Course Title	:	Games in Daily Life
Course Code	:	CLC9018 / CDS255
Number of Credits/Term	:	3
Mode of Tuition	:	Sectional approach
Class Contact Hours	:	Three hours per week
Category in Major Prog.	:	Management and Society/Free Elective
Prerequisite(s)	:	None

Brief Course Description

People, organizations, and states interact in various situations, where the actions of each party (people, organization, or state) will affect the interests of the other parties, which can be conflicting or common. Competitive or cooperative situations of this sort are regarded as "games." To make strategic and rational decisions in game situations, each party needs to understand the rationale behind others' actions or responses to his or her own decisions. This necessitates the game methods, which underpin how each party can adopt rational strategies in everyday interactions with other parties.

This course presents the concepts, social contexts, and basic methods of games. We use the game-based lecture method to teach how students can undertake strategic reasoning and decision-making in a wide range of social situations. Students will be encouraged and supported—through active engagement in a series of real games and game experiments, and participation in reflective discussions about their game experiences—to develop rational and effective approaches to strategic reasoning and decision-making as players in competitive and cooperative settings.

Aims

This course aims to

1. open a new horizon for students to think systematically and act rationally in their social encounters,

2. foster students' critical thinking and strategic decision-making abilities in interacting with others,

3. strengthen students' ability to understand and predict others' decisions and actions in various social situations,

4. enhance students' awareness of their social responsibilities by helping them understand the impact of their decisions on others and the society,

5. stimulate students' passion for understanding and engaging in game theoretic reasoning.

Learning Outcomes

Students will be able to

1. apply concepts and tools in game theory to develop game models for social problems that arise in real life,

2. analyze and solve typical puzzles concerning human behavior in game situations,

3. demonstrate logical and rational reasoning and decision-making in game situations,

4. explain how game theory can guide and inform socially responsible interaction with others,

5. recognize and explain the incentives that exist across diverse social settings for people to adopt cooperative strategies with one another.

Measurement of Learning Outcomes

Learning Outcomes	Class Attendance and Experiment Participation	Individual Game Assignments	Written Group Project Report	Group Project Presentation	Written Final Exam
1. Apply concepts and tools in game theory to develop game models for social problems arising in real life.	X	X	X		
2. Analyze and solve typical puzzles concerning human behavior in game situations.		X			X
3. Demonstrate logical and rational reasoning and decision-making in game situations.	X	X	X		X
4. Explain how game theory can guide and inform socially responsible interaction with others.	X		X	X	
5. Recognize and explain the incentives that exist across diverse social settings for people to adopt cooperative strategies with one another.	X		X	X	

1. **Class Attendance and Experiment Participation**: In classes, students are required to analyze real competition- or cooperation-related problems, develop corresponding game models, and find solutions. This can help assess students' ability of using game theory in real life (*Learning Outcome 1*). Moreover, through the in-class experiments (e.g., Rock, Paper, Scissors), students can demonstrate and improve their logical and rational reasoning and decision-making ability (*Learning Outcome 3*). We use the results of students' game experiments to show the applications of game theory (*Learning Outcome 4*). In some group game experiments, students will identify their roles and responsibilities in games (*Learning Outcome 5*).

2. **Individual Game Assignments**: Students will individually complete several after-class game assignments, which help students understand the game-theoretic skills for solving interactive problems. In these assignments, students are required to (i) identify and model game problems (*Learning Outcome 1*), (ii) analyze all game players' possible strategies (*Learning Outcome 2*), and (iii) solve the game models and find the decisions for players (*Learning Outcome 3*).
3. **Written Group Project Report**. We will divide students into several project groups, and assign a real game-related project to each group for students' practice. The game project provides each student with a chance to experience the applications of game theory in a teamwork setting (*Learning Outcome 1*). All students must analyze their game problems to suggest strategic decisions for all game players (*Learning Outcome 3*). Since all teammates in each group must interact with each other in a cooperative manner, each teammate should understand his or her role in the group study (*Learning Outcome 4*), and the project teamwork is students' *best* practice in applying game theory to critically think about their strategic behavior in such a social situation (*Learning Outcome 5*).
4. **Group Project Presentation.** We will require project teams to present their major findings drawn from game projects and submit project reports. We will perform evaluations mainly according to the following criteria. We will assess the oral presentation based on (i) organization of the presentation, (ii) completeness of the statement on the game problem and model, (iii) quality of the delivery of major findings, and (iv) responses to questions. Each student understands his or her role in the presentation (*Learning Outcome 4*), and this also assesses students' cooperative incentives and behaviors (*Learning Outcome 5*).
5. **Written Final Exam.** The close-book final exam mainly includes 5—7 game problems that are suitable to undergraduate students. For each game problem, students are required to develop a corresponding model and identify game players' possible strategic actions and payoffs (*Learning Outcome 2*) and analyze the logical and rational process to find a decision for each game player (*Learning Outcome 3*).

We can conclude from the above that this course can effectively guide students to think and behave *rationally* (Learning Outcomes 1, 2, 3, and 4), strategically (Learning Outcomes 1, 2, 3, and 4), and systematically (Learning Outcome 5) about interactive phenomena.

Indicative Content

Brief Summary: We apply the *game-based teaching method* to this course, in which students will learn practical game theoretic concepts and tools through studying 15 real-life games in five sections, each corresponding to an application discipline. Specifically, the five sections include Sociology (5 games), Business and Economics (3 games), Politics and International Relations (3 games), History (2 games), and Sports (2 games). We will cover three most important game types: (i) simultaneous-move non-cooperative games, (ii) sequential-move non-cooperative games, and (iii) cooperative games. In Type (i)—which is the most common in practice, each decision maker chooses his strategy without knowing other decision makers' strategies ("simultaneously"), e.g., *Rock, Paper, Scissors*; in Type (ii), a decision maker decides after learning other decision makers' strategies ("sequentially"), e.g., *Auto dealer's Pricing Game*; and in Type (iii), all decision makers share a profit in a fair manner, e.g., *The*

Cake-Cutting Problem. Game theory provides a set of concepts and tools to solve the games of the above three types. That is, for Types (i) and (ii), the decision makers' strategic decisions are characterized by Nash equilibrium and Stackelberg equilibrium, respectively; and for Type (iii), the fair allocation scheme is based on equal division approach, Shapley value, etc. Our game-based teaching method is expected to help students understand *what the games in real life are* and *how real-life games can be solved using game theory.*

1. **Defining a game**. In the first section, we introduce basic concepts in the theory of games that are useful in the analysis of real-life games, including "strategy," "payoff," "decision process," etc.

2. **Games in Social Context.** In this section, we discuss the reasoning and decision-making processes of two or more persons in five social situations. For example, we consider a situation in which a person is experiencing a security problem in a public area where there are two or more witnesses. Each witness can keep silent or make a call to police or hospital, which represent the witness's two possible decisions. All witnesses hope that the person in trouble can survive. The survival can be viewed as each witness's "gain." The witness who keeps silent has not cost, but the witness making a call incurs a "cost/social responsibility" including the phone cost, the service time for such an issue, etc. In such a game (*Volunteer's Dilemma*), all witnesses make decisions simultaneously to maximize their net gains (gain minus cost). A representative real game for the Volunteer's Dilemma is "*The Murder of Kitty Genovese*," in which each of two witnesses decides whether to make a call to save the girl Kitty Genovese who is stabbed on a street.

   Other relevant games include "*Rock, Paper, Scissors*," in which each player in a two-person hand game decides a hand sign; "*Terrorists at an Airport*," which is a game between a terrorist and an airport security guard; "*The ultimatum game*," in which two players sequentially (by turns) suggest how to divide a sum of money between them until they agree on an allocation scheme; and "*The Cake-Cutting Problem*," in which a mother considers how to cut a cake among three kids in a fair manner.

   The games "*The Murder of Kitty Genovese*," "*Rock, Paper, Scissors*," and "*Terrorists at an Airport*" are regarded as three **simultaneous-move non-cooperative game**s; "The ultimatum game" is a **sequential-move non-cooperative game**; and the game "*The Cake-Cutting* Problem" is a **cooperative game**.

3. **Games in Business and Economics**. In this section, we discuss the decision making processes of two or more firms or persons in conflicting or cooperative business/economics problems. For example, we consider a business problem in the automobile retailing industry, where a dealer and a buyer bargain over the price of a car. In this "Auto Dealer's Pricing Game," the dealer initially offers a price to the buyer, who then decides to accept the offer, or make a counteroffer, or reject the offer and leave. For the case of "counteroffer," the dealer can decide to accept or reject with a new offer. The negotiation process—in which the dealer and the buyer make their decisions sequentially—will continue until two decision makers agree on a price or the buyer leaves.

   Other relevant real-life games include *Banning Cigarette Advertising on Television*, in which two cigarette manufacturers cooperate on their TV advertising expenditures under government-imposed restrictions; and *The Centipede Game*, in which two persons take turns choosing either to take a slightly larger share of a slowly-increasing pot, or to pass the pot to the other person.

   The Auto Dealer's Pricing Game and *The Centipede Game* are two **sequential-move non-**

cooperative games, and the game *Banning Cigarette Advertising on Television* is a **cooperative game**.

4. **Games in Politics and International Relations**. We discuss practical games that arise between two or more countries or governments. For example, a government (e.g., Iraq, North Korea) may intend to acquire weapons of mass destruction, which are boycotted by the United Nations. In the game "Weapons of Mass Destruction," the government decides to possess or not to possess such weapons, and the United Nations decides whether to request inspections. If such weapons are found, then the United Nations imposes sanctions on the government. The government aims to maximize her national benefit, and the United Nations decides to control weapons of mass destruction. Students will investigate a real game that has taken place between Iraq and the United Nations.

   Other relevant real-life games include *Competition for Elected Office*, in which the Republican and Democratic candidates choose their feasible campaign platforms; and *Guerrillas vs. Police*, in which the guerrillas capture one or both arsenals, and the police must defend.

   The above games are viewed as **simultaneous-move non-cooperative games**.

5. **Games in History**. We analyze two games arising in historical stories. For example, during the Chinese "Spring-Autumn" period (770--403 B.C.), China consisted of a group of independent states under a weak central court. One day, in the state of Qi, the King and his chief minister Tianji wanted to race their horses in three rounds. Each player owns three horses of different speed classes. In each round, a horse of the King's and a horse of Tianji's compete; thus, the two players must decide the sequence of their horses to compete against each other. The player who wins two or three rounds is the final winner. Using a strategy suggested by the respected Chinese strategist Sun Bin, Tianji won the horse race game. We will understand Sun Bin's strategy by discussing the "Chinese Horse Race Game," a **simultaneous-move non-cooperative game**.

   The other relevant real game is "*Galileo Galilei and the Inquisition*," in which Galileo Galilei must decide to *confess* or not to confess his support of the Copernican theory, and the Inquisition decides whether to *torture* Galilei. Galilei and the Inquisition made their decisions by turns. This is a **sequential-move non-cooperative game**.

6. **Games in Sports**. In two sports games, we discuss the strategies for players or teams. A typical real game is "*Soccer Penalty Kicks*," in which a goal keeper decides where (left or right) to dive in order to prevent the goal, and a kicker decides where (left or right) to kick in order to achieve the goal. The game is characterized as a **simultaneous-move non-cooperative game**.

   The other real sports game is "*Olympic Drug Testing*," in which an athlete decides whether to dope and the organizer decides whether to test. This is also modeled as a **simultaneous-move non-cooperative game**.

Teaching Method

The course is designed to generate student engagement by augmenting video-enhanced lectures with tasks involving game puzzles, problems, experiments and projects, guided by Gambit software, and reviewed through interactive discussions with students.

Assessment

Class Attendance and Experiment Participation:	20%
Individual Game Assignments:	20%
Group Game Project:	25% (report: 15%; presentation: 10%)
Written Final Examination:	35%

Required/Essential Readings

J. Harrington. "Games, Strategies, and Decision Making." Worth Publishers, New York, 2009.

Recommended/Supplementary Readings

1. H. Brightman, "Nash in Najef: Game Theory and Its Applicability to the Iraqi Conflict," *The Air and Space Power Journal*, Vol. 21, pp. 35—41, 2007.

2. L. Fisher. "Rock, Paper, Scissors: Game Theory in Everyday Life." Basic Book, Philadelphia, 2008.

3. M. Leng and M. Parlar. "Game-Theoretic Analysis of an Ancient Chinese Horse Race Problem." *Computers & Operations Research*, Vol. 33, pp. 2033-2055, 2006.

4. J. Mead, "Game Theory and the Second Iraq War," *Defense & Security Analysis*, Vol. 21, pp. 303—321, 2005.

5. D. Snidal, "The Game Theory of International Politics," *World Politics*, Vol. 38, pp. 25—57, 1985.

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