

GAME THEORY: COURSE OUTLINE

BRIAN TYRRELL

INTRODUCTION

Welcome to the CTYI Session I course *Game Theory*.

Game theory is the study of mathematical models of conflict and cooperation arising when rational, intelligent decision-makers (“players”) compete against one another according to a predefined set of universally agreed upon rules. This course is intended to serve as an introduction both to the spirit and mathematics of the subject where we will study *games* and their application to real life scenarios. The following is a brief outline of how the course is organised and what I hope we can tackle in the coming weeks.

1. UNIT I

- *An introduction to the subject with some simple games.* We will play some games and then determine mathematically what are the winning strategies.
- *The history of Game Theory.* We will read a little bit about the development of the subject and some of the key players.

2. UNIT II

- *Intuitive examples of games \mathcal{G} approaching the definition of a Nash equilibrium.* We will develop more serious mathematics used to calculate optima.
- *Analysing some simple games.*
- *The Dark Knight \mathcal{G} Game Theory.* We will look at how one can apply game theory in real life or fictional situations.

3. UNIT III

- *An introduction to some technicalities.* We’ll explore the definition of a “Nash equilibrium” in more detail.
- *Strategic games \mathcal{G} what we can learn from them.*

4. UNIT IV

- *The mathematics of Hex.* This will be our first in depth analysis of a game.
- *Some existence and uniqueness proofs.* (See handbook.)

5. UNIT V

- *Dominated actions, the Nash Equilibrium and the Best Response Function.* These scary looking words will be explained in this section of the course.

6. UNIT VI

- *Pandemic! the board game.* We will discover how Game Theory and Epidemiology are connected.
- *Evolutionary Biology and Game Theory.* We will watch some economics lectures online, delivered at Yale.

7. UNIT VII

- *Game Theory in the media.*
- *Game Theory in real life.* The Cold War & the nuclear capacity of Iran will be analysed.
- *A Market for Lemons & other applications and essays in Economics.*

8. UNIT α

- *A trip to SIG:* a global quantitative trading group will show us how they use Game Theory in the business world. See bit.ly/2t6n8DW for their interest in Game Theory.
More details to come.

9. UNIT β

Group Projects! More details to come. Last year's project ideas consisted of several possibilities.

- Devise or discover your own strategic game. Theorise what the results will be. Test it out in class on each other. Write a report based on the findings.
- Apply some of our games to real life situations. Take a game such as the Prisoner's Dilemma and try and use it to analyse real life events. How does knowledge of these games benefit society? Much overlap between this option and other CTYI programmes going on, if one has multiple interests!
- Similarly, Game Theory in the Media - try and see if game theory can be applied to something within a few tv show(s)/book(s) you enjoy.
- Previous projects include *additional results on the Brouwer Fixed-Point theorem*, *game-theoretic data for Bagh-Chal*, and *determining the optimum seating arrangement in the cafeteria*.

Of course these are only suggestions - I look forward to seeing what students will come up with themselves.

10. UNIT γ

- I am always happy to talk about my research in number theory and model theory. This doesn't overlap with Game Theory but is very, very interesting.
- At some point we could have a debate. Last year we spent some time talking about the game theory of conflict and debated on the decision for the U.S. to invade Iraq.
- Class-wide games of *Ultimate Tic-Tac-Toe*, *Tigers and Goats*, etc.