Constructive machine learning: A new neuro-symbolic approach

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Abstract

Hybrid neuro-symbolic systems have been used recently to combine with success Artificial Neural Networks (ANN) and Knowledge Based symbolic systems (KBS). Such hybrid systems try to take advantage of their respective component strengths [GIA92, ORS95, SUN97, TOW91]. In this paper we present the INSS system, a new hybrid approach based upon the principles of KBANN networks. It represents an important improvement in comparison with its predecessor because the learning and the knowledge extraction process are faster and are accomplished in an incremental way. INSS offers a new approach applicable to constructive machine learning with high-performance tools, even in the presence of incomplete or erroneous data.

Keywords:

Constructive machine learning, hybrid neuro-symbolic systems, Cascade-Correlation algorithm, Artificial Neural Networks, ANN rule insertion and extraction.

1. Introduction

The main argument, and the most used one, to justify the study and the application of hybrid symboli-connectionist systems is the complementarity of symbolic AI methods and sub-symbolic connectionist methods (Artificial Neural Networks - ANN).

Such a justification is a very general one. And it remains to be more precise about the real contribution of the hybrid approach. What exactly provides the combination of neural networks and knowledge based systems? Researchers claim that hybrid systems take advantage of their respective component strengths. Is it a real property of the existing hybrid system? And what are these advantages?

To valid an hybrid system, one have to answer these questions, and to describe what really can be done with this system which was hardly done with just one of its components. Particularly the system has to be given proof of the following properties:

- possibility to use and to take into account several kinds of knowledge representation.
- best efficiency of the global system when compared to each of its components.