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J. G. Williams

Instantiation Theory

On the Foundations of Automated Deduction

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PREFACE

Instantiation theory is the study of instantiation in an abstract context that is applicable to most commonly studied logical formalisms. This book begins with a survey of general approaches to the study of instantiation, as found in tree systems, order-sorted algebras, algebraic theories, composita, and *instantiation systems.*

A classification of instantiation systems is given, based on properties of substitutions, degree of type strictness, and well-foundedness of terms. Equational theories and the use of typed variables are studied in terms of quotient homomorphisms and embeddings, respectively. Every instantiation system is a quotient system of a subsystem of first-order term instantiation.

A general unification algorithm is developed as an application of the basic theory. Its soundness is rigorously proved, and its completeness and efficiency are verified for certain classes of instantiation systems. Appropriate applications of the algorithm include unification of first-order terms, order-sorted terms, and first-order formulas modulo α-conversion, as well as equational unification using simple congruences.

I am indebted to William Farmer for acquainting me with the literature on unification algorithms, for help in formulating the basic theory, and for valuable advice regarding its development. I also wish to thank Hans-Jürgen Bürckert, Dale Johnson, John Stell, and an anonymous referee for valuable feedback on its presentation. This work was sponsored by the Rome Laboratories, Griffiss Air Force Base, Rome, NY 13441, under the direction of John C. Faust, COAC.

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TABLE OF CONTENTS