Adaptive Hybrid System Architecture For Forecasting

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Abstract

The aim of the research is to combine Symbolic Artificial Intelligence (AI) (Case Base Reasoning systems) and Connectionist AI (particularly Radial Basis Functions, Multi-layer Perceptron and Neuro-fuzzy Algorithms) to develop an improved joint approach to forecasting. New ways to combine Connectionist and Symbolic AI techniques to obtain stronger, more flexible and more adaptive forecasting systems are being investigated.

Background, Strategy and Focus

Case Based Reasoning (CBR) systems are especially appropriate when rules from the knowledge domain are difficult to discern or the number and complexity of the rules is too large for the normal knowledge acquisition process. Artificial Neural Networks (ANNs) have the potential to provide some of the human characteristics of problem solving that are difficult to simulate using the logical, analytical techniques of knowledge based systems and standard software technologies. ANNs are able to analyse large quantities of data to establish patterns and characteristics in situations where rules are not known and, in many cases, can make sense of incomplete or noisy data. CBRs and ANNs are complementary reasoning methods.

Both the ANNs and the CBR mechanism can be used as a means of forecasting and their outcomes can be compared. The ability of the ANN to generalise produces better results than the CBR when it has been trained with an appropriate data set. At this point it would be possible to rely on the ANN and its generalising abilities. However, if the system is inserted in a dynamic environment, whose characteristics change in an unpredictable manner, an agent will need an adaptive mechanism capable of reacting to such changes. It is possible to endow a CBR mechanism with the ability to detect big changes in the environment. Normally big changes will decrease the performance of the ANN, which is more effective when it has been trained with a significant amount of data representative of the whole possible data set. At this point the efficiency of the CBR will be higher than the NN and the ANN will be retrained.

The real time factor is a key issue in this particular learning and forecasting method. It is important to make sure that the agent uses an appropriate technique at the right time; the CBR indexing mechanisms can be very slow, if there are a large number of cases. Furthermore, training a neural network requires an unpredictable amount of time. When an ANN is being trained the CBR should have priority in forecasting; whenever a CBR contains an excessive number of cases a well trained NN can be used to reduce the amount of cases in the CBR. There are several Neurofuzzy algorithms which may be used to extract knowledge from an ANN.

Expected contribution to Knowledge

The aim of the research is to create an Autonomous Agent based environment for forecasting, combining Symbolic and Connectionist AI. The research will investigate the belief that: (i) the combination of connectionist and symbolic AI methods may provide a more effective problem solving capability than either of them in isolation, (ii) these two problem solving approaches may be effectively combined in the form of an autonomous intelligent agent architecture, and (iii) such an architecture may enable systems to learn from experience and be able to predict future events.

References

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