EP2900 Networked Artificial Intelligence 7.5 credits

Nätverkad artificiell intelligens

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

Establishment

The official course syllabus is valid from the autumn semester 2026 as decided by the Faculty Board decision HS-2025-2042. Date of decision: 2025-10-07

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Computer Science and Engineering

Specific prerequisites

Knowledge in linear algebra, 7.5 credits, equivalent to a completed course such as SF1624/SF1672/SF1684.

Knowledge in multivariable analysis, 7.5 credits, equivalent to a completed course SF1626/SF1674/SF1686.

Knowledge in probability theory and statistics, 6 credits, equivalent to a completed course SF1910-SF1925/SF1935 or completed exam module TEN1 within SF1910/SF1925/SF1935.

Knowledge and skills in programming, 6 credits, equivalent to a completed course such as DD1337/DD1310-DD1319/DD1321/DD1331/DD1333/DD100N/ID1018/ID1022.

Knowledge of English equivalent to the upper secondary course English B/English 6.

Intended learning outcomes

After passing the course, the student should be able to

- explain the basics of AI systems operating in network environments, including search, reasoning, planning, machine learning and multi-agent systems
- apply statistical methods and optimisation to analyse and design AI systems operating in network environments
- formulate and solve optimisation and learning problems in distributed networks
- explain and implement methods for consensus, federated learning and distributed reasoning
- analyse trade-offs between communication, computation and performance in AI systems operating in network environments
- develop simple prototypes of distributed AI systems in Python or similar environments
- critically evaluate ethical and security aspects of AI implemented over networks

in order to prepare the student for research or qualified engineering work in artificial intelligence for distributed and networked systems.

For higher grades, the student should also be able to

- conduct a theoretically well-grounded analysis of convergence, robustness and scalability of different algorithms for networked AI
- independently design and implement a complex application of networked AI and analyse its limitations.

Course contents

The course covers both machine learning and classical AI paradigms in a network context. Here, the concept of network is understood in a broad scientific sense (e.g. networks of agents, sensors, computing nodes, social networks or communication networks).

The course covers theories, methods and practical applications of artificial intelligence in network environments. The focus is on both machine learning and other AI paradigms such as search, planning, reasoning and multi-agent systems. The course is divided into three parts:

- **Part I: Basic concepts and tools**
  Introduction to networked AI, intelligent agents and multi-agent systems. Statistical foundations and optimization methods for distributed systems. Classical AI methods for search, problem solving, knowledge representation and logical reasoning in networked environments.

- **Part II: Distributed learning and decision making**
  Optimization over networks and consensus algorithms. Multi-agent systems with communication, coordination and negotiation. Game theory and strategic decision-making in networks. Planning under uncertainty, including Markov decision processes (MDP), distributed MDPs, and partially observable MDPs (POMDPs).
- **Part III: Advanced topics and applications**
  Federated and distributed learning, including communication and security aspects. Neurosymbolic AI and the combination of logic and machine learning. Practical applications in areas such as smart grids, the Internet of Things, autonomous vehicles, and wireless networks.

The course includes both theoretical lectures and exercises. The exercises consist of mathematical problems, analysis of algorithm properties, and practical implementations in Python or a similar programming environment.

Examination

- INL1 - Hand-in Assignment, 1.5 credits, grading scale: P, F
- INL2 - Hand-in Assignment, 1.5 credits, grading scale: P, F
- INL3 - Hand-in Assignment, 1.5 credits, grading scale: P, F
- TEN1 - Written Exam, 3.0 credits, grading scale: A, B, C, D, E, FX, 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.

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.