ANALYSIS OF STAGES OF DEVELOPMENT, CURRENT STATE AND PROSPECTS OF THE EXPERT SYSTEMS

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Abstract: The objects of the study are stages of development and modern state. In general terms, expert systems are knowledge-based systems. This paper focuses on the components and principles of expert systems. Expert systems are also described. The components of expert systems include knowledge base, logical impact mechanism, user interface and decision-making. In addition, this article describes the capabilities of expert systems. One challenge is to identify the future prospects of expert systems. The research examined the expert system and its significance. It also focuses on generations of expert systems. The first generation of expert systems includes systems created before 1990. This article discusses SAINT, DENDRAL and HEARSAY-1. The features of this expert systems are also discussed here. First-generation expert systems are research prototypes. As a result, the foundations of artificial intelligence were developed. Mostly first-generation expert systems were used as a passive assistant expert. The second generation of expert systems refers to systems created since 1990. Features of second-generation expert systems include dynamism, interactivity, and processing of disparate knowledge. Unlike first-generation expert systems, these systems are able to test the completeness of the knowledge base, to process fuzzy knowledge. Their main difference is the ability to integrate second-generation expert systems with existing systems. At the moment, statistical and dynamic expert systems are distinguished. This article describes the current status of both types. Here are also discussed the tools of statistical and dynamic expert systems. At the end, possible prospects of expert systems are received.

Keywords: expert systems, knowledge-based systems, perspective expert systems.

INTRODUCTION

Expert systems are complex programs that reflect the expertise of a particular subject matter and provide advice to low-skilled users. Such systems help decision makers with less experience in specific subject areas. Therefore, such systems are sometimes referred to as systems that support decision-making. Expert system is a type of application program that solves problems, gives recommendations and even makes decisions based on certain information and analytical rules set up by experts in the field (such as finance and medicine). Expert-people apply their factual knowledge, using their ability to judge when solving problems. In the expert system, these two fundamental principles are realized as two interrelated components: the knowledge base and the logical consequence mechanism. The knowledge base provides specific facts and rules related to the subject matter, while the logical result (output) mechanism executes judgments that allow expert systems to draw conclusions. Expert systems also include additional tools such as user interface and decision-making. User interfaces, like other applications, allow you to form queries, provide information, and interact with the system in other ways. One of the most interesting components of expert systems is that reasoning tools allow you to explain the results that you bring to the system. These tools allow developers to test the performance of those systems [1].

Expert systems, in other words, are called «knowledge-based systems». These systems, which include a variety of software tools, provide the description and use of actual knowledge to solve problems. For example, diagnostics of diseases, diagnostics of technologic systems, advance information on mineral deposits, production planning, and so on [2].

Therefore, it is practical to study the possibilities of expert systems. Thus, *the objects of the research* are selected stages of development, the current state of expert systems, whereas *the aim of the study* is to determine the future prospects of expert systems.

Methods of research

Expert system development stages

The first practical result of scientific works in the field of artificial intelligence since the 60s of the last century was the creation of experimental systems of experimental type in the 1970s [3]. As a result of the evolution of knowledge-based systems, including expert systems, a theoretical framework has been established, methodological and practical frameworks have been developed for the efficient collection of information, descriptions and processing problems, and programs have been developed to keep up with the possibilities of modern computer technology. Expert systems have been divided into two phases so far, and they are called first and second generation systems [4].

Expert systems of the first generation

Expert systems (ES), which were created until the late 90s of the last century, belong to the first generation. These systems are basically designed as research prototypes to explore and substantiate the theoretical foundations of artificial intelligence. The research carried out during this period was fundamental and focused on the acquisition of knowledge, the use of tools, and the establishment of a mechanism for extracting knowledge by various means [5].

The ES of this generation was intended primarily for autonomous application. As a result, methods and tools have been developed that form the basis of artificial intelligence as a scientific direction. However, all this does not mean that any universal technology, which takes into account the variety of features and their specificity, solved through computer technology. On the contrary, the experience has shown that universal strategies do not succeed because they require many restrictions to solve complex problems. Therefore, many researchers have come to the conclusion that the use of narrow frameworks with the help of expert systems can be more effective and promising [6].

Due to the origin of the structure, subject areas, inheritance of ideas, methods and tools, I generation expert systems and related tools can be divided into several families:

1. The SAINT program, designed for mathematical transformations at the Massachusetts Institute of Technology (USA), later became the basis for the creation of SIN, MATLAB and MACSYMA systems. The MACSYMA system, which implements differentiation and integration in the form of symbols, is often dominated by mathematicians and widely used by mathematicians and physicists worldwide [7].

2. The DENDRAL and META-DENTAL systems developed under the Stanford (USA) project are used to derive the probable structure of an unknown chemical compound based on nuclear magnetic resonance, mass-spectrographic and other chemical experimental data. META-DENDRAL automates the process of acquiring knowledge for the DENDRAL system. With its help, the rules for the formation of fragments of chemical structures are generated [8].

3. The HEARSAY-1 and HEARSAY-2 systems were created to recognize the conjugate human speech. The words used in the speech are taken from a known dictionary. Although the quality of speech recognition through these systems is not high (comparing this quality to a 10-year-old child). These systems have laid the groundwork for artificial intelligence in speech recognition, and the ideas and methods used in these systems are subsequently used for instrumental tools, including HERSAY-3 and AGE form the basis of instrumental systems [9].

The common features, disadvantages of the first generation expert systems, their main areas of application and their heritage can be summarized as follows:

- The first-generation expert systems were intellectual activities at the level of the user's passive assistant. They only had knowledge acquired from experts and put into the system by «knowledge engineers». The ES responds to user requests by analyzing this knowledge and imitating the logical extraction process.
- In most systems of the first generation, it was not possible to evaluate the knowledge included in the knowledge base, to detect contradictions in it, to automatically determine the correctness of the knowledge and to generate new knowledge.
- The first-generation expert systems were widely used in medical diagnostics [2]. These sys-

tems include functional medical knowledge and the expertise of professional physicians. These systems played the role of a questionnaire developed by experienced experts and were widely used in the training of medical personnel. Further development of medical expert systems was due to the use of fuzzy extracts.

- The main role of the first-generation ES in the development of artificial intelligence, including expert systems, is that theoretical methods of artificial intelligence and ES have been developed and tested in these systems.

Expert systems of the second generation

Expert systems established since the 1990s refer to the II generation. Realization of features inherent in this generation of expert systems, such as dynamism, interactivity, processing of scattered knowledge, new achievements in computer and communication technologies during this period, lead to the creation of high-performance and broadband personal computers and meframes, local and global computer networks, including Internet. To gain the dynamism of the expert system, new components were added to its architecture: subsystem modeling, communication with the external environment, and the logic of processing events.

The 2nd generation expert systems have the means to acquire new knowledge from the data entered during their creation and operation. It is possible to detect contradictions between new knowledge and data entered into the system with the knowledge stored in this ES, ie checking the completeness of the knowledge base.

In more advanced 2nd generation systems, the processing of fuzzy knowledge is being implemented. Such systems are called fuzzy expert systems. The use of fuzzy logic greatly improves the processing of fuzzy judgments and the quality of logical conclusions based on them. In practical applications, the number of fuzzy systems exceeds that of traditional systems. The main difference between real-time ES and first-generation systems is their integration.

At present, there is a tendency to create expert systems without the knowledge engineer. The mass use of personal computers and the rise of expert users' computer literacy have made it possible for ES to integrate knowledge and expertise in the system. It is expected that through expert dialogue with the participation of the knowledge engineer, as well as experimental protocols, dialogues, articles, instructions, pointers and guidelines, schemes, etc. knowledge acquisition will be the main focus of knowledge formation for the creation of modern perspective expert systems.

RESEARCH RESULTS AND DISCUSSION

Current state of statistical expert systems

The current state of statistical expert systems can be summarized as follows:

- Most expert systems are integrated and open according to application types; scattered ESs are usually used by client-server architecture.
- According to the scale (type of computer) more than 82 % of expert systems are implemented on workstations and personal computers, 12 % of the characters in computers are 6 %.
- Static ES 1,2,3,3 is created for the type of problem environment; For the 1st and 2nd environment, simple ESs performed on PCs and workstations are used, and for those types of environments, ESs on workstations and meframes are used [1].

Many of the tools for static expert systems have been implemented simultaneously on different types of computers (personal, workstations, characters, and mefream), which can be attributed to different types of tools. However, the tool is usually the most commonly used type. For example, the GUBU Instrument (Cover) works on PC PCs and Micro VAX computers.

World-wide static ES instrumental tools include:

- Large instrumental tools: Aion DS 5.1 (Trinsic), KBMS (Trinzic), ART (İnference).
- Medium instrumental tools: Nexpert Object (Neuron Data), ProKappa (İntellicorp), Art-İM, ART Enterprice (İnference), Level 5 Object (İBİ), CLİPS.
- Small instrumental tools: Expert (Paperback Software), İST Class (İst Class Expert System), Personal Consultant Easy, Procedure Consultant, Crystal.
- Simvol instrumental tools: KEE (İntellicorp), ART (İnference), Gold Works (GoldenHill), Mercury (AГT).

Most of these tools can use packages (Lotus 1-2-3) integrated into databases (dBase, DB-2, Oracle, IMS, etc.). Some of them (eg East Class, KDS2&2, Super Expert, etc.) use inductive methods of knowledge acquisition. Most of the instruments are in C and Pascal. There are tools such as Instant Expert +, Intelledgent Dev eloper, Level 5 that are linked to hypertext processing tools (Hypertext, HyperCard).

Current state of dynamic expert systems

Dynamic expert systems, including real-time ESs, are developing more intensively. Currently, the sales of these systems worldwide make up 70 % of knowledge-based problem/problem-oriented systems [10]. The importance of these systems is not only in the continuous management of commercial production processes (oil transportation and refining, chemical, metallurgy, formakology, etc.), but also in aerospace research, nuclear and thermal power plants, financial operations, communications and so on. apps that are strategically important.

Recently, dynamic tools have been created to simulate the intellectual imitation used in reengineering business processes. Interest in this type of ES and instrumental tools comes from the fact that, unlike static ES and instrumental tools (IV), used to automate the current state of business, dynamic ES and IV are used to solve more important and complex issues in business process reorganization.

The first instrumental tools to create a dynamic ES was introduced in 1985 by Lisp Macjine Inc. Made in the firm. This instrumental tools Symbolics symbol called Picon was implemented on a computer. The success of this instrumental tools prompted its developers to create a private firm called Gensun in 1986. The firm developed Picon's ideas and in 1988 created the 1st version of the G2 IV (G2 1.0). Currently, versions 5.0, 6.0 and 7.0 of this system are widely used.

Perspective expert systems

The main feature of perspective systems is their dispersion, the processing and application of scattered knowledge. The basis for the establishment of perspective expert systems are methods for detecting regularities, recognition of copies, structural and logical analysis of data and knowledge, results in mathematical linguistics, as well as accumulated experience in creation of expert systems. The aforementioned factors play a part in the expert systems established today [2].

Perspective ESs should provide not only knowledge and data processing, but also meaning (semantics). These systems should be able to analyze the sentences of the natural language and build a network structure that corresponds to their semantic content. The ES should be able to understand the meaning of the information contained in the natural language and to make sentences relating to the subject matter under consideration. To this end, the problem of automatic recognition of texts and situations becomes more urgent. An important feature of this problem is that the recognition result should reflect the situation described by the user, the expert, and the decision maker. To solve this problem, a rich theoretical and practical framework in the field of artificial intelligence has been created.

The perspective expert system should build the model of the applied problem area, ie its theory. Also ES has to construct the model of the user (learner and tutor) and his/her own to optimize the process of forming the model of the investigated action (situational) in the thinking of the learner.

The main function of future expert systems is to make valid conclusions based on the discovery of the relationship between the data processing and the characteristic of the inputs that represent the known characteristics.

In addition to experts as a source of knowledge, you can use experimental protocols, articles, appointments, scientific and methodological guidelines and guidelines, schemes, etc. should be used. Thus, it is possible to automatically acquire new knowledge based on existing knowledge.

At present and in the near future, updating the concept of creation of expert systems and use of artificial intelligence is connected with the transition from local artificial intelligence systems to information processing and multidimensional intellectual systems.

Finally, we can point out that the logical output mechanism of a promising ES should be able to simulate human judgments based on similarity, to find the proximity of the studied and stored data sets with the computer's memory. This method can greatly accelerate the process of logical extraction in big databases.

CONCLUSIONS

1. This article has theoretical significance. The research analysed the characteristics of modern statistical and dynamic expert systems. Attention was also paid to expert systems of the first generation and their difference from expert systems of the second generation.
2. The research examined the stages of development of expert systems, which consist of two phases (first generation and second generation). The result of the research is an overview of the current state of expert systems in the world. The following promising directions of expert systems were also considered: automatic discovery and extraction of knowledge, methods of checking inconsistencies and completeness, processing of non-factor information, automatic forecasting of missing data in the database.

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