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**Knowledge Description and Semantics  
in Non-Deductive Reasoning**

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# Abstract

Desire to mechanize non-deductive reasonings has resulted some fruits in the field of artificial intelligence. On induction, classification rule learning systems have been widely studied. On analogical reasoning, a problem solver that uses a similar experience in the past was proposed. On abduction, an efficient mechanism to manage consistency of sets of hypotheses is developed.

However the past studies also have problems. The first issue is on knowledge description. A way to describe a task of non-deductive reasoning system can hugely influence effectiveness of the system. The second issue is on semantics. A unique application of abduction on logic program is seldom discussed, though its semantics is widely studied. In analogical reasoning, a desire to implement practical systems has somehow postponed analyzing semantic nature of analogical reasoning.

The thesis attempts to propose solutions for the problems. For the first issue, a preprocess system or a subsystem that can change the description of the task is given for the main reasoning system. For the second issue, analogical reasoning is regarded as an application of abduction and its declarative semantics is given.

The main outcomes of the thesis are as follows.

1. Preprocessing for learning of classification rules

The inductive classification-rule learner's performance is heavily influenced by a set of attributes that is used to describe the cases. The current mainstream approach to the issue is to include potentially redundant attributes in the set. However the approach does not work when the redundant attributes contain noises. Several studies have tried to resolve the problem and some have succeeded at the cost of computational expensiveness. This thesis proposes a new method that is effective and computationally efficient.

2. Analogical reasoning without predetermined partition

The analogical reasoning system's performance is influenced by how

knowledge is partitioned into clusters called domains. Generally a pre-partitioned knowledge has been given to the analogical reasoning system. In the thesis, importance that the system is able to change the partition at will is explained and a new framework of analogical reasoning that includes partitioning as an internal subprocess is proposed.

3. Creativity support system based on analogical reasoning

One example of analogical reasoning processes in which the beforehand partition is impossible is analogical reasoning as a basic mechanism of human creativity. In the thesis a creativity support system that assists human by providing fragments of ideas using its analogical reasoning system based on the framework shown above is implemented.

4. Analogical reasoning as a form of abduction

Semantics for abduction on logic programs is widely studied. On the other hand, analogical reasoning on logic programs can be regarded as a form of abduction, introducing negation of atoms that represent abnormal situations. Combining results of the abduction study with the idea, declarative semantics for analogical reasoning is given.