Chapter 11
Object-Oriented Technology for Expert System Generation

ABSTRACT

A technology for rapid prototyping expert systems or intelligent systems as a whole is proposed. The main constituents of the technology are the object-oriented model of data and knowledge representation and the mechanism for data-knowledge transformation on the basis of an effective algorithm of inferring all good classification tests. An approach to expert system development by means of this technology is analyzed. The toolkits for expert system generation are described and the application of these tools to the development of a small geological expert system is demonstrated.

INTRODUCTION

The epoch of certain skepticism with respect to expert systems came after the period of the bloom of their development and application in the 80s-90s of past century. This is explained by several reasons:

- Extremely complex proved to be the problem of obtaining knowledge directly from the experts;
- The knowledge packed into knowledge bases is actually static and isolated from its bearers – the experts;
- The mechanisms of machine learning on which creating new knowledge is based, prove frequently to be labor-consuming and do not cover all problems of data mining. In reality, any applied problem requires the full-scale application of entire arsenal of data mining methods including statistical methods, preliminary data analysis, formation and interpretation of knowledge.

However, the loss of interest in expert system development is not entirely justified. This activity is an excellent research field allowing finding some new solutions for the problems of dynamic interaction of data and knowledge in computers.

In this chapter, the experience of creating a small and rather simple expert system is described in which the problem of data-knowledge interaction has been solved on the basis of integrating deductive and inductive inferences.

The following programs have been created for maintaining the process of automated development of expert system: the Former of Problem Domain (or Problem Domain Generator), the Interface Generator (or Object-Oriented Window’s Editor), and the Editor of Knowledge and Data. The program of Knowledge Interpreter performs the deductive inference in expert system. The program BESTTEST realizes the inductive inference of logical rules of the first type from expert examples. The expert system has been applied to selecting the necessary and sufficient collections of aircraft and satellite surveys of earth’s surface with the goal of automated geological mapping.

AN OBJECT-ORIENTED MODEL FOR DATA AND KNOWLEDGE REPRESENTATION

The main requirements to the knowledge bases of expert systems can be formulated as follows:

- The naturalness of knowledge representation with the point of view of experts;
- The possibility of direct completion of knowledge base by experts;
- The natural interaction between the data and knowledge bases.

The object-oriented model of knowledge representation meets these requirements most adequately.

An object-oriented model of data and knowledge representation is based on the following basic elements: CLASS OF OBJECT (OBJECT, as a particular case of CLASS), ATTRIBUTE, VALUE of ATTRIBUTE and LINK. The creation of domain models is directed by a domain expert. This model is used for generating the schemes of database and the interface to the data and knowledge bases of expert system, simultaneously. Therefore the model of database is also object-oriented (OODM). The object-oriented knowledge model (OOKM) is an extension of the OODM and the rules contained in knowledge base are viewed as the links between the conceptual unites of database (attributes, values of attributes).

Our approach to developing expert systems supports the following technology:

- Analysis of problem domain;
- Creating the object-oriented model of problem domain;
- Creating the interface to data and knowledge bases;
- Entering and editing data and knowledge via the interface obtained;
- Developing the mechanism of logical inference for a particular application;
- Evolution of expert system with the use of machine learning mechanisms.
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