GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Game Theory and Multiagent Systems (E003710)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2025-2026

A (semester 1)	English	Gent

Lecturers in academic year 2025-2026

Steendam, Heidi	TW07	lecturer-in-charge
Fiems, Dieter	TW07	co-lecturer

Offered in the following programmes in 2025-2026	crdts	offering
Master of Science in Electrical Engineering (main subject Communication and Information Technology)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	A
Master of Science in Computer Science Engineering	6	A
Master of Science in Industrial Engineering and Operations Research	6	A

Teaching languages

English

Keywords

Game theory

Position of the course

Game theory studies decision making by several distinct agents, each having their individual and often conflicting objectives. This course introduces the concepts of game theory and multi-agent systems applied to various engineering problems where the overall system dynamics follow from the actions of multiple agents. Prime engineering examples include flow control where agents adapt their demand to possible congestion, routing decisions in networks, where agents look for the best route through a network, and power control where agents make a trade-off between the power needed for and the success of an operation (like a transmission over a wireless channel).

Contents

- **Introduction:** Game theory and mechanism design for multi-agent systems; medium access control problems; routing problems; resource allocation problems.
- **Static non-cooperative games**: Matrix games and continuous-kernel games; Dominating strategies; Nash Equilibrium; Price of anarchy; Price of stability; Mixed and correlated equilibria; Computation of Nash equilibrium in matrix games. Multiple resource congestion game.
- **Dynamic non-cooperative games**: Extensive form games with imperfect information: normal form, subgame perfect equilibrium, sequential equilibria; Multistage games with observed actions; Repeated games; Stackelberg games; Relay selection and power control game.
- **Evolutionary games:** Evolutionary stable strategies; Replicator dynamics; Hawk-dove game; Evolutionary games for the Aloha protocol and for peer-to-peer networking.
- **Games with incomplete information:** Mixed and behavioural strategies. Bayesian Nash equilibrium. Applications in auctions. Different auction formats. Revenue and efficiency properties of different auctions.

- **Mechanism design:** Optimal auctions; Revelation principle. Implementability; Revenue-equivalence theorem; Vickrey–Clarke–Groves mechanisms; Mechanisms in networking, decentralized mechanisms.
- **Cooperative games**: Coalitions; Monotone games; Superadditive games; Convex games; Core of the game; Shapley value.
- **Bargaining games**: bargaining games without transfer of utility, Nash bargaining solution, Kalai-Smorodinsky bargaining somution, bargaining games with transfer of utility.

Initial competences

Basic probability theory and statistics; basic real analysis.

Final competences

1 Master the formulation and mathematical solution techniques of non-cooperative games.
2 Select the most suitable models, methods and techniques for specific game-theoretic engineering problems.
3 Assess the outcome of games quantitatively and qualitatively.
4 Master the design of decentralized mechanisms.
5 Master the formulation and mathematical solution techniques of cooperative games.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Study material

Type: Syllabus

Name: Game Theory and Multi-Agent Systems
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Pages : 250
Oldest Usable Edition : version of 2020
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No
Additional information: Students can print the course material.

References

- Z. Han, D. Niyato, W. Saad. T. Basar, A. Hjørungnes. Game theory in wireless and communication networks. Cambridge University Press, 2012.
- T. Basar, G.J. Olsder, Dynamic Noncooperative Game Theory, SIAM, 1999
- M. Mashler, E. Solan, S. Zamir, Game Theory, 2013, Cambridge
- Y. Shoham, K. Lleyton-Brown, Multi-Agent Systems: Algorithmic,Game-Theoretic, and Logical Foundations, 2009, Cambridge

Course content-related study coaching

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Written assessment open-book

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Calculation of the examination mark

Examination: 100%