

titel	reihe math e	angewandte mathe	lehrende	titel	bachelo r	master r	BSc-Plätze	MSc-Plätze	inhalt	voraussetzungen	literatur	informationen	email	einheit	typ	sprache
Algorithm Design – Dijkstra, Fibonacci & Co	1	1	Marcus Kaiser, Clara Waldmann	Algorithm Design – Dijkstra, Fibonacci & Co	ja	nein	12		Solving problems algorithmically is an important part of mathematics, in particular, of discrete mathematics. Designing an algorithm means breaking down an abstract task into a sequence of simple steps. A vast toolbox of techniques has been developed including divide-and-conquer, dynamic programming, and greedy algorithms. Their implementation often relies on suitable data structures. Choosing the right way to manage intermediate results and data may have a major influence on the efficiency in theory as well as in practice. One of the most prominent examples is Dijkstra's algorithm to compute a shortest path in a graph. Using a Fibonacci heap for its implementation allows to apply it to large-scale networks. Along that line, we focus on algorithmic approaches to combinatorial problems in this seminar. We will look into the interplay of algorithm design and finding and using appropriate data structures.	necessary: Algorithmische Diskrete Mathematik (MA2501)	"Algorithm Design", Jon Kleinberg, Éva Tardos and "Introduction to Algorithms", Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	More information will be available at https://www.or.tum.de/teaching/summer2020/seminaralgorithms	clara.waldmann@tum.de	1st. für Operations Research	Seminar	englisch
Berechnung hoch-oszillatorischer Integrale	1	1	Caroline Lasser	Computing Highly Oscillatory Integrals	ja	ja	6	6	Numerische Methoden zur Berechnung hoch-oszillatorischer Integrale	Solide Kenntnisse in Analysis und linearer Algebra, Grundkenntnisse in Numerik.	Computing Highly Oscillatory Integrals; Alfredo Deano, Daan Huybrechts and Arئه berles (SIAM, 2018)	https://www-m8.ma.tum.de/foswiki/pub/M8/Allgemeines/CarolineLasser/Seminar_OsCQuad_S520.pdf	lasser@ma.tum.de	M8	Seminar	deutsch
Biostatistik	0	1	Prof. Donna Ankerst	Biostatistics	nein	ja		23	In this seminar students will be introduced to contemporary biostatistics topics gaining traction to meet the challenges stemming from emerging data sources in clinical medicine and public health. Upon assignment of a topic, students will summarize the literature, and identify a leading biostatistics method and medical applications paper to present in detail. They will present these to the class as a lecture for 1 hour, followed by an open 30 minute discussion and question period, where all students will be required to actively participate. Before registering for the seminar please note the following restrictions as registration confirms acceptance of these requirements for passing the course: •Attendance to all seminar sessions is required to pass the seminar. •Students must check emails and meet deadlines set by emails. •Upon successful completion of the seminar, including attendance, the student may be eligible to write a Master's thesis with Prof. Ankerst. If so, then the thesis must be on the topic of the seminar and registered to start no later than Oct 1 2020. Interested students who accept the requirements should provide a transcript of grades along with a statement of motivation for the seminar (email text up to two paragraphs) to ankerst@tum.de for consideration of selection. Topics: 1) Multiple imputation methods for handling missing data 2) propensity score methods for performing treatment comparisons in observational data	Applied regression Generalized linear models Multivariate statistics	Biostatistical journals including Biostatistics, Biometrics, and Statistics in Medicine Medical papers from PubMed	The seminar takes place Thursdays 2:15-15:45.	ankerst@tum.de	M12	Seminar	englisch
Clifford Algebren und Clifford Analysis	1	1	PD Dr. Peter Masospust	Clifford Algebras and Clifford Analysis	nein	ja		10	This advanced seminar provides an introduction to Clifford algebras and Clifford analysis. Both are extensions of the classical theory of complex algebra and of complex functions to higher dimensions. In recent years, concepts from Clifford algebra and analysis have been applied to areas such as signal analysis and theoretical physics. In this seminar, the construction of Clifford algebras is presented as is the extension of holomorphic functions to monogenic functions via the Dirac operator. The generalization of the Cauchy integral Theorem to monogenic functions is derived. Applications to polynomial B-splines are also presented.	Analysis, linear algebra, basic algebra, complex function theory, functional analysis (recommended but not absolutely necessary)	Gürlebeck, Habermann & Sprößig: Funktionentheorie in der Ebene und im Raum. Birkhäuser Verlag, 2006 Gürlebeck & Sprößig: Quaternionic and Clifford Calculus for Physicists and Engineers. John Wiley & Sons, 1997. Ablamowicz & Sobczyk: Lectures on Clifford (Geometric) Algebras and Applications. Birkhäuser Verlag, 2004. Kantor & Solodovnikov: Hypercomplex Numbers: An Elementary Introduction to Algebras. Springer Verlag, 1989. Original research papers.	massospust@ma.tum.de	M15	Seminar	englisch	
Das Problem des Handlungsreisenden	0	1	Ulf Friedrich	The Traveling Salesperson Problem	ja	ja	4	6	We study one of the most famous problems in discrete optimization: the traveling salesperson problem (TSP). The seminar is based on classical and recent research articles. Topics of the seminar are exact and approximate algorithms for the TSP, structural properties, and (industry) applications of the TSP.	Discrete Optimization or Combinatorial Optimization	The research articles will be presented in the first meeting.	ulf.friedrich@tum.de	Operations Research (M9)	Seminar	englisch	
Der Satz über Implizite Funktionen und verwandte Theoreme	1	1	Andreas Johann	The Implicit Function Theorem and related Theorems	ja	ja	6	6	Im Zentrum dieses Seminars soll der Satz über Implizite Funktionen stehen. Neben dem klassischen Satz und Verallgemeinerungen (z.B. unter Verzicht auf Differenzierbarkeit) wollen wir uns auch mit Anwendungen dieser Theoreme beschäftigen. Für besonders Interessierte können gerne auch weiterführende Themen vergeben werden - etwa über das Moser-Nash Theorem.	Grundvorlesungen Analysis möglichst auch: Funktionalanalysis	Stephen G. Krantz and Harold R. Parks: The Implicit Function Theorem. History, Theory, and Applications, Birkhäuser 2002.	Seminartermin: Do 14:15-15:45 Uhr	johann@ma.tum.de	M6	Seminar	deutsch
Discrete Differential Geometry: Integrable Structure	1	1	Tim Hoffmann	Discrete Differential Geometry: Integrable Structure	ja	nein	10		Wir werden ausgewählte Kapitel des Buches "Discrete Differential Geometry: Integrable Structure" von Bobenko und Suris durcharbeiten.	LADS/Analysis Differentialgeometrie: Grundlagen	Alexander I. Bobenko, Yuri B. Suris, Discrete Differential Geometry: Integrable Structure, Graduate Studies in Mathematics, Vol. 98, AMS, 2008, xxiv + 404 p; hardcover ISBN-10: 0-8218-4700-7 ISBN-13: 978-0-8218-4700-8	Registration is solely possible through the lecturers and by application only: Further information including the date of the seminar overview ("Vorbesprechung") and the application procedure will be available on the course homepage soon (https://dss.in.tum.de/teaching.html).	tim.hoffmann@ma.tum.de	M10	Seminar	englisch
Economics and Computation	1	1	Prof. Dr. Felix Brandt, Christian Stricker	Economics and Computation	nein	ja		5	In recent years, there has been an increasing interest in topics at the intersection of economics and computer science, as witnessed by the continued rapid rise of research areas such as algorithmic game theory and computational social choice. This development is due to the emergence of computational networks such as the Internet as well as the need to get a grip on algorithmic questions in economics. The emphasis in this seminar lies on the independent study of classic economics papers, but also, and in particular, more recent papers from computer science. Among the topics to be covered are matching theory, mechanism design, and voting theory.	Basics of algorithms and complexity theory (P vs NP). Ideally, completed at least one of the courses "Computational Social Choice" or "Algorithmic Game Theory".	Please see the course homepage (https://dss.in.tum.de/teaching.html) or the list of papers of last year (https://go.tum.de/493086).	Registration is solely possible through the lecturers and by application only: Further information including the date of the seminar overview ("Vorbesprechung") and the application procedure will be available on the course homepage soon (https://dss.in.tum.de/teaching.html).	christian.stricker@tum.de	Decision Sciences & Systems 18	Seminar	englisch
Einführung in die Informationstheorie	0	1	Robert König	Introduction to Information Theory	ja	ja	5	5	This seminar will serve as an introduction to basic concepts of information theory. Topics to be discussed include information-theoretic quantities (entropies) and corresponding inequalities, differential entropies and continuous variables, as well as operational problems such as Shannon's noisy channel coding, data compression and rate distortion theory.	Analysis 1 & 2, Lineare Algebra 1 & 2, Einführung in die diskrete Mathematik	Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, Wiley-Interscience; 2nd edition (2006). David MacKay, Information Theory, Inference, and Learning Algorithms, Cambridge University Press; First edition (2003).	This seminar will be held in block-form at the beginning of term. Additional information: see here http://www-m5.ma.tum.de/Allgemeines/Lehrveranstaltungen	robert.koenig@tum.de	M5	Seminar	englisch

Hochdimensionale Wahrscheinlichkeitstheorie	1	1	Nina Gantert, Felix Kraemer, Stefan Bamberg	High-Dimensional Probability	ja	ja	4	8	This seminar will cover random objects in high-dimensional space. In particular, random vectors, random matrices, and random projections. We will discuss a selection of theoretical skills for the analysis of these objects, such as concentration inequalities, covering and packing arguments, decoupling and symmetrization tricks, chaining, and comparison techniques for stochastic processes.	Probability Theory and/or Probabilistic Methods and Algorithms for Data Analysis	R. Vershynin, High-Dimensional Probability - An Introduction with Applications in Data Science, Cambridge University Press	Students in the Master's program Mathematics in Data Science are also eligible; they will be required to give an extended presentation. The seminar will be held in blocks of multiple talks on Friday afternoons.	felix.kraemer@tum.de	M14, M15	Seminar	englisch
Innovationen in Risiko-, Performance- und Investimentmanagement	0	1	Prof. Dr. Rudi Zagst	Innovations in Risk, Performance, and Investment Management	nein	ja		6	This seminar is based upon a list of papers on different areas of risk, performance, and investment management. Each participant presents one of the selected papers and discusses subsequent developments in the respective field. This provides a broad overview to all participants on the different fields, recent aspects, and historical development of the topics.	Continuous Time Finance MA3702, Fixed Income Markets MA3703 (recommended), Investment Strategies MA3709 (recommended)	Papers will be presented at the preliminary meeting to the seminar (Seminarvorbereitung). The date of the preliminary meeting will be announced at https://www.groups.ma.tum.de/en/mathfin/nice/lehre/summer-term-2020/		min@tum.de	M13	Seminar	englisch
Kausale Inferenz	0	1	Claudia Crado, Mathias Drton	Causal Inference	nein	ja		10	Classical Statistics warns that correlation does not imply causation, yet inferring cause-effect relationships is the fundamental goal of many scientific studies. This seminar gives an introduction to formal statistical modeling of cause-effect relationships and methods for their inference from data. To this end the participants will present chapters from a forthcoming textbook.	Probability Theory, Basic Statistics. Please provide a CV and a list of courses in statistics and probability you passed.	Hernan MA, Robins JM (2020). Causal Inference: What If. Boca Raton: Chapman & Hall/CRC. Available at https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/ Issues will be on https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/	Preliminary meeting in early February 2020.	mathias.drton@tum.de	Mathematical Statistics (M4)	Seminar	englisch
Mathematik der Data Science	0	1	Massimo Fornasier and Peter Massopust	Mathematics of Data Science	nein	ja		10	Machine learning is about parametric nonlinear algorithms, whose parameters are optimized towards several tasks such as feature selection, dimensionality reduction, clustering, classification, regression, generation. We review the most important methods for these tasks by reading established and most recent scientific literature on the topics.	Foundations of Data Analysis Probabilistic Methods and Algorithms of Data Analysis	Samples of literature: Dimensionality reduction: Fornasier M., Raufut H. (2011) Compressive Sensing. In: Scherzer O. (eds) Handbook of Mathematical Methods in Imaging. Springer, New York, NY https://people.riceam.oeaw.ac.at/m.fornasier/CSFornasierRaufut.pdf Clustering (k-means etc.): Awasthi, Pranjali & Bandeira, Afonso & Charikar, Moses & Krishnaswamy, Ravishankar & Villar, Soledad & Ward, Rachel. (2014). Relax, No Need to Round: Integrality of Clustering Formulations. 10.1145/2688073.2688116 https://arxiv.org/pdf/1408.4045.pdf Nonconvex optimization: Jos e A Carrillo, Young-Pil Choi, Claudia Totzek, and Oliver Tse. An Analytical Framework for consensus based global optimization method. Mathematical Models and Methods in Applied Sciences, Nonconvex optimization: Jos e A Carrillo, Young-Pil Choi, Claudia Totzek, and Oliver Tse. An Analytical Framework for consensus based global optimization method. Mathematical Models and Methods in Applied Sciences,		massimo.fornasier@ma.tum.de	M15	Seminar	englisch
Mathematische Modellierung infektiöser und nicht-infektiöser Krankheiten	0	1	Christina Kuttler	Mathematical Modeling of Infectious and Non-Infectious Diseases	ja	ja	6	5	In earlier times, infectious diseases were big threats to human population. Antibiotics helped to control some of these diseases, but not all; additionally more and more resistances against classical antibiotics develop. Thus, a better, quantitative understanding of infection and the spread of epidemics, helps to decide for or against certain treatment strategies, also how to optimise treatments. Often, the dynamic behaviour for whole populations is described by differential equation models. PDEs allow e.g. for considering spatial models. For small populations, stochastic models may be more appropriate. We will discuss typical modelling approaches including their analysis as well as concrete examples for diseases and how to set up appropriate models.	Mathematical models in Biology, Knowledge in Ordinary differential equations	This seminar will be based on original papers as well as on parts of the books "Modeling to Inform Infectious Disease Control" by Nels G. Becker and "Mathematical Epidemiology" edited by Fred Brauer, Pauline van den Driessche and Jianhong Wu, dependent on the interests and previous knowledge of the participants.	Further organisation, e.g. choice of preferred topic for the talk etc. will be done after the group of participants is fixed. Questions are always welcome!	kuttler@ma.tum.de	M6	Seminar	englisch
Matrix Analysis	1	1	Robert König	Matrix Analysis	ja	ja	4	4	We will discuss a selection of classical and more recent results of matrix analysis. Relevant topics include matrix norms, functional calculus, matrix monotone functions and convexity, matrix inequalities, majorization, matrix polynomials and polynomial identities, complete positivity, eigenvalues and Horn's conjecture.	Linear Algebra 2 (MA1102)	R. Bhatia "Matrix Analysis" (Springer) and "Positive Definite Matrices" (Princeton). A. Horn and C. Johnson "Matrix Analysis" (Cambridge University Press) Additional literature: TBA.	The seminar will be held in block-form at the beginning of term. For additional information: see https://www-m5.ma.tum.de/Allgemeines/Lehrveranstaltungen	robert.koenig@tum.de	M5	Seminar	englisch
Mengenlehre	1	1	Oliver Deiser	Set Theory	ja	ja	6	6	Mengenbegriff, Mächtigkeiten und Kardinalzahlen, Wohlordnungen und Ordinalzahlen, Axiome der Mengenlehre und mengentheoretische Axiomatik, Auswahlaxiom und äquivalente Prinzipien, Kontinuumsproblem, Grundlagen der deskriptiven Mengenlehre	Grundvorlesungen in Mathematik (Analysis und Lineare Algebra)	Oliver Deiser: Einführung in die Mengenlehre Thomas Jech: Set Theory		deiser@tum.de	M8	Seminar	deutsch
Mengenorientierte Numerik: Auf dem Weg zu GAIO, II	0	1	Oliver Junge	Set Oriented Numerics: Towards GAIO, II	nein	ja		13	The seminar continues the lecture on Set Oriented Numerics from the winter semester 19/20. The goal of the seminar will be to develop a Julia implementation of the GAIO software package. To this end, group discussions will be combined with a collaborative software development on gitlab. Each participant will be responsible for one particular aspect of the package, but everybody will be able to contribute to all parts. The seminar will be concluded by a little workshop where everybody gives a brief talk about his contributions.	MA 3333 Numerics of Dynamical Systems	Delintz, M.; Froyland, G.; Junge, O.: The algorithms behind GAIO - Set oriented numerical methods for dynamical systems, In: B. Fiedler (ed.): Ergodic theory, analysis, and efficient simulation of dynamical systems, Springer, 2001. Delintz, M.; Jun	preliminary discussion: 7.2.20, 10.00, room T.b.a.	oj@tum.de	M3	Seminar	englisch
Paradoxien	1	1	Prof. Dr. Peter Gritzmann	Paradoxes	ja	nein	12	0	Die Vortragenden stellen verschiedene Paradoxien (aus Bereichen wie Wahlverfahren, Verkehrsplanung, Statistik) vor und analysieren diese. Das Seminar verfolgt ein innovatives Konzept: Literaturswahl, Fixierungs- und Vorbereitungsworkshop eingeschlossen.			Vorbereitung: 24.02.2020, 16 Uhr, Glaskasten M9 (Adobe-Raum). Teilnahme unbedingt erforderlich, da das Konzept ausführlich besprochen werden soll.	gritzmann@tum.de	M9	Seminar	deutsch
Prozesse mit Verstärkung	1	1	Silke Rolles	Processes with Reinforcement	ja	ja	6	6	Stochastic processes with reinforcement are a very active area of research. The literature on this subject has been growing tremendously during the past 20 years. In the seminar, we will have a look at various important models. These include urn models, edge-reinforced random walks, vertex-reinforced random walk, processes in discrete and in continuous time. The common feature are random transition probabilities. They can change over time or they can be sampled before the motion starts. This exciting subject gives many opportunities to write a bachelor's or master's thesis.	Probability theory (MA2409) and interest in the subject.	see http://www-m5.ma.tum.de/Allgemeines/MA6015_2020S	see http://www-m5.ma.tum.de/Allgemeines/MA6015_2020S Depending on the wishes of the participants the talks will be in English or German.	srolles@ma.tum.de	M5	Seminar	englisch

Quantum Computing	0	1	Volker Hölzel, Johannes Müller	Quantum Computing	ja	nein	10	<p>In der Presse werden Quantencomputer entweder als omnipotent beschrieben, als entscheidende Hilfsmittel, die Medizin, Gesellschaft, und Technik in ungeahnter Weise voranbringen könnten, oder aber als Hype und völliger Unsinn, als ein Spielzeug der Physiker ohne praktischen Nutzen[1].</p> <p>Spätestens die Presseerklärung von GOOGLE, dass die "Quantenüberlegenheit" erreicht sei - also ein Problem gelöst wurde, das mit herkömmlichen Computern nicht in überschaubaren Zeiträumen gelöst werden könnte (was einige Tage darauf von IBM bezweifelt wurde), deutet an, dass sich Quantencomputer für relevante Anwendungen nutzen lassen [1].</p> <p>In diesem Seminar werden wir weder die physikalische Basis von Quantencomputern diskutieren, noch die Kontroverse von GOOGLE und IBM aufgreifen, ob die Quantenüberlegenheit tatsächlich erreicht wurde.</p> <p>In diesem Seminar wollen wir uns auf der Basis des Buches "Hofmeister, Quantum Computing verstehen" [3] die mathematische Grundlage der Quantencomputer ansehen, und lernen wie Quantenalgorithmen aussehen.</p> <p>Im Rahmen des Seminars wollen wir verstehen, was wir tatsächlich von Quantencomputern zu erwarten haben, wo ihre Stärke liegt, und welche Probleme für Quantum Computing völlig ungeeignet sind.</p>	Grundlagenvorlesungen.	<p>[1] F. Ature et al. Quantum supremacy using a programmable superconducting processor, Nature 574(2019), 505-510.</p> <p>[2] http://backreaction.blogspot.com/2019/06/quantum-supremacy-what-is-it-and-what.html</p> <p>[3] Mathias Hofmeister Quantum Computing verstehen Springer Vieweg, 2005</p>	<p>Lieber Hans Peter, es wäre schön, wenn das Seminar wieder am Mo oder Fr stattfinden könnte;</p> <p>Herr Hölzel muss eventuell wieder pendeln. Falls sich da etwas verschiebt, so melden wir uns sobald als möglich.</p> <p>Viele Grüße Johannes</p>	johannes.mueller@mytum.de	M12	Seminar	deutsch
Selbstinteragierende Irrfahrten	1	1	Noam Berger	Self Interacting Random Walks	ja	ja	4	<p>Self-interacting random walks are non-markovian models of random walks. They were designed in order to find models that better describe real-world phenomena than the simple random walk does. The analysis of those models required the development of a beautiful and sophisticated methodology, part of which we will discuss in the seminar.</p> <p>The models that we discuss in the seminar include the self-avoiding random walk, the reinforced random walk, the exited random walk, and a few other models.</p>	Probability Theory or equivalent (necessary)	We will work through several papers from the last two decades.	The seminar will take place in english.	noam.berger@tum.de	M14	Seminar	englisch