



FEL3390 Game Theory and Control 7.5 credits

Spelteori och Reglerteknik

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

The official course syllabus is valid from the spring semester 2026 as decided by the Faculty Board: dnr PA-2026-0008. Decision date: 2026-02-24

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Doctoral students at the School of Electrical Engineering and computer Science. External participation by admission of the examiner.

Intended learning outcomes

1. Formalize control problems with multiple decision makers as non-cooperative games;
2. Analyse a given non-cooperative game to determine key structural properties.
3. Successfully apply suitable algorithms to compute equilibria of non-cooperative games;
4. Design game-theoretic strategies to solve decision and control problems in complex systems;

5. Critically evaluate the performance and limitations of the proposed game-theoretic strategies.

Course contents

Introduction to the course (abstract):

Game theory is the study of mathematical models of conflict and cooperation between intelligent, rational decision-makers. Although its modern foundations were laid in economics and mathematics, game theory has since expanded far beyond its original scope. Today, it is increasingly adopted in engineering fields such as smart mobility, communication networks, energy grids, autonomous systems, and logistics. This course introduces core concepts and methods in non-cooperative game theory, including equilibrium concepts, existence and uniqueness results, dynamic and repeated interactions, and computational approaches based on convex analysis and monotone operator theory. Moreover, the course illustrates how these tools enable the modeling, analysis, and control of complex socio-technical systems, with applications ranging from energy and mobility infrastructures to autonomous systems.

Course content:

- Introduction to game theory (static, zero- and general-sum, potential games, pure strategies, mixed strategies);
- Equilibria definitions (Nash, Stackelberg, Wardrop, Generalized), existence and uniqueness results;
- Mathematical preliminaries of convex analysis (convex sets and functions, monotone operator theory);
- Numerical methods for the computation of equilibria in continuous games (best response, operator splitting methods, etc.);
- Dynamic games and game-theoretic control strategies;
- Population games and auctions;
- Application to modelling, analysis, and control of complex systems (electrical power grids, smart mobility, autonomous driving and racing);

Examination

- INL1 - Homework 1, 2.0 credits, grading scale: P, F
- INL2 - Homework 2, 2.0 credits, grading scale: P, F
- INL3 - Homework 3, 2.0 credits, grading scale: P, F
- PRO1 - Project, 1.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability. The examiner may apply another examination format when re-examining individual students. If the course is discontinued, students may request to be examined during the following two academic years.

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Other requirements for final grade

A passing grade is based on three homework projects and a final presentation. Students will work individually or in groups (depending on the total number of participants) on independent projects. Each homework assignment will be corrected and discussed by peers and teachers. The final project presentation may consist of either a presentation of some uncovered materials during the course or a presentation of a research article relevant to both the student's research interests and the course content.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.