SOLVING "ALL-SOLUTION" PROBLEMS BY ET-BASED GENERATION OF PROGRAMS

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ABSTRACT. *In this paper, we present a method for solving logical problems based on Equivalent Transformation (ET) theory. We first formulate the logical problem as "All-Solution" problems that is composed of logical expressions such as FOL, DL, and Horn Clauses. We then propose a method to solve the problem including Skolem function based on a new theory of meaning-preserving Skolemization and also generate ET N rules from the logical problem. Finally, we show that we can acquire a sound answer from logical problems by transforming from ET rules to C programs, and executing the C programs.*
Keywords: FOL, Skolemization, Clause, "All-solution" problem, ET rules

1. **Introduction.** The *Semantic Web* has recently been proposed as the next stage in the evolution of the web. The *Semantic Web* is expected to understand and satisfy the requests of people and to also allow machines to understand and use web content. A sound reasoning system is essential in the *Semantic Web* in order to process the knowledge described by ontologies and rules, etc. We know that Description Logic (*DL*) is a cornerstone of the *Semantic Web* for its use in the design of ontologies, and adding a rule layer on top of the *DL*-based Web Ontology Language (*OWL*) is currently the central task in the development of the *Semantic Web* [1] [2]. Therefore, the knowledge described in the *Semantic Web* is a logical problem precisely composed of *DL* and *rules*. We will formulate this kind of logical problem as an "All-Solution" problem. The problem in this paper is not only a proof problem, but also a problem whose solution can be obtained as ground facts. Several approaches have been proposed to solve the logical problems. However, the previously proposed methods solve only a narrow range of logical problems and the validity of the methods is difficult to understand.

The logical problems in the *Semantic Web* are too complex to be solved intuitively without a good principle. In order to get a sound answer, these kinds of logical problems will probably need to be solved by transforming the logical problem into some simple and small problems based on equivalent transformation. To guarantee the validity of the solution, equivalent transformation is necessary. We will propose a method to solve the logical problems based on Equivalent Transformation (ET), where a given logical formula representing a logical problem is successively transformed into a formula that is logically equivalent to it but has a form that is simpler to be solved.

In addition, knowledge representation using an inference system based on clauses is convenient for reasoning. Skolemization is necessary for transformation from logical expressions into clauses. Although it always yields a satisfiability-preserving transformation step, classical Skolemization in general does not preserve the logical meaning of a source