Postgraduate Course: Algorithmic Game Theory and its Applications (INFR11020)

Course Outline

School	School of Informatics	College	College of Science and Engineering
Credit level (Normal year taken)	SCQF Level 11 (Year 4 Undergraduate)	Availability	Available to all students
SCQF Credits	10	ECTS Credits	5
Summary	Game theory is the formal study of interaction between "self-interested" (or "goal-oriented") "systems" (or "agents" or "decision makers" or "players"), & strategic scenarios that arise in such settings. It began life in Economics in the 1940's with the work of von Neumann & Morgenstern, but has since been applied to an extraordinary range of subjects, including political science, evolutionary biology & even to inspection regimes for arms control. Game theory has for years also played an important, if less recognized, role in several branches of computer science. Applications within computer science include the use of games in automated verification & model checking to model computing systems in an unknown and possibly adverse environment. In AI games are applied to the analysis of multi-agent systems. Recently, with the advent of the internet and e-commerce, many game theoretic questions in the interplay between economics & computing have received extensive attention. These include electronic auctions, & more generally mechanism design questions (inverse game theory) related to finding incentive structures for cooperation between independent entities on the internet. Wherever game theory plays a quantitative role, algorithmic and computational questions related to "solving" games are also of central importance. This course aims to bring together as a coherent body of knowledge the game theoretic algorithms & models that underpin several flourishing subjects at the intersection of computer science, economics and e-commerce, & AI.		
Course	* Examples of diverse games.		

Navigation

Help & Information
Home
Introduction
Glossary
Search DPTs and Courses
Regulations
Regulations
Degree Programmes
Introduction
Browse DPTs
Courses
Introduction
Humanities and Social Science
Science and Engineering
Medicine and Veterinary Medicine
Other Information
Combined Course Timetable
Prospectuses
Important Information

description	* Zero-sum two-person games: LP, simplex, LP-duality, mixed strategies and the minimax theorem. * General games in strategic form: o Equilibria and Nash's theorem. o 2-player equilibria: Lemke-Howson algorithm and its variants. * Games in Extensive form (mainly zero-sum, perfect information): o Game trees. Relation to Strategic games. o And/Or game graphs and reachability games. o bisimulation, simulation, parity games, and other omega-games on automata(finitely presented, infinite duration games). o mean value games, MDPs, and stochastic games. * Mechanism design and inverse game theory: designing games where selfish players will behave as desired. o Vickery auctions and other mechanisms. o Combinatorial auctions. o Incentive structures for the internet. Relevant QAA Computing Curriculum Sections: Artificial Intelligence, Data Structures and Algorithms, e-commerce, Simulation and Modelling, Theoretical Computing

Entry Requirements (not applicable to Visiting Students)

Pre-requisites	It is RECOMMENDED that students have passed Algorithms and Data Structures (INFR10052)	Co-requisites	
Prohibited Combinations		Other requirements	This course is open to all Informatics students including those on joint degrees. For external students where this course is not listed in your DPT, please seek special permission from the course organiser. Some mathematical maturity, and concretely some basic background in: - Linear Algebra - Discrete Mathematics - Probability at the level of the year 1 and 2 required undergraduate courses in these topics. Background in algorithms at the level of Informatics 2B - Algorithms, Data Structures and Learning, and preferably at the level of Algorithms and Data Structures. Exposure to computational complexity theory (NP - completeness, etc.) at the level of

			Computational Complexity is desirable but not required.

Information for Visiting Students

Pre-requisites	Visiting students are required to have comparable background to that assumed by the course prerequisites listed in the Degree Regulations & Programmes of Study. If in doubt, consult the course lecturer.
High Demand Course?	Yes

Course Delivery Information

Academic year 2022/23, Available to all students (SV1)		**Quota: None**	
Course Start	Semester 2		
Timetable	Timetable		
Learning and Teaching activities (Further Info)	Total Hours: 100 (Lecture Hours 20, Seminar/Tutorial Hours 8, Summative Assessment Hours 2, Programme Level Learning and Teaching Hours 2, Directed Learning and Independent Learning Hours 68)		
Assessment (Further Info)	Written Exam 80 %, Coursework 20 %, Practical Exam 0 %		
Additional Information (Assessment)	Students will be given written practical assignments reinforcing the material taught in class. The assigments are mainly theoretical, but some of the assigned questions may ask students to implement parts of algorithms for "solving" a game. This includes marked coursework (which will count for 20% of the overall marks for the course), plus weekly tutorial sheets which are not marked, but whose solutions are discussed at weekly tutorials. You should expect to spend approximately 32 hours on the coursework and tutorial sheet exercises, combined, for this course.		
Feedback	Not entered		
Exam Information			
Exam Diet	**Paper Name**	**Hours & Minutes**	
Main Exam Diet S2 (April/May)		2:00	

Learning Outcomes

On completion of this course, the student will be able to:

1. Understanding of various models of games, how they are related, and how they arise in various applications in computer science and elsewhere
2. An understanding of linear programming and some of its broad applicability
3. An understanding of algorithms used to "solve" such games and their efficiency
4. Ability to model various scenarios as strategic games, and devise algorithms to solve them

5. An understanding of some of the aims of the current research frontier

Reading List

-- M. Maschler, E. Solan, & S. Zamir, "Game Theory", 2013.
-- V. Chv谩tal, "Linear Programming", 1980.
-- N. Nisan, T. Roughgarden, E. Tardos, and V. Vazirani (editors), "Algorithmic Game Theory", 2007.
-- Y. Shoham & K. Leyton-Brown, "Multiagent systems: algorithmic, game-theoretic, and logical foundations", 2009.
-- A. Mas-Colell, M. Whinston, and J. Green, "Microeconomic Theory", 1995.
-- T. Roughgarden, "Twenty Lectures on Algorithmic Game Theory", 2016.

Additional Information

Course URL	http://course.inf.ed.ac.uk/agta
Graduate Attributes and Skills	Not entered
Keywords	Not entered

Contacts

Course organiser	Dr Kousha Etessami **Tel:** (0131 6)50 5197 **Email:** Kousha@inf.ed.ac.uk	**Course secretary**	Miss Lori Anderson **Tel:** (0131 6)51 4164 **Email:** lori.anderson@ed.ac.uk