

Abstracts of Ph.D. theses defended by the  
collaborators and post graduates of the  
Laboratory of Artificial Intelligence Systems of  
the Institute of Mathematics ASM

1. *Author:* Yury Pechersky

*Title:* Algorithmic methods in some pattern recognition problems

*Language:* Russian

*Scientific Supervisor:* Prof. A. Zakrevski

*Date of defence:* April 1973

*Place of defence:* Institute of Technical Cybernetics AS Belorussia, Minsk

**Abstract**

The representation of boolean functions (BF) by boolean trees is proposed and their specific properties are studied. On the basis of this representation effective BF type recognition algorithms are developed. Some properties of partially symmetrical BF are studied and a simple criterion of BF partial symmetry recognition is proposed. The algorithm is built with the help of which the catalog of four variable functions is composed. A practical example of using results obtained is considered.

Logico-combinatorial approach to the solution of multiattribute objects classification problem with the attributes of different scale is developed. New criteria of object description similarity are proposed and studied. Classification algorithms are developed which make use of the graph and set theory methods. Algorithms

of minimization of recognizable object discrete descriptions are proposed including the case of weighted attributes.

Computer programs developed on the basis of theoretical results have been used for solving classification problems, recognition and diagnosis in comparative ampelography, agrochemistry, sociology, and geology.

2. *Author:* Sergei Solowiev

*Title:* Context free grammatics restoring methods

*Language:* Russian

*Scientific Supervisor:* Dr. N. Trifonov

*Date of defence:* April 1981

*Place of defence:* Moscow University, Russia

**Abstract**

A method of restoring simple context free grammatics is developed. The possibility of restoring such grammatics is proved in the case when the sample satisfies fundamentality requirement. A method of sample structure enlargement is proposed and substantiated. Methods of restoring LL(1)-grammatics and finitely characterized languages are developed. Heuristic methods of sample replenishment are developed. It is proved that these methods can be used for restoring grammatics.

3. *Author:* Fedor Frolov

*Title:* Spatially digital method of processing and recognition of post code hand written index

*Language:* Russian

*Scientific Supervisors:* Prof. B. Kutasin, Dr. Yu. Pechersky

*Date of defence:* April 1984

*Place of defence:* Institute of Technical Cybernetics AS Belorussia, Minsk

**Abstract**

Spatially digital method of pattern filtration for its further refining is proposed. An analysis of several filters with monomodal

dispersion functions is carried out and the optimal one is chosen from the point of view of pattern refining and high frequency interference removal in the domain of background and sign line. Spatial filter circuit solutions are developed allowing adaptation to the width of line.

The algorithm for processing image and forming refined image is proposed which is independent of high frequency interference in the zone of outline and background. Image refinement is carried out during line scanning and does not require that information about all image be remembered. The system of logical filters for Freeman codes selection is developed. To form compressed description a special algorithm is developed for approximation of sign outline which allows parallel analysis of outline in all coordinate planes.

On the basis of the method of sequential synthesis of recognizable pattern and multilevel decision making the algorithms for recognizing hand written digits, zip codes are developed with the probability of recognition 0.975.

4. *Author:* Galina Solowieva

*Title:* Methods for constructing expert systems based on the knowledge representation in the system of alternatives

*Language:* Russian

*Scientific Supervisor:* Dr. V. Serebriakov

*Date of defence:* April 1986

*Place of defence:* Computing Center of Russian Academy of Sciences, Moscow

**Abstract**

The method of knowledge representation in the simple system of alternatives (SA) is studied. The possibility of constructing the simple SA recognizing any class of objects represented by values of a fixed number of attributes is proved. The method for implementing logical inference procedure is proposed. The universal method for building any knowledge module in the simple SA is

developed.

The knowledge base structure in the form of SA is developed. The method for building knowledge modules in the regime of expert by screen editing a selected number of attributes and their values is developed. The instrumental expert system is realized which supports knowledge base organization in the form of SA and which is tested on the tomatoes gormonal balans prognosis problem.

5. *Author:* Eugen Rotari

*Title:* Methods and tools for accompanying scientifico–technical programs on the basis of expert estimations

*Language:* Russian

*Scientific Supervisor:* Dr. Yu. Pechersky

*Date of defence:* April 1990

*Place of defence:* Institute of Cybernetics of Ukrainian AS, Kiev

**Abstract**

The conception of automatic monitoring scientifico–technical programs is proposed and studied which is based on applying the technology of complex object expert estimations with using crisp and fuzzy expert estimations, interactive control methods and heuristics. In particular, the algorithms of calculating group expert estimations, finding conflict expert groups and taking them into account when aggregating estimations, determining dynamic rating for experts are developed. The algorithms of cooperative generating control acts, monitoring development paths of scientifico–technical programs in time.

The computer interactive system for monitoring scientifico–technical programs is created. It is used also for processing results of production technical indices expertise and analyzing medical service data.

6. *Author:* Gennadi Gincul

*Title:* Game approach for knowledge base forming in expert systems

*Language:* Russian

*Scientific Supervisor:* Dr. V. Pilschikov

*Date of defence:* April 1991

*Place of defence:* Moscow University, Russia

**Abstract**

To increase the effectiveness of knowledge base forming a new game approach to deal with expert is proposed. Main principles of expert games are formulated. A number of expert games is developed which are oriented on attribute models of problem domains. For them, procedures analyzing game protocols and forming inference rule are created. In the framework of game approach the computer system is created which provides automatic support of knowledge engineer work when forming knowledge base.

7. *Author:* Gennadi Andrienko

*Title:* Methods of comparison for automatic expert knowledge acquisition

*Language:* Russian

*Scientific Supervisor:* Dr. S. Solowiev

*Date of defence:* April 1992

*Place of defence:* Moscow University, Russia

**Abstract**

Typical models of the recognition and decision problems are selected for which the method of knowledge representation and solving is proposed in the formalism of descriptive tables. Different variants of comparison as a method stimulating acquisition and verbalization of knowledge in the recognition and decision problems are proposed: comparison of pairs, triples, comparison in the framework of computer games and role dialogue.

Knowledge acquisition techniques are developed which are oriented at typical models: the method of deviding a set of decisions, the method of grouping decisions, the method of synthesis of textual descriptions. Computer complex of instrumental knowledge acquisition tools and development of expert systems is realized.

8. *Author:* Natalia Andrienko

*Title:* Instrumental tools for forming procedural knowledge bases

*Language:* Russian

*Scientific Supervisor:* Dr. S. Solowiev

*Date of defence:* February 1993

*Place of defence:* Moscow University, Russia

**Abstract**

The knowledge acquisition problems for control and planning tasks are formulated as a problem of finding out control scheme of achieving goal situation and a problem of acquisition of prior and post conditions for actions, allowing building control scheme. Knowledge acquisition techniques are developed which are aimed at the problems of considered types: the method of partial ordering and the method of recovering scheme by examples — for control problems, the method of relation analysis — for planning problems.

The possibilities of hypertext as means of solving the problem of combined tasks integral knowledge representation. An approach is proposed for creating automatic expert knowledge acquisition system for problems with components of different types. Computer system implementing this approach is developed.

9. *Author:* Vasili Sarbu

*Title:* Instrumental tools for forming procedural knowledge bases

*Language:* Russian

*Scientific Supervisor:* Dr. S. Solowiev

*Date of defence:* November 1993

*Place of defence:* Moldavian Technical University, Kishinev

**Abstract**

The paper is devoted to the development of methods and means for revealing and eliminating principal errors in knowledge bases of FIACR-like expert systems. To solve the problem raised conventional methods of the knowledge base correction in a number of existing expert systems are studied. An analysis is carried out

and the principal types of possible errors occurring in knowledge bases of FIACR-like expert systems are selected.

It is proved that the knowledge base of expert system created with the help of FIACR-like shell can be represented within propositional logic. Inference procedure used in the system turns into the unique resolution algorithm. The structure and scheme of functioning of the knowledge base correction subsystem for FIACR-like expert system are proposed which are aimed at revealing and eliminating errors of the given type.

The library of algorithms is created which implements proposed methods of the knowledge base correction. Based on this library the knowledge correction subsystem is developed and implemented which is included in experimental system FIACR+ combining functions of the expert system shell FIACR and the functions of the knowledge base correction in static and dynamic regimes.

Application of the results obtained makes it possible to enhance considerably consistency of information stored in knowledge base.

10. *Author:* Alexandre Savinov

*Title:* The matrix representation of fuzzy knowledge in expert systems

*Language:* Russian

*Scientific Supervisor:* Dr. V. Levchenko

*Date of defence:* November 1993

*Place of defence:* Moldavian Technical University, Kishinev

**Abstract**

In the paper new approach to the knowledge representation and logical inference in expert systems based on the notion of attribute model of the problem domain is proposed and studied. At the syntactical level the problem domain is described by a number of attributes with their values. By semantics or knowledge we mean fuzzy constraints on the possible combinations of the values of attributes.

To represent the semantics a technique of sectional vectors and matrices is proposed which is a generalization of the corresponding method of Zakrevski of the fuzzy case. Each line of the matrix is fuzzy disjunct, and the whole matrix is fuzzy CNF, Properties and means of equivalent transformations of sectional matrices are studied. The main operation on fuzzy disjuncts is fuzzy resolution. It is shown that it entirely generalizes the properties of classical resolution.

Based on the formalisms studied algorithms of logical inference in fuzzy knowledge base, explanations and forming the hypothesis are developed and which were implemented in two versions (fuzzy and non-fuzzy) of the expert system shell EDIP running under DOS.

*Dr. Yu.Pechersky*