

CS-E407522 - Special Course in Machine Learning, Data Science and Artificial Intelligence D: Introduction to Geometric Deep Learning, Lectures, 24.10.2024-13.2.2025

This course space end date is set to 13.02.2025 [Search Courses: CS-E407522](#)

Syllabus

/ Department of Computer Science / CS-E407522 - Special Course in Machine Learning, Data Science and Artificial Intelligence D: Introduction to Geometric Deep Learning, Lectures, 24.10.2024-13.2.2025

CourseGradesCourse feedback

General

General Information

Credits: 5

Schedule: 24.10.2024 - 20.02.2025 (Period II and III). No courses during the evaluation weeks.

Teacher in charge: Vikas Garg

Language of instruction and studies (applies in this implementation): English. Languages of study attainment: English

Learning outcomes: By the end of the course, students will understand and implement key models in Graph Neural Networks, equivariant networks using group theory and symmetries, and grasp concepts of Riemannian geometry applied in machine learning. They are expected to critically engage with the latest research in these areas.

Slack: The Slack discussion forum can be used to discuss anything related to the course, and it is intended as **the main communication channel between the students and the teaching personnel** during the course. Please join via the invite link below. You can seek help for assignments, discuss lecture topics/papers and ask questions outside the lectures. However, please avoid posting (partial) solutions to the assignments.

Our Slack is organized in different channels that correspond to different course activities/topics (lecture topics, assignments, # paper). If you have any questions regarding these activities please post your question in the most suitable channel. We warmly welcome students to answer questions from other students. However, we will also try to help you and answer your questions.

Slack invite link: https://join.slack.com/t/aaltogdlcourse/shared_invite/zt-2t4r062ud-3APnAhU26K2PBJFu8ov70Q

Support: Instructors can be contacted via email. In general, for quick follow-up, we encourage writing (Cc'ing) to all the instructors.

- Alison Pouplin: alison.pouplin@aalto.fi
- Katsiaryna Haitsiukevich: katsiaryna.haitsiukevich@aalto.fi
- Caglar Hizli: caglar.hizli@aalto.fi
- Erik Schultheis: erik.schultheis@aalto.fi

Content Description

This course offers an introduction to geometric deep learning, focusing on three topics: Graph Neural Networks, Symmetries and Equivariance, and Manifold Learning with Differential Geometry.

Graph Neural Networks

By the end of this course, students will be able to explain and implement fundamental models such as Graph Convolutional Networks and Graph Attention Networks. They should be able to address various tasks such as node classification, graph classification, and link prediction. Students will understand essential concepts like message passing and graph isomorphism.

Symmetries and Equivariance

Students will learn how to integrate symmetries into neural networks. This includes acquiring basic knowledge of group theory, Lie groups, and representation theory. By the end of the course, students will be capable of designing equivariant networks that exhibit consistent behavior under data transformations, such as Spherical Convolutional Neural Networks and their generalizations.

Manifold Learning with Differential Geometry

Students will learn the basics of Riemannian geometry and understand how these concepts can be applied to Machine Learning. The course provides a concise introduction to manifolds, geodesics, and curvature, and some insights into Information geometry. The students will be assessed through a series of notebooks and exercises for each topic, and they will present a research paper selected from a list provided by course instructors.

Registration

This course admits max. 28 participants (due to 14 slots for paper presentations done in pairs). We will take several factors into consideration for student selection including, prior studies, mathematical maturity, programming experience, major of study, and motivation. Note that this course is primarily intended for PhD and MSc students.

The pairings and paper selections must be made before the second session (week 44, 31.10.2024). Each pair should rank their top 6 papers from a provided list that they would like to present in decreasing order of their preference. The instructors would get back shortly afterwards with the presentation schedule and the assigned presenters.

The course meetings will take place every Thursday from 14:15-16:00 in room TU4 in the TUAS building.



Announcements

MyCourses support for students



Students

- MyCourses instructions for students
- Support form for students

Teachers

- MyCourses help
- MyTeaching Support

About service

- MyCourses protection of privacy
- Privacy notice
- Service description
- Accessibility summary