AUTOMATED REASONING WITH SITUATION THEORY:

A NOVEL APPROACH TO BELIEFS AND PERCEPTION

by

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Submitted to the Department of Computer Science and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Science.

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Abstract

The central claim of this thesis is that situation theory is superior to classical logic as a foundation for knowledge representation in artificial intelligence.

This claim is elaborated by the following hypotheses:

1) A version of situation theory can be defined which has a characterizing logic (an "infon" logic) similar in form and expressivity to classical first order logic.

2) There is a semi-decision procedure for this new infon logic, and a theorem prover can be devised which implements it. Further, many of the techniques of automated theorem proving developed for classical logic can be applied to automated theorem proving in this new infon logic.

3) This new version of situation theory and the associated theorem prover is appropriate as a knowledge representation and reasoning system for theories of perception and belief.

4) Theories of perception and belief as defined by their embeddings in the new version of situation theory provide a better account of human reasoning than classical logic-based computational approaches to perception and belief.

The first three hypotheses are proved in this thesis. Also, arguments in favor of the fourth hypothesis are presented.

Novel contributions in pursuit of this research include the following:

A new "infon" logic is developed for a new version of situation theory,

Theories of perception and belief are formalized in this new situation theory using the new logic,

A theorem prover is developed which reasons in both classical and infon logic modes and which reasons in and across multiple intensional contexts of intensional relations (such as belief and support).

Acknowledgments

I would like to acknowledge the many helpful discussions on logic, intuitionism and situation theory with Dr. Arthur Skidmore. Dr. Frank Brown and Dr. Costas Tsatsoulis helped to focus the research on which this thesis reports. This thesis would not have been possible without the constant encouragement provided by my wife, Dr. Kim Roddis. Also, her editorial comments have made this thesis much more readable than it would otherwise have been.

List of Exhibits