

# CS929-15 Algorithmic Game Theory

23/24

**Department**

Computer Science

**Level**

Taught Postgraduate Level

**Module leader**

Matthias Englert

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

The focus of the module is on algorithmic and computational complexity aspects of game-theoretic models.

### Module aims

To familiarise students with formal methods of strategic interaction, as studied in game theory. One of the aims will be to give a flavour of current research and most recent advances in the field of algorithmic game theory.

### Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Game models: Strategic form, extensive form, games of incomplete information (eg auctions), succinct representations, market equilibria, network games, co-operative games;

Solution concepts: Nash equilibria, subgame perfection, correlated equilibria, Bayesian equilibria, core and Shapley value;

Quality of equilibria: Price of anarchy, price of stability, fairness;

Finding equilibria: Linear programming algorithms, Lemke-Howson algorithm, finding all equilibria;

Complexity results: Efficient algorithms, NP-completeness of decision problems relating to set of equilibria, PPAD-completeness;

Some parts of the module will be research-led, so some topics will vary from year to year.

## Learning outcomes

By the end of the module, students should be able to:

- Understand a variety of advanced algorithmic techniques and complexity results for computing game-theoretic solution concepts (equilibria).
- Apply solution concepts, algorithms, and complexity results to unseen games that are variants of known examples.
- Understand the state of the art in some areas of algorithmic research, including new developments and open problems.
- Understand the fundamental concepts of non-cooperative and co-operative game theory, in particular standard game models and solution concepts.

## Indicative reading list

Osborne and Rubinstein, A Course in Game Theory;

Roughgarden, Selfish Routing and the Price of Anarchy;

Nisan, Roughgarden, Tardos and Vazirani (eds), Algorithmic Game Theory;

Selected research papers.

## Subject specific skills

Advanced algorithmic techniques;

## Transferable skills

Problem Solving;

Communication skills

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## Study

### Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Seminars	9 sessions of 1 hour (6%)
Private study	111 hours (74%)
Total	150 hours

### Private study description

private reading and revision

## Costs

No further costs have been identified for this module.

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## Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

### Assessment group D1

	Weighting	Study time
Coursework 1 question sheet 1 - peer assessed.	5%	
coursework 2 question sheet	15%	
In-person Examination CS929 examination	80%	

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- Answerbook Gold (24 page)

### Assessment group R1

	Weighting	Study time
In-person Examination - Resit CS929 resit paper	100%	

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- Answerbook Gold (24 page)

## Feedback on assessment

Written comments and marks.

[Past exam papers for CS929](#)

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## **Availability**

### **Pre-requisites**

Students must have studied the material in CS260 or equivalent relevant content.

### **Courses**

This module is Optional for:

- Year 1 of TCSA-G5PD Postgraduate Taught Computer Science
- Year 1 of TCSA-G5PA Postgraduate Taught Data Analytics
- Year 1 of TMAA-G1PF Postgraduate Taught Mathematics of Systems