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Bob Carpenter
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THE LOGIC OF TYPED FEATURE STRUCTURES

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Bob Carpenter
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More information

Contents

Acknowledgments vii

1. Introduction 1

I. BASICS

2. Types and Inheritance 11
Type Inheritance Hierarchies 11
Constructing Inheritance Hierarchies 17

3. Feature Structures 33
Feature Structures 36
Subsumption 40
Abstract Feature Structures 43
Unification 45

4. Attribute-Value Descriptions and Satisfaction 51
Description Language 52
Satisfaction 53
Proof Theory 60

II. EXTENSIONS

5. Acyclic Feature Structures 73

6. Appropriateness and Typing 77
Appropriateness 85
Well-Typed Feature Structures 88
Totally Well-Typed Feature Structures 94
Static Typing 104

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Bob Carpenter
Frontmatter
More information

7. Inequations 109
Inequations and Negation 109
Inequated Feature Structures 112
Fully Inequated Feature Structures 117

8. Identity and Extensionality 124
Identity in Feature Structures 124
Extensionality 126
Collapsing 135

9. Maximality, Groundedness, and Closed World Inference 139

III. ALTERNATIVES

10. Variables and Assignments 151

11. Feature Algebras 160

12. Infinite Feature Structures and Domains 167

IV. APPLICATIONS

13. Unification-Based Phrase Structure Grammars 185
Unification Phrase Structure Grammars 188
Rewriting 196
Tree Admissibility 198
Denotational Semantics 204
Top-Down and Bottom-Up Evaluation 206

14. Definite Clause Programming 215
Definite Clause Programs 217
Forward Chaining and Program Meaning 219
Backward Chaining and Program Operation 222

15. Recursive Type Constraints 227
Type Constraint Systems 228
Queries and π-Resolution 230
Phrase Structure with Constraints 234
Junk Slots, Definite Constraints, and Parsing 238
Domains and Infinite Solutions 242

Bibliography 245

Index of Symbols 259

Index 263

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Acknowledgments

This project could not have been completed without the encouragement, enthusiasm, and careful eye for detail of Carl Pollard. He not only contributed valuable insights and references so that I could absorb the state of the art on feature structures, but also provided feedback and comments on the original results reported here as they were developing. Almost all of the innovations presented here were directly inspired by the HPSG grammar formalism of Pollard and Sag (1987). Most of the well known and published results concerning feature structures came out of two projects: the PATR-II project at SRI international, with contributions by Lauri Karttunen, Fernando Pereira, and Stu Shieber, and by the group at the University of Michigan including Bob Kasper, Drew Moshier, and Bill Rounds. The basic approach and some of the more sophisticated results and techniques upon which this work was based were developed by Carl Pollard and Drew Moshier. Another major source of inspiration was the work of Gert Smolka (1988, 1989), in particular with respect to the connections between feature algebras and feature structures.

An early source of inspiration was the Unification Categorial Grammar project at the University of Edinburgh, involving Ewan Klein, Mike Reape, Jo Calder, and Henk Zeevat. It was in the context of this project, and in Ewan Klein's introduction to GPSG, that I was first exposed to feature structures. An unpublished paper by Mike Reape was partially responsible for the treatment of extensionality, and Jo Calder's development of typed feature structures was always in the back of my mind.

This research has also benefited from presentations at the International Workshop on Inheritance in Natural Language Processing hosted by the University of Tilburg, at Carnegie Mellon University, at the Second International Workshop on Parsing Technology in Cancun and at the 29th Association for Computationl Linguistics meeting in Berkeley. The first draft of this monograph was provided for students at the Second European Summer School for Language, Logic and Information at Leuven. It was this group that made me realize that the audience for results in the theory of feature structures was much larger than I had previously imagined, and cemented my resolve to finish this monograph sooner rather than later. In particular, some comments of Gert Smolka's during the Summer School led me to change the way in which I

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thought of his and Mark Johnson's work. This in turn led to a general rewriting of all of the criticisms and comparisons between the logical/algebraic approach and the feature-structure-based approaches. I now hope that this monograph can help to reconcile some of the apparent differences between the algebraic, logical and graph-based approaches. It was Gert Smolka who first demonstrated the connection between the two approaches, bringing with it a view of feature structures as representations of normal-form descriptions.

I originally began thinking about inheritance while working with Rich Thomason at the University of Pittsburgh. It was with his encouragement that I tried to work out connections between knowledge representation formalisms and unification-based linguistic grammar formalisms. Unfortunately, many of the comparisons and contrasts between the inheritance-based feature structure logics presented here and terminological knowledge representation systems such as KL-ONE still remain unclear. Hopefully, this avenue of exploration can be taken up in the future by myself and others. Another task waiting in the wings is the integration of non-monotonic inheritance into the feature structure framework. Recently, foundational work on non-monotonic inheritance has progressed enormously, in part due to the work of the NSF funded LINKUP project involving Dave Touretzky at Carnegie Mellon University, Rich Thomason at the University of Pittsburgh, and Jeff Horty at the University of Maryland.

The ideas presented here originally developed in the context of an HPSG interest group at Carnegie Mellon University consisting of myself, Carl Pollard, Alex Franz, Sondra Ahlèn, and Andreas Kathol. Many fruitful discussions took place among various subsets of this group, and during these meetings we forced ourselves to clarify issues and come up with concrete proposals. Many of our false starts, negative results, and alternative proposals are not reported here for the sake of readability, continuity, and conciseness.

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