University of St.Gallen

Course and Examination Fact Sheet: Spring Semester 2026

10,369: Optimization for Data Science

ECTS credits: 4

Overview examination/s

(binding regulations see below)
decentral - Oral examination and technical discussions, Analog, Individual work individual grade (50%)
Examination time: Term time
decentral - Written examination, Analog, Individual work individual grade (50%)
Examination time: Term time

Attached courses

Timetable -- Language -- Lecturer
10,369,1.00 (GSERM) Optimization for Data Science -- English -- Sutter Tobias

Course information

Prerequisites

A basic background in linear algebra and calculus is required. Elementary knowledge of probability theory is necessary.

Learning objectives

By the end of this course, students will understand the fundamental principles of convex optimization and modern algorithmic techniques used to solve large-scale problems in economics, machine learning, and data science. They will be able to formulate optimization problems, analyze their structure, apply key theoretical tools such as duality and optimality conditions, and implement scalable algorithms including gradient-based and second-order methods. Students will also learn to critically evaluate the performance and suitability of different optimization methods for real-world applications.

Content

This course teaches an overview of modern optimization methods for applications in economics, machine learning, and data science. In particular, it covers the scalability of algorithms to large datasets, both in theory and in implementation.

Preliminary course structure:

1. **Convex optimization**
    - Optimization problems
    - Convex sets, convex functions, convex optimization problems
    - Lagrangian duality
    - Optimality conditions
    - Optimization in econometrics, statistics, and machine learning
2. **Algorithms**
    - Gradient descent

- Projected gradient descent
- Stochastic gradient descent
- Newton methods

Structure and indications of the learning and teaching design

The course consists of several lectures that introduce the key theoretical concepts; slides for all lecture material will be provided. Throughout the semester, multiple exercise sheets will be distributed, discussed in class, and assigned as homework. Sample solutions will be made available to support students in their learning.

At the end of the course, there will be a final written examination.

Literature

The lecture uses material from the following textbooks (detailed slides will be provided)

- Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2009.
- D.P. Bertsekas, Convex Optimization Theory, Athena Scientific, 2009.
- Y. Nesterov, Introductory Lectures on Convex Optimization, Springer, 200

Additional information

Tobias Sutter is an Associate Professor for Econometrics in the Department of Economics at the University of St.Gallen. He holds B.Sc. and M.Sc. degrees in Mechanical Engineering and a Ph.D. in Electrical Engineering, all from ETH Zürich. Before joining St.Gallen, he was an Assistant Professor for Machine Learning at the University of Konstanz and held research positions at EPFL and ETH Zürich.

His research focuses on the statistical foundations of algorithmic decision making. He is particularly interested in how data can be used to make optimal and robust decisions in complex and uncertain environments. Current topics include data-driven robust optimization, reinforcement learning, and dynamic decision-making under uncertainty, especially in economic and control settings.

Students working with him can expect to engage with both theoretical and applied problems at the intersection of optimization, machine learning, and decision theory. The research group uses tools from reinforcement learning, stochastic programming, and control theory to design algorithms that are not only principled but also scalable and robust in practice.

Tobias Sutter's work has been recognized with the IEEE George S. Axelby Outstanding Paper Award and the ETH Medal for his doctoral research.

Examination information

Examination sub part/s

1. Examination sub part (1/2)

Examination modalities

Examination type	Oral examination and technical discussions
Responsible for organisation	decentral
Examination form	Oral examination
Examination mode	Analog
Time of examination	Term time
Examination execution	Asynchronous
Examination location	On Campus
Grading type	Individual work individual grade

Weighting	50%
Duration	--

Languages
Question language: English
Answer language: English

Remark
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Examination-aid rule
Closed Book

The use of aids is prohibited as a matter of principle, with the exception of pocket calculator models of the Texas Instruments TI-30 series and, in case of non-language exams, bilingual dictionaries without any handwritten notes. Any other aids that are admissible must be explicitly listed by faculty members in the paragraph entitled “Supplementary aids” of the course and examination fact sheet; this list is exhaustive.

Procuring any aids, as well as ensuring their working order, is the exclusive responsibility of students.

Supplementary aids

One cheat sheet (one-sided A4 page) allowed.

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2. Examination sub part (2/2)

Examination modalities

Examination type	Written examination
Responsible for organisation	decentral
Examination form	Written exam
Examination mode	Analog
Time of examination	Term time
Examination execution	Synchronous
Examination location	On Campus
Grading type	Individual work individual grade
Weighting	50%
Duration	--

Languages
Question language: English
Answer language: English

Remark
Duration: 60 minutes

Examination-aid rule
Closed Book

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Supplementary aids

Content

Examinable is all the material provided during the lectures (slides, exercise sheets, and sample solutions to the exercise sheets).

Literature

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Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are binding and takes precedence over other information, such as information on StudyNet (Canvas), on lecturers' websites and information in lectures etc.
Any references and links to third-party content within the fact sheet are only of a supplementary, informative nature and lie outside the area of responsibility of the University of St.Gallen.

Documents and materials are only relevant for central examinations if they are available by the end of the lecture period (CW21) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 13 (Monday, 23rd March 2026) are relevant for testing.

Binding nature of the fact sheets:

- Course information as well as examination date (organised centrally/decentrally) and form of examination: from bidding start in CW 04 (Thursday, 22nd January 2026);
- Examination information (supplementary aids, examination contents, examination literature) for decentralised examinations: in CW 12 (Monday, 16 March 2026);
- Examination information (supplementary aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 14 (Monday, 30 March 2026);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before ending with de-registration period in CW 15 (Monday, 06 April 2026).