Acquiring Knowledge in Extended Hierarchical Censored Production Rules (EHCPRS) System

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ABSTRACT

EHCPRs system is a knowledge representation and reasoning system for representing common sense knowledge and reasoning with it. In such a system an EHCPR is used as a unit of knowledge for representing any universal concept. There are a number of EHCPRs at various levels of hierarchy of knowledge structure in the EHCPRs system, which results in a tree of EHCPRs. This EHCPRs tree has the capability of continuous growth through new added EHCPRs to it at proper place as well as to get refined continuously with time through improvement in the already acquired EHCPRs. The EHCPRs tree will become stronger in terms of strength of implication and richer in knowledge as time passes. This paper discusses different schemes for enhancing the intelligence, i.e., the knowledge base and the database in the EHCPRs system. By simple and general snippets of code, the EHCPRs system is able to acquire new pieces of knowledge and assimilate it properly in the already acquired knowledge base. The EHCPRs system dynamically restructures the EHCPRs tree in each learning phase by maintaining consistency and minimizing redundancy as well.

Keywords: Extended Hierarchical Censored Production Rule (EHCPR), Knowledge-Based System, Knowledge Representation, Learning, Logic, Restructuring

INTRODUCTION

When building knowledge-based systems, it is not reasonable to expect that all the knowledge needed for a set of tasks could be acquired, validated, and loaded into the system at the outset. More typically, the initial knowledge will be incomplete, contain redundancies, inconsistencies, and other sources of uncertainty. Even if it were possible to assemble complete, valid knowledge initially, it probably would not remain valid forever in a continually changing environment. Even when programmers include every rule, exception, and special case that is made available to them, still a lot may be missing. A system is intelligent if it adapts itself to

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changes, i.e., it should offer enriched learning techniques for the continuous maintenance of its Knowledge Base and the acquisition of new knowledge. To be effective, the newly acquired knowledge should be integrated with existing knowledge in such a way that the system has a resultant body of knowledge which is accurate, non redundant, and consistent.

Zhou (1990) developed a computational model of cumulative learning based on a classifier system as an attempt to convert classifier systems into long-lived cumulative learning systems. Jain and Bharadwaj (1998) suggested inherent learning algorithms in HCPRs based knowledge representation system to generate new HCPRs and refine existing HCPRs, which are independent of domain or area of application. A cumulative learning methodology based on dynamic structuring of Hierarchical Production Rules (HPRs) clusters has been discussed in (Bharadwaj & Kandwal, 2005). A Cumulative Learning Approach to Data Mining Employing Censored Production Rules (CPRs) has been discussed in (Kandwal & Bharadwaj, 2005). Cumulative Growth of Production Rules with Fuzzy Hierarchy (PRFH) has been shown in (Kandwal & Bharadwaj, 2006). Based on the inherent properties of HCPRs and the corresponding HCPRs tree, a cumulative learning scheme has been suggested in (Kandwal & Bharadwaj, 2007) for automated updating of censor conditions. The methodology appropriately updates censors at various levels of hierarchy in the tree structure. Cumulative learning techniques in production rules with fuzzy hierarchy (PRFH) have been studied in (Bharadwaj & Kandwal, 2008).

An intelligent system is readily acceptable to all, if it is highly consistent, having minimum possible redundancy in representation and high degree of integrity in the stored knowledge. The system should exhibit the capability to acquire fresh knowledge through its rigorous interaction with the external world in a given working environment. Capability of automatic restructuring of the knowledge base and to view the fresh knowledge in the context of its already acquired knowledge is central to a learning system. Procedures to look into the periodically sinking of unwanted knowledge from the knowledge base are also important. All these objectives, which are so important of a learning system, are shown to exhibit through an implemented learning system employing EHCPRs (Jain, Bharadwaj, & Marranghello, 1999; Jain, Jain, & Goel, 2007; Jain et al., 2008a; Jain et al., 2008b; Jain et al., 2009a; Jain & Jain, 2009b; Jain & Jain, 2009c) as knowledge representation scheme. Our approach in this paper is to explore various knowledge enhancement procedures, which are very natural and general for learning in EHCPRs based system of knowledge representation and reasoning. The EHCPRs system supports various learning schemes and it can improve upon its reasoning power using past and present experience. As far as learning is concerned, the EHCPRs system includes a variety of interface tools that permit the user to browse, edit, grow, and restructure the knowledge base. Learning in EHCPRs system includes three major cases:

1. Modification of existing EHCPRs.
2. Addition of New EHCPRs.
3. Restructuring of EHCPRs Tree.

Jain and Bharadwaj (1998) discuss different learning algorithms, which are inherent to a HCPRs-based (Bharadwaj & Jain, 1992) knowledge representation system. It discusses various procedures to generate new HCPRs or refine existing HCPRs independent of domain or area of application. These algorithms are refined, extended, and implemented in regard to EHCPRs based system in this paper. This is first time that learning in EHCPRs system is part of research as well as implementation.

Since in this research project, the EHCPRs system of knowledge representation has been used, it is discussed in some detail in the next section. Then an overview of learning methods in the EHCPRs system are provided, followed by concluding remarks regarding the work done.
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