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Intellectual analysis of case-based data in time series prediction

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Abstract - *The data analysis method is used to predict time series. This article discusses the method of intellectual analysis of precedent data, algorithm ideas and provides a diagram of the developed software.*

Key Words: Time series, forecasting, analysis, precedents, intellectual analysis, algorithms, inference systems.

1.INTRODUCTION

Research on the widespread application of the principles of knowledge reflection through the widespread introduction of elements of intelligent data analysis in modern information systems is becoming increasingly important. An example of this is the e-government system, which focuses on public administration. An increase in the appearance and quantity of queries in an information system, that is, an increase for information entered into the system, leads to an increase in the complexity of finding solutions [1].

General formulation of the problem. In the development of logical conclusions of knowledge in modern information technology, decision-making is divided into two directions:

- development of rule-based reasoning systems;
- Development of case-based reasoning systems [2].

Almost all early expert systems modeled the expert decision-making process as a pure deductive process using rule-based conclusions. This meant that the system included a set of rules in the form of "if ... then ..." according to which one or another conclusion on the problem of interest was developed on the basis of the data entered. The chosen model was the basis for the creation of first-generation expert systems, which was very convenient for both developers and expert users. However, over time, it has become clear that the deductive model is one of the least common approaches of an expert in solving a problem [1].

In fact, instead of solving each problem on the basis of primary principles, the expert often analyzes the situation as a whole and recalls what decisions have been made in similar situations before. He then uses these solutions or adapts them to situations that have changed for a particular problem.

Modeling this approach in solving a problem based on past situation experience has led to the emergence of situation-based thinking technology (Case-Based Reasoning or CBR) and in the future - to the creation of software products that do this [2].

In a number of cases, a situation-based conclusion has significant advantages over a rule-based conclusion and is particularly effective in the following cases:

- The main source of knowledge on the problem - experience, not theory;
- solutions are not specific to the situation and can be applied in other cases;
- The goal is not a guaranteed correct solution, but the best possible.

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Thus, a precedent-based conclusion is a method of constructing expert systems that draw conclusions on a given problem or situation based on the search results of analogies stored in the precedent database.

Summary systems show very good results in a variety of tasks, but they have a number of important shortcomings.

First, they usually do not create models or rules that generalize previous experience - in choosing a solution they are based on a whole set of available historical data, so the precedent cannot be based on specific factors of reasoning systems, but on their specific answers.

There are two main challenges that such systems face: the search for the most appropriate precedents and the subsequent adaptation of the solution.

All approaches to the selection of precedents are based on one or another method of measuring the degree of closeness between the precedent and the current situation. It is the numerical value of some measurements that determines the composition of a set of usage cases that must be processed to achieve a satisfactory classification or prognosis with such measurements.

The main disadvantage of such systems is the self-selection that the systems recognize when choosing a proximity scale. Furthermore, extending the scale of proximity to a general data sample seems unreasonable.

Another disadvantage of the method is related to the construction of use cases and the determination of weights corresponding to their attributes, which reduces their application (universality).

In many cases, precedent search methods are probably abbreviated to decision trees or the "nearest neighbor" algorithm, supplemented by the use of knowledge on the topic. As for the adaptation and application of the solution found, this task is still insufficiently formalized and remains strongly related to the subject area.

Both problems - the search for precedents and the adaptation of the chosen solution - are solved using (in whole or in part) background knowledge, in other words, domain knowledge. There are different ways to get information on a topic:

- Involvement of expert knowledge. This can be expressed, for example, in the restrictions placed on the ranges of changes in the properties of objects, or in the formation of rules for classifying the database of cases of use.
- to obtain the necessary knowledge from the existing data set using data search methods (in English - Data Mining). This includes all methods of determining relationships in data, in particular clustering, regression, and the search for associations. The use of data retrieval methods can highlight a narrow set of indicators that depend on the characteristic of interest to the researcher and present the found pattern in an analytical form.
- Formation of knowledge on the basis of the sample of training provided by the expert (training with the teacher). This method involves both of the first.

Initially, experts in precedent reasoning systems - highly qualified specialists in the sciences, as well as text materials - worked as protocols from textbooks and, of course, databases as sources of background knowledge. The task of the expert was to express verbally, that is, to translate such sources into concrete form. Given that the most important task in the process of formalizing knowledge is to minimize the role of the expert, its role should be occupied by data retrieval tools.

Equivalence and order relations are more common among the laws enacted in practice. The first is particularly specific to the problems of classification, diagnosis, and pattern detection. On the other hand, order relations are inherent in problems of scaling, forecasting, and so on.

The need to anticipate future events has never been more important than it is now. The decisions made today are based on the signs of development of events. In turn, they will be more or less affected in the future. Therefore, studying time series forecasting models in the face of insufficient data can help avoid

fundamental errors in any decision making. The study of this problem is relevant for both theory and practice.

The idea of the algorithm

Traditionally, the algorithm involves the following steps:

1. Enter a time series for some variables;
2. Select "Current date" and the number "k" of the nearest neighbors;
3. Determine the distances from the current date value to the previous date values;
4. Sorting distances in ascending order;
5. Select the first distances "k" after sorting;
6. Formation of the array "Subsequent values";
7. Adjust and analyze values, such as finding the arithmetic mean, minimum, or maximum value;
8. Subtract the value obtained as a result of the forecast;

Estimate the value of the time series for the future time period based on the patterns and relationships defined in the database that contain the values (dimensions) of the given series for the previous period.

2. CONCLUSIONS

The advantage of the developed algorithm is its ability to predict the dynamic indicators and factors of any field of knowledge and human activity. For example, forecasting meteorological parameters and weather conditions, stock prices and currency dynamics, forecasting consumer demand, forecasting lending for the next reporting period, forecasting profitability, and more.

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