Deutscher Name	Englischer Name	Dozierende	Bachelor-Plätze	Master-Plätze	Flexible-Plätze	Englisch	Beschreibung	Voraussetzungen	Literatur
Stochastische Aspekte dynamischer Systeme: Operatoren, Chaos und Entropie	Stochastic aspects of dynamical systems: Operators, chaos and entropy	Johannes Zimmer	3	7	0	✓	This seminar is based on the book "Chaos, fractals and noise" by Andrzej Lasota and Michael Mackey, ideally augmented by further literature presenting applications. We will first study a model dynamical system with 'chaotic' behaviour and then collect tools from measure theory to describe such systems. A central part will be so-called evolution operators, specifically Markov operators and Frobenius-Perron operators and Koopman operators. We plan to cover invariant measures and ergodic transformations before discussing applications, in particular of algorithmic nature. A nice aspect of the book is that it brings together concepts from different areas (Markov operators, deterministic dynamical systems, ergodic theory), and explains them carefully. Some of the material covered, for example Koopman operators, nowadays play a central role in machine learning approaches for dynamical systems. Depending on the participants' interest, the seminar can aim to bridge between theory and practice	Analysis 1-3. There will be a planning meeting soon after the matching results have been announced, to assign the talks.	Andrzej Lasota and Michael Mackey, Chaos, fractals and noise", Springer, Applied Mathematica Sciences 97 (1994)
Der Satz von de Finetti: klassische Ergebnisse und neue Entwicklungen	De Finetti's theorem: Classical results and new developments	Silke Rolles	5	6	0	✓	A sequence of random variables is exchangeable if its joint distribution is invariant under finite permutations. De Finetti's theorem states that any exchangeable sequence is a mixture of i.i.d. sequences. This is fundamental to Bayesian statistics and allows to analyse exchangeable sequences. In 1980, Diaconis and Freedman proved a de Finetti theorem for Markov chains providing a mixture of Markov chains for partially exchangeable sequences under a recurrence assumption. We start the seminar with a brief introduction to Bayesian statistics. With this motivation in mind, we study both versions of de Finetti's theorem. Furthermore, we discuss a recent proof of a conjecture of Diaconis and Freedman on transient partially exchangeable sequences by Halberstam and Hutchcroft from 2024. Their proof uses Eulerian paths on rooted digraphs, uniform spanning trees, and loop-erased random walks.	Einführung in die Wahrscheinlichkeitstheorie und Statistik (MA0009 or MA1109). Some talks require some knowledge of Markov chains or probability theory. You should be interested in these subjects, but it is not required that you have taken a course on it.	P. Diaconis and D. Freedman: De Finetti's theorem for Markov chains, The Annals of Probability 1980, Vor. 8, No.1, 115-130. G. Grimmett: Probability on graphs, Cambridge University Press 2010. N. Halberstam and T. Hutchcroft: Proof of the Diaconis--Freedman Conjecture on partially-exchangeable processes, Preprint 2024, https://arxiv.org/abs/2405.20276 A. Klenke: Probability Theory, Third Edition, Springer, 2020 M.A.A. Turkman, C.D. Paulino and P. Müller: Computational Bayesian statistics, An introduction,
Learning-Augmented Online Algorithms for Combinatorial Optimization Problems	Learning-Augmented Online Algorithms for Combinatorial Optimization Problems	Andreas Schulz	0	8	2	✓	Many discrete optimization problems require decisions to be made without full knowledge of future inputs. Online algorithms address this challenge, traditionally evaluated by comparing their performance to optimal solutions of underlying offline problems. Recently, the study of learning-augmented algorithms has become a very vibrant research area. These algorithms aim to enhance performance by utilizing predictions, while still ensuring robust worst-case guarantees. In this seminar, we will explore interesting classical and recent results at the transition from offline to online optimization, with applications including scheduling, optimal stopping, mechanism design, and facility location.	Some course(s) in combinatorial/discrete optimization	Selected original articles; repository of exemplary articles for learning-augmented algorithms: https://algorithms-with-predictions.github.io/
Numerics of Stochastic Differential Equations	Numerics of Stochastic Differential Equations	Caroline Lasser	0	0	8	X	The seminar is a reading course of the text book "An introduction to the Numerical Simulation of Stochastic Differential Equations" by Desmond Higham and Peter Kloeden (SIAM, 2021).	Solid background knowledge in linear algebra, analysis (calculus, ordinary differential equations) and some basics on numerics and partial	Desmond Higham and Peter Kloeden: An introduction to the Numerical Simulation of Stochastic Differential Equations" (SIAM, 2021)
Matrixgruppen und -algebren: Erste Schritte in der Lie-Theorie	A First Introduction to Lie Theory via Matrix Groups and Algebras	Carsten Lange	12	0	0	X	In der Linearen Algebra werden bereits die Matrixgruppen O(n), SO(n), U(n) und SU(n) betrachtet, wobei sie allerdings nicht als Beispiele von Lie-Gruppen eingeführt werden. Neben diesen Gruppen werden wir weitere Matrixgruppen, die symplektischen Gruppen SP(n), und Matrixalgebren kennenlernen, betrachten und deren Verbindungen studieren. Mit Hilfe der Exponential- und Logarithmusfunktion sowie dem Konvergenzbegriff aus der Analysis werden wir insbesondere eine Brücke zwischen den Matrixgruppen und ihren Matrixalgebren in Form der Formel von Campbell, Baker und Hausdorff schlagen. Auch wenn die Literatur englischsprachig ist, sollen die Vorträge auf deutsch gehalten werden. Eine Vorbesprechung und die Themenvergabe findet in der ersten Februarhälfte statt.	Lineare Algebra 1 und 2 sowie Analysis 1 und 2	J. Stillwell, Naive Lie Theory, Springer-Verlag, 2008 (Hauptreferenz) G. Segal, Lie Groups (in R. Carter, G. Segal und I. Macdonald, Lectures on Lie Groups and Lie Algebras, Cambridge University Press, 1995 W. Fulton, J. Harris, Representation Theory, Springer-Verlag, 1991

Chemical Reaction Networks	Chemical Reaction Networks	Dingenis Roelant Michiel Renger	0	8	0	✓	The mathematical theory of chemical reaction networks is a relatively small but active field of research. We shall study two common mathematical models for chemical reactions: 1. systems of ODE's that describe the evolution of concentrations of species undergoing reactions, 2. Markov processes that describe systems of many particles undergoing random reactions. Apart from studying the relation between these two models, a strong focus will be on steady states and invariant measures (existence, (non)-uniqueness, and explicit solutions).	ODE's Markov processes	There is no textbook, so we shall study several papers (of course, we shall also go into the precise proofs). One old but great survey paper is: Anderson, Craciun, Kurtz - Product-Form Stationary Distributions for Deficiency Zero Chemical Reaction Networks
Algorithms with and for elliptic curves	Algorithms with and for elliptic curves	Lorenz Panny	2	4	4	✓	Elliptic curves play a vital role not just in cryptography, but also in computer algebra and computational number theory. In this seminar we will take a thorough look at important algorithmic results in connection with elliptic curves, which includes algorithms _for_ elliptic curves, as well as algorithms for other purposes that rely on elliptic curves as a computational tool.	- Good knowledge of groups, rings, and fields (in particular finite fields). - Good understanding of basic algorithms and essential computer-algebraic techniques. - For some topics: Familiarity with algebraic number theory (in particular imaginary-quadratic fields).	- Lawrence C. Washington, "Elliptic Curves: Number Theory and Cryptography" - Joseph H. Silverman, "The Arithmetic of Elliptic Curves" - Relevant research papers will be provided as sources for each topic.