

| Deutscher Name | Englischer Name | Dozierende | Bachelor-Plätze | Master-Plätze | Englisch | Beschreibung | Voraussetzungen | Literatur | Lehrstuhl | Dozierenden-E-Mails |
|---|--|---------------------------------------|-----------------|---------------|----------|---|---|---|--|---|
| Scheduling: Theorie und Algorithmen | Scheduling: Theory and Algorithms | Andreas Schulz, Maximilian von Aspern | 0 | 12 | ✓ | Scheduling problems appear in many applications, ranging from manufacturing processes to healthcare. In this seminar, we will look at various such problems, new and old, and strategies to solve them. We focus on applying techniques from combinatorial optimization and linear programming to develop beautiful and fast solution algorithms. Further, we will learn how to design good approximation algorithms for NP-hard problems in the world of scheduling. | | Original journal articles (which will be provided in due time). | Operations Research | andreas.s.schulz@tum.de, maximilian.aspern@tum.de |
| Neue Entwicklungen in der Nichtlinearen Optimierung | Recent Developments in Nonlinear Optimization | Michael Ulbrich | 5 | 8 | ✓ | The seminar is centered around recent advances and trends in nonlinear optimization and related fields. It also serves as a preparation for a Bachelor's or Master's thesis in this area. The talks cover innovative developments in the following fields: Optimization theory; efficient numerical solvers and their convergence theory; stochastic and robust optimization; nonsmooth optimization; optimization of complex systems; optimal control; game theory; applications in data science and machine learning, technology, engineering, natural sciences, etc. | | The talks are typically based on recent journal publications. Requirements for participation: For Bachelor students: Einführung in die Optimierung (MA2012) recommended, but not mandatory, is also Nonlinear Optimization (MA3503) For Master students: Einführung in die Optimierung (MA2012) or Nichtlineare Optimierung: Grundlagen (MA2503) Nonlinear Optimization (MA3503) | Mathematical Optimization, M1 | m.ulbrich@tum.de |
| Numerische Modellierung in der Physik | Computational Modelling in Physics | Caroline Lasser | 6 | 6 | ✓ | The seminar is a reading course of selected chapters of the book "A First Guide to Computational Modelling in Physics" by P. Scharoch, M. Polak, R. Szymon (Cambridge University Press, 2024). | | A First Guide to Computational Modelling in Physics; P. Scharoch, M. Polak, R. Szymon (Cambridge University Press, 2024) | Numerics of Partial Differential Equations | classer@tum.de |
| Implizite Regularisierung in den Datenwissenschaften | Implicit regularization in data science | Felix Kraemer | 0 | 9 | ✓ | Over decades, the guiding paradigm of machine learning was the bias-variance trade-off. It was believed that a model with too many parameters leads to overfitting if no preventive measures such as overfitting are applied. Recently, it was observed that this only partly true: the best performance is often achieved for highly overparametrized models. The mathematical theory explaining such phenomena is only in its beginnings. In this seminar, we will review some recent works that provide partial understanding of why this is the case, demonstrating that gradient descent and gradient flow can exhibit a bias towards "simple" solutions. The participants will review recent research articles on the topics. Please note that each presentation will be given jointly by multiple participants, and each participants will be involved in two such team presentations and will hence also need to read two articles. | | Original research articles, will be provided to the participants. No formal requirements, sound knowledge of probability, statistics, analysis, optimization, and machine learning is helpful. | Professur für Optimierung und Datenanalyse | felix.kraemer@tum.de |
| COVID-19: Von medizinischen Tests bis zu politischen Richtlinien. Wie Mathematik eine Pandemie handhabt | COVID-19: From medical tests to political guidance. How mathematics handles a pandemic | Christina Kuttler | 5 | 5 | ✓ | This seminar will take a closer look at the COVID-19 pandemic and how it was handled from a statistical/mathematical perspective in Munich and the world. We will start with an analysis and comparison of the diagnostic methods available at the start of the pandemic for detecting antibodies post-SARS-CoV-2 infection and the development of innovative diagnostic methods for detecting antibodies using dried blood spots (DBS) on filter papers. The knowledge gained during this process was applied to establish biological-based models for monitoring the pandemic within the population. A statistical/epidemiological approach involves analyzing infection prevalence and identifying risk and hospitalization from the Robert Koch Institute (RKI) with further information to create a compartmental biological-based model that simulates the epidemic's spread in the population, enabling predictions of potential future scenarios. This seminar will guide students through an evolving pandemic as mathematicians experienced it during the last five years, including statistical methods, as well as mathematical modelling, ending up with learnings for future pandemics and a look at future mathematical work in the field of epidemiology. Hence, students will gain an overview over a variety of research topics and methods within the world of epidemiology. | Mathematical models in Biology Einführung in die Wahrscheinlichkeitstheorie und Statistik. | Selected papers and publications (Concerning previous knowledge, it's sufficient to have the background in Math. models in Biology OR some basics in statistics, but being open minded for both directions). | Mathematik in den Lebenswissenschaften | christina.kuttler@mytum.de |

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| Evolution und Sozialwissenschaften | Evolution and Social Sciences | Volker Gerd Jürgen Hösel, Johannes Müller | 8 | 2 | ✓ | <p>"War is a man's game". "The demography of human warfare can drive sex differences in altruism". "Authority matters: propaganda and the coevolution of behavior and attitude".</p> <p>These are the titles of some of the papers we want to look at: There is a line of research that aims to better understand human behavior based on a classical theory of evolution, the evolutionary game theory. Unlike game theory, evolutionary game theory is not based on the homo oeconomicus (individuals aim to maximize their gain on the basis of a rational analysis of the situation), but establishes a link between fitness and behavior. When individuals choose a certain strategy, their fitness can be higher (or lower) depending on the strategy. At the same time, the behavior of individuals influences the resources available to the group. This non-trivial interplay between behavior and available resources will determine the fate of the population.</p> <p>Interestingly, blind evolution often leads to a Nash equilibrium as a long-term outcome (this is the so-called Folk's theorem of evolutionary game theory). Therein, classical game theory and evolutionary game theory are closely related.</p> <p>After discussing the basics of evolutionary game theory [1], we will turn to papers that directly address various aspects of human behavior based on this theory.</p> <p>This is a joint seminar with Prof. Aurelien Tellier from the School of Life Science.</p> | | Hofbauer, Sigmund. Evolutionary Games and Population Dynamics. Cambridge University Press, 2008 and original research articles. | M12 | volker.hoesel@tum.de, johannes.mueller@mytum.de |
| Algorithmische Spieltheorie und Entwurf von Mechanismen | Algorithmic Game Theory and Mechanism Design | Andreas Schulz, Chiara Vanoli | 12 | 0 | ✓ | <p>How bad is it that drivers can choose their route in a street network? (Selfish Routing) What is the best bidding strategy at an online auction? (Combinatorial) Auctions) How difficult is it to find an equilibrium in a game? (Computing in Games) How are online ads being sold? (Sponsored Search Auctions) Can one strategize in democratic voting? Do better voting rules exist? (Social Choice, Voting Rules) How should one cut a cake? (Fair Division) Whose kidney is going to be transplanted? (Matching under Preferences)</p> <p>These questions can be addressed by algorithmic game theory and mechanism design, scientific fields where strategic agents interact directly or indirectly with each other by some game or mechanism. In this seminar, students will discuss selected topics in algorithmic game theory and mechanism design topics and learn about exciting results, methods and applications.</p> | | Original articles from the recent literature on the subject. | Operations Research | andreas.s.schulz@tum.de, chiara.vanoli@tum.de |
| Mathematik visualisieren | Visualising Mathematics | Jürgen Richter-Gebert | 6 | 6 | ✓ | <p>Visualising mathematics, making abstract objects accessible to the human imagination, has a long tradition in mathematics. Very often the process of visualisation itself requires scientific methods. On the basis of selected mathematical texts from the last century students will get the challenge to visualise selected mathematical objects and concepts. Concepts and Objects of investigations will be for instance: the Clebsch diagonal surface, quaternions, 4-dimensional regular polytopes, reflection groups and many more. The use of interactive programs, 3D prints or concrete physical models will serve as visualisation media. The seminar places equal emphasis on text work as well as on the creation of objects and programs. The students are required to work in small groups and at the end present their topic of the seminar in a presentation that highlights the concepts and objects and shows a concrete visualisation.</p> | Lineare Algebra I+II, Having visited a Geometry class is helpful The willingness to do hands-on visualisation work | Hilbert & Cohn Vossen: Anschauliche Geometry Coxeter & Greitzer: Geometry revisited Coxeter: The beauty of geometry: twelve essays | Geometry and Visualisation | richter@tum.de |