| 1. | S Tadelis, Game Theory: An Introduction, Princeton University Press, ISBN: 9780691129082, <a href="https://press.princeton.edu/titles/10001.html">https://press.princeton.edu/titles/10001.html</a> |
|----|---|

**2.2. Additional Readings**

*(Additional references for students to learn to expand their knowledge about the subject.)*

|    |   |
|----|---|
| 1. | AK Dixit and BJ Nalebuff, The Art of Strategy, W. W. Norton & Company, ISBN: 9780393062434, <a href="http://www.artofstrategy.net/">http://www.artofstrategy.net/</a> |
|----|---|