Preface

This is a book about doing model theory without an underlying logical system. It teaches us how to live without concrete models, sentences, satisfaction and so on. Our approach is based upon the theory of institutions, which has witnessed a vigorous and systematic development over the past two decades and which provides an ideal framework for true abstract model theory. The concept of institution formalizes the intuitive notion of logical system into a mathematical object. Thus our model theory without underlying logical systems and based upon institution theory may be called 'institution-independent model theory'.

Institution-independent model theory has several advantages. One is its generality, since it can be easily applied to a multitude of logical systems, conventional or less conventional, many of the latter kind getting a proper model theory for the first time through this approach. This is important especially in the context of the recent high proliferation of logics in computing science, especially in the area of formal specification. Then there is the advantage of illuminating the model theoretic phenomena and its subtle network of causality relationships, thus leading to a deeper understanding which produces new fundamental insights and results even in well worked traditional areas of model theory.

In this way we study well established topics in model theory but also some newly emerged important topics. The former category includes methods (in fact much of model theory can be regarded as a collection of sometimes overlapping methods) such as (elementary) diagrams, ultraproducts, saturated models and studies about preservation, axiomatizability, interpolation, definability, and possible worlds semantics. The latter category includes methods of doing model theory 'by translation', and Grothendieck institutions, which is a recent successful model theoretic framework for multi-logic heterogeneous environments. The last two chapters (14 and 15) digress from the main topic of the book in that they present some applications of institution-independent model theory to specification and programming and Chap. 13 shows how to integrate proof theoretic concepts to institution-independent model theory (including a general approach to completeness).

This book is far from being a complete encyclopedia of institution-independent model theory. While several important concepts and results have not been treated here, we believe they can be approached successfully with institutions in the style promoted by our work. Most of all, this book shows *how* to do things rather than provides an exhaustive

account of all model theory that can be done institution-independently. It can be used by any working user of model theory but also as a resource for learning model theory.

From the philosophical viewpoint, the institution-independent approach to model theory is based upon a non-essentialist, groundless, perspective on logic and model theory, directly influenced by the doctrine of *śunyata* of the Madhyamaka Prasangika school within Mahayana Buddhism. The interested reader may find more about this connection in the essay [54]. This has been developed mainly at Nalanda monastic university about 2000 years ago by Arya Nāgārjuna and its successors and has been continued to our days by all traditions of Tibetan Buddhism. The relationship between Madhyamaka Prasangika thinking and various branches of modern science is surveyed in [176].

I am grateful to a number of people who supported in various ways the project of institution-independent model theory in general and the writing of this book in particular. I was extremely fortunate to be first the student and later a close friend and collaborator of late Professor Joseph Goguen who together with Rod Burstall introduced institutions. He strongly influenced this work in many ways and at many levels, from philosophical to technical aspects, and was one of the greatest promoters of the non-essentialist approach to science. Andrzej Tarlecki was the true pioneer of doing model theory in an abstract institutional setting. Till Mossakowski made a lot of useful comments on several preliminary drafts of this book and supported this activity in many other ways too. Grigore Roşu and Marc Aiguier made valuable contributions to this area. Lutz Schröder made several comments and gave some useful suggestions. Achim Blumensath read very carefully a preliminary draft of this book and helped to correct a series of errors. I am indebted to Hans-Jürgen Hoenhke for encouragement and managerial support. Special thanks go to the former students of the Informatics Department of "Şcoala Normală Superioară" of Bucharest, namely Marius Petria, Daniel Găină, Andrei Popescu, Mihai Codescu, Traian Şerbănuţă and Cristian Cucu. They started as patient students of institution-independent model theory only to become important contributors to this area. Finally, Jean-Yves Béziau greatly supported the publication and dissemination of this book. I acknowledge financial support for writing this book from the CNCSIS grants GR202/2006 and GR54/2007.

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December 2007