תאריך עדכון: 11.9.2022

שם ומספר הקורס:

תורת המשחקים החישובית

Computational Game Theory

89-909-01

סוג הקורס: (שיעור)

שנת לימודים: תשפ"ג **סמסטר**: א **היקף שעות**: 1 ש"ס

אתר הקורס באינטרנט:

א. מטרות הקורס (מטרות על / מטרות ספציפיות):

The aims of this module are twofold:

* To introduce the key models and solution concepts of non-cooperative and cooperative game theory;

* To introduce the issues that arise when computing with game theoretic solution concepts, and the main approaches to overcoming these issues, and to illustrate the role that computation plays in game theory.

ב. תוכן הקורס: (רציונל, נושאים)

Game theory is the mathematical theory of strategic interactions between self-interested agents. Game theory provides a range of models for representing strategic interactions, and associated with these, a family of solution concepts, which attempt to characterize the rational outcomes of games. Game theory is important to computer science for several reasons:
First, interaction is a fundamental topic in computer science, and if it is assumed that system components are self-interested, then the models and solution concepts of game theory seems to provide an appropriate framework with which to model such systems.
Second, the problem of computing with the solution concepts proposed by game theory raises important challenges for computer science, which test the boundaries of current algorithmic techniques.
This course aims to introduce the key concepts of game theory for a computer science audience, emphasizing both the applicability of game theoretic concepts in a computational setting, and the role of computation in game theoretic problems.

The course assumes no prior knowledge of game theory.

מהלך השיעורים: (שיטות ההוראה, שימוש בטכנולוגיה, מרצים אורחים)

תכנית הוראה מפורטת לכל השיעורים: (רשימה או טבלה כדוגמת המצ"ב)

מס' השיעור	נושא השיעור	קריאה נדרשת	הערות
1			
2			
3			

LECTURE 1: PREFERENCES, UTILITIES, AND GOALS

* Preference relations and their interpretation; utility as a numeric model of preference.

* Decision-making under uncertainty: preferences over lotteries; von Neumann and Morgenstern utility functions; expected utility and expected utility maximisation.

* Paradoxes of expected utility maximisation; framing effects and prospect theory.

* Compact representations for preference relations

* Dichotomous preferences and goals. Representations for specifying goals (e.g., weighted formula representations for combinatorial domains); expressiveness and computational issues.

LECTURE 2: STRATEGIC FORM NON-COOPERATIVE GAMES

* The basic model; solution concepts: pure strategy Nash equilibrium; dominant strategies; notable games (e.g., Prisoner's Dilemma; Game of Chicken; Stag Hunt); coordination games and focal points; complexity of pure strategy Nash equilibrium.

* Measuring social welfare; utilitarian social welfare; egalitarian social welfare.

* Mixed strategies; Nash's theorem; computing mixed strategy Nash equilibria.

* Compact representations for strategic form games; Boolean games

LECTURE 3: EXTENSIVE FORM GAMES

* Extensive form games of perfect information; Zermelo's algorithm and backward induction; P-completeness of Zermelo's algorithm; subgame perfect equilibrium.

* Win-lose games; Zermelo's theorem.

* Compact representations for extensive form games; the PEEK games and EXPTIME-completeness results; the Game Description Language (GDL).

* Imperfect information games; information sets; solution concepts for imperfect information games; behavioural strategies; Kuhn's theorem.

* Compact representations for imperfect information games; PEEK games with incomplete information; undecidability results.

LECTURE 4: ITERATED GAMES

* Finitely repeated games and backward induction.

* Infinitely repeated games; measuing utility over infinite plays; modelling strategies as finite state machines with output (Moore machines); the folk theorems.

* Iterated Boolean games.

* Axelrod's tournament; the Hawk-Dove game; evolutionary game theory; evolutionarily stable strategies.

LECTURE 5: COOPERATIVE GAMES

* Transferable utility (TU) characteristic function games; the basic model; stability \& fairness solution concepts: the core; the cost of stability; the Shapley value; the Banzhaf index.

* Compact representations for TU games; induced subgraph representation; marginal contribution nets.

* Simple TU games; swap and trade robustness; weighted voting games; vector weighted voting games; network flow games.

* NTU games and representations for them; hedonic games.

* Coalition structure formation; exact and approximation algorithms.

ג. חובות הקורס:

דרישות קדם: בינה מלאכותית – 89-570-01

חובות / דרישות / מטלות: חובת נוכחות, תרגילים, השתתפות בניסויים.

מרכיבי הציון הסופי (ציון מספרי / ציון עובר):
100% עבודה

ד. ביבליוגרפיה: (חובה/רשות)

ספרי הלימוד (textbooks) וספרי עזר נוספים:

• Michael Maschler, Eilon Solan, Shmuel Zamir. Game Theory, Cambridge UP, 2013.
The best contemporary overview of game theory.
• Martin J. Osborne and Ariel Rubinstein. A Course in Game Theory. MIT Press, 1994.
An excellent introduction to game theory, freely available from: 4http://books.osborne.economics.utoronto.ca
• Y. Shoham and K. Leyton-Brown. Multiagent Systems. Cambridge UP, 2009.
Freely available from: http://www.masfoundations.org/
• G. Chalkiadakis, E. Elkind, and M. Wooldridge. Computational Aspects of Cooperative Game Theory. Morgan & Claypool, 2011.
The book for cooperative games.

חומר מחייב למבחנים: כל מה שנילמד בקורס.

הקורס יינתן בשפה האנגלית.