
Tame Topology and *O*-Minimal Structures

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I first want to thank Professor Brown for his kind introduction. My goal is to give everyone a sense of the subject of *o*-minimality. Ten hours is a lot of time to lecture, but the literature on this topic has grown vast, so I will ignore a lot of things in order to get at issues relevant for this audience. I confess that this is the first time I have spoken to economists.

I want to start with an outline of the talks. The topic is tame topology and *o*-minimal structures, but today I'm not going to tell you what either one really is. Today I'm going to give you a sense of what's important so that you can understand things better in my subsequent lectures.

Outline of Lectures

1. An introduction to definability and quantifier elimination
2. The semialgebraic case
3. *O*-minimality and some basic properties
4. Examples and some further properties
5. VC dimension and applications

1 An Introduction to Definability

For which x do we have

$$\exists y \begin{bmatrix} ax + by > e_1 \\ cx + dy \leq e_2 \end{bmatrix} \quad (*)$$

where $a, b, c, d, e_1, e_2 \in \mathbb{R}$? We want to know

$$\{x \in \mathbb{R} \mid \text{statement (1) holds for } x\}.$$

We also can replace the constants a, b, c, d, e_1, e_2 by variables u, v, w, z, s_1, s_2 and ask for which $u, v, w, z, s_1, s_2 \in \mathbb{R}$ do we have

Tame Topology And O Minimal Structures

**Alberto Bemporad, Antonio
Bicchi, Giorgio C Buttazzo**



Tame Topology And O Minimal Structures:

Tame Topology and O-minimal Structures Lou Van den Dries, 1998-05-07 These notes give a self contained treatment of the theory of o minimal structures from a geometric and topological viewpoint assuming only rudimentary algebra and analysis This book should be of interest to model theorists analytic geometers and topologists Tame Topology and O-minimal Structures L. P. D. van den Dries, 1998 These notes give a self contained treatment of the theory of o minimal structures O-minimal Structures Mário J. Edmundo, 2005 *Lecture Notes on O-Minimal Structures and Real Analytic Geometry* Chris Miller, Jean-Philippe Rolin, Patrick Speissegger, 2012-09-14 This volume was produced in conjunction with the Thematic Program in o Minimal Structures and Real Analytic Geometry held from January to June of 2009 at the Fields Institute Five of the six contributions consist of notes from graduate courses associated with the program Felipe Cano on a new proof of resolution of singularities for planar analytic vector fields Chris Miller on o minimality and Hardy fields Jean Philippe Rolin on the construction of o minimal structures from quasianalytic classes Fernando Sanz on non oscillatory trajectories of vector fields and Patrick Speissegger on pfaffian sets The sixth contribution by Antongiulio Fornasiero and Tamara Servi is an adaptation to the nonstandard setting of A J Wilkie s construction of o minimal structures from infinitely differentiable functions Most of this material is either unavailable elsewhere or spread across many different sources such as research papers conference proceedings and PhD theses This book will be a useful tool for graduate students or researchers from related fields who want to learn about expansions of o minimal structures by solutions or images thereof of definable systems of differential equations , Computational Aspects of General Equilibrium Theory Donald Brown, Felix Kubler, 2008-01-08 This monograph presents a general equilibrium methodology for microeconomic policy analysis It is intended to serve as an alternative to the now classical axiomatic general equilibrium theory as expounded in Debreu s Theory of Value 1959 or Arrow and Hahn s General Competitive Analysis 1971 The monograph consists of several essays written over the last decade It also contains an appendix by Charles Steinhorn on the elements of O minimal structures **Ordered Exponential Fields** Salma Kuhlmann, 2000 Model theoretic algebra has witnessed remarkable progress in the last few years It has found profound applications in other areas of mathematics notably in algebraic geometry and in singularity theory Since Wilkie s results on the o minimality of the expansion of the reals by the exponential function and most recently even by all Pfaffian functions the study of o minimal expansions of the reals has become a fascinating topic The quest for analogies between the semi algebraic case and the o minimal case has set a direction to this research Through the Artin Schreier Theory of real closed fields the structure of the non archimedean models in the semi algebraic case is well understood For the o minimal case so far there has been no systematic study of the non archimedean models The goal of this monograph is to serve this purpose The author presents a detailed description of the non archimedean models of the elementary theory of certain o minimal expansions of the reals in which the exponential function is definable The example of exponential Hardy

fields is worked out with particular emphasis The basic tool is valuation theory and a sufficient amount of background material on orderings and valuations is presented for the convenience of the reader

Hybrid Systems: Computation and Control Frits W. Vaandrager, Jan H. van Schuppen, 2003-05-21 This volume contains the proceedings of the Second International Workshop on Hybrid Systems Computation and Control HSCC 99 to be held March 29 31 1999 in the village Berg en Dal near Nijmegen The Netherlands The first workshop of this series was held in April 1998 at the University of California at Berkeley The series follows meetings that were initiated by Anil Nerode at Cornell University The proceedings of those meetings were published in the Springer Verlag LNCS Series Volumes 736 999 1066 1201 and 1273 The proceedings of the first workshop of the new series was published in LNCS 1386 The focus of the workshop is on modeling control synthesis design and verification of hybrid systems A hybrid system is a theoretical model for a computer controlled engineering system with a dynamics that evolves both in a discrete state set and in a family of continuous state spaces Research is motivated by for example control of electro mechanical systems robots air traffic control control of automated freeways and chemical process control The emerging search area of hybrid systems overlaps both with computer science and with control theory The interaction between researchers from these fields is expected to be fruitful for the development of the area of hybrid systems

Logic Colloquium 2005 Costas Dimitracopoulos, Ludomir Newelski, Dag Normann, John R. Steel, 2007-12-03 The Annual European Meeting of the Association for Symbolic Logic generally known as the Logic Colloquium is the most prestigious annual meeting in the field Many of the papers presented there are invited surveys of developments and the rest of the papers are chosen to complement the invited talks This 2007 volume includes surveys tutorials and selected research papers from the 2005 meeting Highlights include three papers on different aspects of connections between model theory and algebra a survey of major advances in combinatorial set theory a tutorial on proof theory and modal logic and a description of Bernays' philosophy of mathematics

Models and Computability S. Barry Cooper, John K. Truss, Association for Symbolic Logic, 1999-06-17 Second of two volumes providing a comprehensive guide to the current state of mathematical logic

A Guide to Classical and Modern Model Theory Annalisa Marcja, Carlo Toffalori, 2012-09-10 Since its birth Model Theory has been developing a number of methods and concepts that have their intrinsic relevance but also provide fruitful and notable applications in various fields of Mathematics It is a lively and fertile research area which deserves the attention of the mathematical world This volume is easily accessible to young people and mathematicians unfamiliar with logic gives a terse historical picture of Model Theory introduces the latest developments in the area provides hands on proofs of elimination of quantifiers elimination of imaginaries and other relevant matters A Guide to Classical and Modern Model Theory is for trainees and professional model theorists mathematicians working in Algebra and Geometry and young people with a basic knowledge of logic

Finite and Algorithmic Model Theory Javier Esparza, Christian Michaux, Charles Steinhorn, 2011-03-10 Surveys of current research in logical aspects of computer science

that apply finite and infinite model theoretic methods Hybrid Systems: Computation and Control Alberto Bemporad, Antonio Bicchi, Giorgio C Buttazzo, 2007-03-20 This book constitutes the refereed proceedings of the 10th International Conference on Hybrid Systems Computation and Control HSCC 2007 held in Pisa Italy in April 2007 The 44 revised full papers and 39 revised short papers presented together with the abstracts of 3 keynote talks were carefully reviewed and selected from 167 submissions Among the topics addressed are models of heterogeneous systems computability and complexity issues real time computing and control embedded and resource aware control control and estimation over wireless networks tools for analysis verification control and design programming languages support and implementation applications including automotive communication networks avionics energy systems transportation networks biology and other sciences manufacturing and robotics Geometry, Topology, and Mathematical Physics V. M. Buchstaber, Sergei Petrovich Novikov, I. M. Krichever, 2004 The second half of the 20th century and its conclusion crisis in the physics and mathematics community in Russia and in the West Interview with Sergey P Novikov The w function of the KdV hierarchy On the zeta functions of a meromorphic germ in two variables On almost duality for Frobenius manifolds Finitely presented semigroups in knot theory Oriented case Topological robotics subspace arrangements and collision free motion planning The initial boundary value problem on the interval for the nonlinear Schrödinger equation The algebro geometric approach I On odd Laplace operators II From 2D Toda hierarchy to conformal maps for domains of the Riemann sphere Integrable chains on algebraic curves Fifteen years of KAM for PDE Graded filiform Lie algebras and symplectic nilmanifolds Adiabatic limit in the Seiberg Witten equations Affine Krichever Novikov algebras their representations and applications Tame integrals of motion and o minimal structures **Introduction to Lipschitz Geometry of Singularities** Walter Neumann, Anne Pichon, 2021-01-11 This book presents a broad overview of the important recent progress which led to the emergence of new ideas in Lipschitz geometry and singularities and started to build bridges to several major areas of singularity theory Providing all the necessary background in a series of introductory lectures it also contains Pham and Teissier's previously unpublished pioneering work on the Lipschitz classification of germs of plane complex algebraic curves While a real or complex algebraic variety is topologically locally conical it is in general not metrically conical there are parts of its link with non trivial topology which shrink faster than linearly when approaching the special point The essence of the Lipschitz geometry of singularities is captured by the problem of building classifications of the germs up to local bi Lipschitz homeomorphism The Lipschitz geometry of a singular space germ is then its equivalence class in this category The book is aimed at graduate students and researchers from other fields of geometry who are interested in studying the multiple open questions offered by this new subject **Andrzej Mostowski and Foundational Studies** A. Ehrenfeucht, Andrzej Ehrenfeucht, V.W. Marek, M. Srebrny, 2008-03-06 Andrzej Mostowski was one of the leading 20th century logicians This volume examines his legacy devoted both to his scientific heritage and to the memory of him as a great researcher teacher

organizer of science and person It includes the bibliography of Mostowski's writings *Modern Applications of Automata Theory* Deepak D'Souza, Priti Shankar, 2012 Automata theory has come into prominence in recent years with a plethora of applications in fields ranging from verification to XML processing and file compression In fact the 2007 Turing Award was awarded to Clarke Emerson and Sifakis for their pioneering work on model checking techniques To the best of our knowledge there is no single book that covers the vast range of applications of automata theory targeted at a mature student audience This book is intended to fill that gap and can be used as an intermediate level textbook It begins with a detailed treatment of foundational material not normally covered in a beginner's course in automata theory and then rapidly moves on to applications The book is largely devoted to verification and model checking and contains material that is at the cutting edge of verification technology It will be an invaluable reference for software practitioners working in this area Model Theory, Algebra, and Geometry Deirdre Haskell, Anand Pillay, Charles Steinhorn, 2000-07-03 Model theory has made substantial contributions to semialgebraic subanalytic p -adic rigid and diophantine geometry These applications range from a proof of the rationality of certain Poincare series associated to varieties over p -adic fields to a proof of the Mordell Lang conjecture for function fields in positive characteristic In some cases such as the latter it is the most abstract aspects of model theory which are relevant This book originally published in 2000 arising from a series of introductory lectures for graduate students provides the necessary background to understanding both the model theory and the mathematics behind these applications The book is unique in that the whole spectrum of contemporary model theory stability simplicity o minimality and variations is covered and diverse areas of geometry algebraic diophantine real analytic p -adic and rigid are introduced and discussed all by leading experts in their fields *Logical Approaches to Computational Barriers* Arnold Beckmann, 2006-06-26 This book constitutes the refereed proceedings of the Second International Conference on Computability in Europe CiE 2006 held in Swansea UK June July 2006 The book presents 31 revised full papers together with 30 invited papers including papers corresponding to 8 plenary talks and 6 special sessions on proofs and computation computable analysis challenges in complexity foundations of programming mathematical models of computers and hypercomputers and G del centenary G del's legacy for computability **Valuation Theory and Its Applications** Franz-Viktor Kuhlmann, Salma Kuhlmann, Murray Marshall, This book is the second of two proceedings volumes stemming from the International Conference and Workshop on Valuation Theory held at the University of Saskatchewan Saskatoon SK Canada It contains the most recent applications of valuation theory to a broad range of mathematical ideas Valuation theory arose in the early part of the twentieth century in connection with number theory and continues to have many important applications to algebra geometry and analysis The research and survey papers in this volume cover a variety of topics including Galois theory the Grunwald Wang Theorem algebraic geometry resolution of singularities curves over Prufer domains model theory of valued fields and the Frobenius Hardy fields Hensel's Lemma fixed point theorems and

computations in valued fields It is suitable for graduate students and research mathematicians interested in algebra algebraic geometry number theory and mathematical logic

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