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EXPERT SYSTEM AND ITS PERSPECTIVE

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Abstract

Expert systems are in an early evolutionary phase, but it already has significant impacts on business operations. More and more organizations are becoming interested in applying expert systems as solutions to their business problems.

This paper describes how expert systems started, what is their current situation, and what are their application areas. It outlines what is expert system and how to develop an expert system. And it analyzes expert system shells and shows some current available expert system shells. Lastly, it concludes and predicts the main attributes of the future expert systems.

I. Introduction

Expert system, a significance branch of artificial intelligence (AI), has grown substantially in recent years. Thousands of expert systems have been built and used by specialists for solving problems in their domains. Some expert system applications will allow people to improve significantly the way they do business. More and more expert system development groups have been established. Expert system techniques begin to change the way people think about computers.

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Expert systems will change the way business operate by altering the way people think about solving problems. This new technology will make it possible to develop quick, programmatic answers for a wide range of problems that currently defy effective solutions[4].

In the past three years, over 80 percent of the 500 largest companies in the United States have explorations using expert system techniques[5].

This paper is about expert systems and how they started, what is their current situation, what are their application areas, how an expert system is developed, and what is the future for expert system. In such a short article, we can not explore in depth each aspect stated above, but we try to give a more general idea.

Ⅱ. How Expert System Started

Since the end of World War Ⅱ, the computer industry has been developed very rapidly. As the field of computer science has matured, it became possible to develop computer techniques that would allow computer to do things human being can do. Over the years, the researches have been conducted to symbolic processing which is generally referred to as AI. AI is a scientific field concerned with how to develop computer techniques to simulate the process of human thinking and human reasoning[8]. AI consists of three basic subfields : natural language, robotics, and expert system. Of all the subfields of AI, expert system is a major one of AI. It has received the most attention, has the most applications in the real world, obtains the most economic profit, and reflects most of the techniques of AI. It has a significant impact on today's business areas.

Ⅲ. What is Expert System

Expert system is a computer program that build upon human expert knowledge and experience in specific fields to aid users in a decision-making process. It is a knowledge transfer process how the knowledge originally held by expert is transferred to user group.

Developing an expert system is not easy. It usually takes field experts and knowledge engineers working together for a number of months or years. Field experts are responsible for summarizing and establishing the knowledge package which is used in the expert system, and define the objectives of the system. the knowledge engineers' task is to bridge the gap between the human expert and the future users. Knowledge engineer collaborates with an expert on a specific problem-solving process. The knowledge engineer then tries to model this process using facts about the expert's domain by generating definitions, relations, and heuristics. The interaction continues between the knowledge engineer and the expert, modifying the model until the expert feels that the model genuinely reflects the way he/she solves the problem. This expert system can then be used in place of expert for decision making in other locations by others, or as a tutor for other to learn how to make a decision as the expert does. The system-building architecture is shown in Figure 1 (7). It relates all

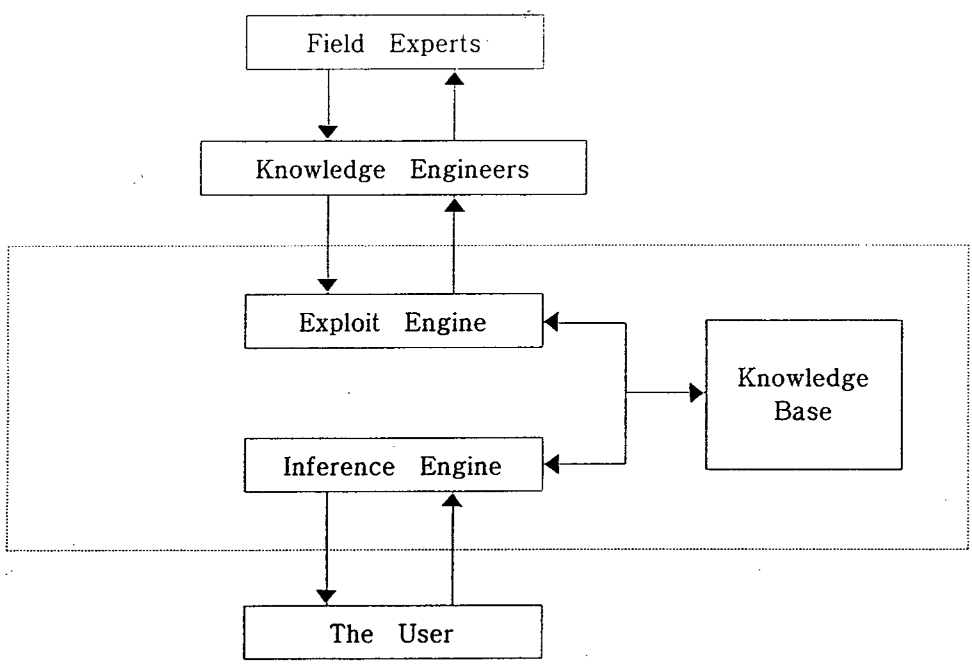

Figure 1. Expert System-Building Architecture

the components which combine to create conditions necessary for the development of expert system.

The exploit engine is used to obtain knowledge in natural language and to build the knowledge base. An expert system is never complete. As time passes, it grows. New facts and rules are added to it, existing rules are modified or updated, outdated rules are purged, and the knowledge base is made current.

The inference engine is used to provide consultation to users in a natural language, based on the knowledge in the knowledge base. There involves two steps. First, the system has to draw inferences and, to do this, it has to evaluate existing facts and rules, and add new ones when necessary. Second, it has to control the chain of reasoning: it has to decide how to begin the reasoning process and set priorities for the inferences when multiple lines of reasoning emerge. The application of rules results in the drawing of certain information and a changed knowledge base.

The knowledge base is represented in such a way that the expert system is able to access it to abtain information, to reason, or to analyze the data and draw conclusions. Such activities are fundamental to the functioning of an expert system, and hence, how knowledge is represented is important. Before building an expert system by effective knowledge representation scheme, a knowledge engineer must acquire knowledge from an expert. The knowledge engineer must be able to truck the line of reasoning of the expert, and evolve a program that simulates the expert's reasoning. The program will consist of a domain of facts and a set of heuristics(i.e. rules of thumb).

Ⅳ. The Application Areas

Expert systems have been arousing much interest in industry and elsewhere. It is envisaged that they have been or will be able to solve problems in the areas where computers have previously failed, or indeed, never been tried. The application areas include : agriculture, computer, equipment maintenance, finance, management, manufacturing, office automation, oil and geology application, transportation, science and medicine, training, and so on [1].

The application of expert system differs according to who is going to use the system, how the user interacts with the system, and how his/her work is affected by the system. Generally speaking, there are three types of users :

1. The user as a client who is seeking answers to a problem.
2. The user as an instructor, adding to the system's knowledge.
3. The user as a pupil, learning from the system and increasing his/her knowledge.

In reality a user may be doing all three of these activities at the same time.

What types of decisions can an expert system handle? Researchers are trying to build expert system that can be applied in a variety of situations. Expert systems may thus be able to address a wide range of questions. Market analysis, financial planning, production scheduling, inventory control, the examination of policy decisions, and the projection of dynamic interactions of variables involved in a decision are just some examples of the current and future applications of expert systems.

Among the expert system applications, a medical expert system is perhaps an exciting example of expert system. The Blaise medical expert system developed by CNRS in France for use by paramedical personnel in tropical Africa is very impressive, it handles 2, 000 symptoms, 500 diseases, and 200 medications and treatments. The potential impacts of this system on quality of health care and hence quality of life in this region are very significant [9].

Financial expertise has been a major target of expert systems developers because the market is huge at both ends. At the low end, nearly everyone has an active interest in maximizing their financial positions. People find themselves making important financial decisions without the benefit of helpful advice. The expertise is either unavailable, too expensive, or too difficult to access. The upper end of the financial applications market is large, not because of a high number of potential clients — there are only so many major financial institutions — but because the stakes are so high. An expert system that could nudge a particular balance sheet amount two or three percentage points in the right direction might add millions of dollars to a large institution's net profit [5].

V. How to Develop an Expert System

Developing and fielding an expert system encounters many activities only somewhat related to knowledge engineering and many other activities very familiar to conventional programmers and managers of any large undertaking.

A systematic way to approach developing an expert system is described in general terms, which constitutes seven phases. It illustrates a broad overview of the entire expert systems development and implementation process.

Phase 1 : Front end analysis. In the initial phase we select the appropriate problem or problems the system will work on. As each individual project is considered, the project team must determine if an expert system is appropriate to the task and if it would be cost-effective. And the team must arrange management support.

Phase 2 : Task analysis. In the second phase we study how the target task is currently performed, meet with human experts, and develop criteria to determine if the resulting system is succesful.

Phase 3 : Prototype development. In the third phase we develop a small version of the expert system to demonstrate the overall feasibility of the proposed system.

Phase 4 : System development. The great majority of knowledge is added to the system in the system development phase. Information is added in bulk after conferences with human experts, the user interface is tailored, and the system' working performance is monitored and compared to the established benchmarks.

Phase 5 : Field testing. We must test the system in the user environment, again comparing its operation against established benchmarks, and modify and polish the system until it performs as we desire.

Phase 6 : Implementation. The next phase in expert system development is actually to field the system in a realworld user environment. This may involve porting the system to different hardware, and helping them accept the system.

Phase 7 : Maintenance. Maintenance, the final phase, is never complete; it continues as long as we use the system. The system must be continually revised and updated as necessary, against benchmarks that dictate new applications or performance improvement.

Ⅵ. Expert System Shells and Some Current Available Expert System Shells

As expert system technology has come of age, many expert system shells have been available. Shell offers numerous features for both developers and users of expert systems.

An expert system shell is expert system tool that develops and executes expert systems, makes the representing the expert's knowledge and reasoning methods in a computer system more accurately. Expert system shell has the reasoning methods and strategies that imitate the way experts make decisions and reason through problems. It is called a shell sine it lacks knowledge specific to any domain of expertise, but otherwise contains the facilities needed to build and run an expert system application. The knowledge engineer does not have to design and code the inference engine, since they are provided within the shell [3].

In general, expert system shells tend to be structured into three components : the knowledge base, the inference engine and the user interface [2].

The knowledge base consists of rules, data, links to external data sources and the formats of questions and output texts. In shells, rules could be expressed in "if …… then" form. Variable types of data are allowed. Questions can be put in menus or multiple-choice formats.

The inference engine of a shell provides the inference mechanism as well as methods of reasoning. The inference engine also provides a method of searching the knowledge base for the rules or data needed to reach conclusions.

The final component of a shell is the user interface. Shells normally provide many features such as windows and graphics to simplify the input and the output of information.

There are three types of expert system shells available : rule-based expert system shells, example-based or inductive expert system shells, and hybrid or knowledge-based expert system shells.

The rule-based shells use the most intuitive way of representing knowledge, the "if …… then" rules. The "if" part of the rule is known as the condition and the "then" part of the rule is the conclusion. "If …… then" rules are formulated by a knowledge engineer who works closely with an expert, carefully observing how he/she works, interviewing the expert and then giving sample cases to an expert-system shell then stored in a knowledge base that can hold hundreds to thousands of rules, depending on the application.

Forward and backward chaining are the typical reasoning methods used to scan rule-based systems for conclusions. The forward chaining is a method of reasoning in which the program reasons toward a goal. It seeks to identify all whose "if" portions are true, and uses the "then" portions of those rules to find other rules that are also true. The backward chaining is a method of resoning by which the program forms a hypothesis and works backward to the "if" portion, thereby satisfying the condition or goal.

Example-based or inductive expert system shells are very limited in power because they can not deal with real-world interdependencies. Example-based shells generate rules with the simple assumption that every variable is independent, rather than interdependent. Because the system reaches conclusion based on stored examples, it is difficult to step in and tell the system what to do.

Knowledge-based expert-system shells include all the rules-based components, plus the capability of knowledge representation through frames. Frames organize and represent knowledge differently than rules, these frames are stored in database, separate from the rules. So the rules can operate against the knowledge.

Currently a lot of expert system shells are available. Some of them are listed in table 1.

Ⅶ. Conclusions and Future of Expert System

Expert Systems are in an early evolutionary phase, but it already has significant impacts on business operations. More and more organizations are becoming interested in applying expert systems as solutions to their business problems. The expert system shells offer more features for both developers and users. The future expert system will be characterized by

Table 1. Some Current Expert System Shells

Product	Company	Minimum Memory (bytes)	Source Language	Price
Xi Plus	American Expertech	640K	C. Prolog	$1, 995. 00
Xi Rule		384K	C	$495. 00
XSYS	California Intelligence	280K	LISP or C	$395. 00
ESP Advisor	Expert System International	364K	Prolog	$895. 00
ESP Frame-Engine		640K	Prolog	$895. 00
EXSYS Professional	EXSYS	512K	C	$795. 00
Gold Works	Gold Hill Computers	5M	LISP	$7, 500. 00
Knowledge Pro	Knowledge Garden	512K	TURBO Pascal	$495. 00
Knowledge Maker		512K	Knowledge Pro	$99. 00
Mice	Machine Intelligence	640K	C	$85. 00 $9, 000. 00
Guru	mdbs	640K	C	$6, 500. 00
VP-Expert	Paperback Software International	384K	C	$124. 95
1st-CLASS	Programs In Motion	256K	Assembler Pascal	$495. 00
1st-CLASS FUSION		512K	Assembler Pascal	$1, 295. 00
Super Expert	Softsync	256K	FORTH	$199. 95
M. I	Teknowledge	384K	C	$5, 000. 00
LightYear	Thoughwara	192K	C	$99. 00

* Source : PC Week, February 9, 1988.

large knowledge-based management systems, It will provide cooperative features to the users.

First let us summarize a few points about current expert system. Present expert systems are knowledge-based programing techniques. More specifically an expert system obtains some data from its user about the particular case under consideration. It then carries out a classification of the data according to internally stored knowledge. The classification process is achieved by applying to the knowledge base, which culminates in presenting one or more results to the user.

Now let us to consider the points which current expert systems have not yet achieved.

1. Current expert systems do not replace human experts in the sense of making them no longer necessary. Because firstly, the human expert is needed to help build the knowledge base. Secondly, the human expert is necessary to keep the knowledge base up to data.
2. Current expert systems are not quite friendly, and much less intelligent to the user.
3. Current expert systems are not cheap, either to procedure or to maintain.

Having summarized the main features of today's expert systems, let us now predict the main attributes of the future expert systems.

1. Today's small, hand-crafted special-purpose knowledge bases will move to large assemblages of knowledge which can be used by a wide variety of different application systems for many different purpose.
2. Today's small, specialized expert systems which are able to carry out diagnostic, classification-type tasks are based on shallow knowledge optimized for a particular task. In the future, their purpose will be to assist people in a cooperative way to solve a wide range of problems in various domains.
3. As more and more knowledge and expertise become available in machine-based form, the problem-solving power available in individual expert systems will be linked for improved cooperation.

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