

Course title: Differentiable programming

Course code: 63546J

ECTS: 6

Professor: Assist. prof. Ciril Bohak

Master's program

Prerequisite knowledge:

- Graduate-level knowledge from Computer Science
- Good Programming skills in C/C++ and Python
- Deep learning basics
- Linear algebra knowledge is recommended

Short course description:

This course covers the principles and techniques of differential programming, which are becoming increasingly important in fields such as machine learning, computer vision, graphics, physics simulation, and scientific computing. Differentiation and optimization are key ingredients in the success of deep learning models, which are used in many applications such as image and speech recognition, natural language processing, and autonomous driving. Backpropagation and automatic differentiation are essential techniques for computing gradients in deep learning models, allowing us to train them efficiently on large datasets. Differentiable physics and rendering are emerging areas that enable us to simulate physical and visual phenomena using deep learning techniques. The ability to solve partial differential equations (PDEs) using neural networks is a promising area of research that has the potential to transform scientific computing by enabling us to model complex physical systems more efficiently. In addition, differentiable convex optimization provides a powerful tool for solving optimization problems that arise in many areas of science and engineering. By mastering the principles and techniques of differential programming, students will be well-equipped to tackle a variety of real-world problems and make significant contributions to the fields of machine learning, computer graphics, physics simulation, and scientific computing.

Students will learn how to apply these techniques to a range of problems, including computer vision, graphics, physics simulation, and scientific computing. They will develop an understanding of the theory behind these techniques as well as practical skills in implementing and using them in software.

The course will include a mix of lectures, programming assignments, and projects, allowing students to gain both theoretical knowledge and practical experience. By the end of the course, students will be able to design and implement differentiable programs and use them to solve a variety of problems in different domains.