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A semantical study of orthologics

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Abstract

In this thesis, we investigate a type of non-classical logics from a semantical point of view. We deal with non-classical propositional logics around orthologics, and the minimum predicate extensions of some of them.

Every propositional logic we consider here is introduced so as to be characterized by a variety of algebras, and so there exists a variety of algebras that corresponds to each propositional logic. Therefore, some properties of a variety of algebras reflects on some properties of its corresponding propositional logic.

One of the topics we focus on in this thesis is the admissibility of completion of a class of algebras. There are mainly two ways of embedding an algebra into a complete one, that is, the Dedekind-MacNeille completion technique and the method via dual space construction. The first can be used when we consider an algebraic semantics of the minimum predicate extension of propositional logics and we establish the completeness theorem with respect to that semantics, because the embedding map preserves all existing joins and meets in this technique. This argument goes through for a few members of our group of logics. Indeed, we can show that their corresponding varieties of algebras admit completion by Dedekind-MacNeille completion technique, which also enables us to discuss the minimum predicate extensions of these logics. On the other hand, the second method is employed when we construct a relational semantics of a propositional logic. In fact, for some of our logics, we will build their relational semantics by using this completion method, and we will show the completeness with respect to these semantics.

Furthermore, by modifying the above completion techniques a little bit, we can prove that some members of our varieties have an algebraic property, which implies that the propositional logics that correspond to them and their minimum predicate extensions have the Craig's interpolation property.

The other topic in this thesis is the construction of a semantics of orthomodular logics. Since we can not take suitable dual spaces for orthomodular lattices, there does not exist a set-theoretic representation theorem for them which is convenient for semantics of orthomodular logics. Here we use a different representation theorem for orthomodular lattices, which is not set-theoretic, to construct Kripke-style semantics for orthomodular logics. This semantics consists of a non-empty set with some operations, instead of some relations. We show that any orthomodular logic is complete with respect to a semantics

of this kind, and moreover, we discuss the infinitary extension of orthomodular logics by using this semantics.

Key Words: orthologic, orthomodular logic, completion technique, super amalgamation property, interpolation property, Kripke-style semantics