

Expert Systems and their Application in Library and Information Systems

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Abstract

This article describes the concept of expert systems, its origin, features, advantages and its application in various areas of library and information system environment.

1. INTRODUCTION

One of the most rapidly growing and fascinating topic in computer science, psychology, linguistics and information science is expert systems. Expert systems are of recent origin barely mentioned in literatures just a few years ago. Now there is an extensive literature with hundreds of books and articles on the subject. Several reviews have been published in the series of *Machine Intelligence* (published by Wiley and Elis Horwood) and in various volumes of ARIST.

Expert systems belong to the broader discipline of Artificial Intelligence (AI) which has been characterised by Barr and Feigenbaum¹ as "the part of computer science that is concerned with designing intelligent computer systems; that is, systems that exhibit the characteristics we associate with intelligence in human behaviour—understanding language, learning, reasoning, solving problems, and so on". AI focuses on symbolic, nonalgorithmic problem solving methods. Of all the branches of artificial intelligence, expert systems hold the greatest potential.

2. DEFINITION

The field of expert systems is so new and rapidly evolving that defining the term is not an easy task. However, broadly speaking, "expert systems are computer programmes composed of knowledge base that contains the information supplied by the expert, and an inference engine that applies the appropriate information from knowledge base to a specific problem"². The key feature of expert systems is that they involve modelling of the thought process of human experts who are very familiar with the given problem domain. For example, if an expert system is to be built that will serve as reference assistant, it must be done by sitting down with expert reference librarians and asking them to codify the heuristics or 'rules of thumb' that guide them in their decision making. Thus, an expert system incorporates the knowledge of human experts (which is not otherwise available other than by consulting them), a human faculty of reasoning, and the modes of reasoning of those human experts³.

3. FEATURES

An alternative way of describing an expert system, as a series of distinctive features; rather than a strict definition, is offered by Forsyth⁴.

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According to him the expert systems have the following characteristics:

- ✦ Limited to a specific domain of expertise.
- ✦ Able to reason with uncertain data.
- ✦ Able to explain itself in a sensible way.
- ✦ Delivering advice as output.
- ✦ Designed to grow incrementally.
- ✦ Having a clear separation of knowledge and inference mechanism.
- ✦ Typically (not necessarily) rule-based.
- ✦ Always restricted to a narrow domain of expertise.
- ✦ The expertise is acquired and codified during lengthy interviews with one or more experts in the relevant domain.
- ✦ The expertise is codified as a collection of facts and rules, which together constitutes the knowledge base.
- ✦ The rules may be held as discrete production rules, or as a semantic network, or occasionally in some other way.

It is sometimes assumed that an expert system should be capable of 'natural language dialogue' with the user. This view is however highly debatable, and certainly many existing systems have no such features. Until computers begin to accept continuous spoken input, it is likely that the most efficient form of input will involve selection from menus, perhaps using a touch-sensitive screen; most systems will also require a facility for the input of words or numbers through a keyboard, and the appropriate 'mix' will depend on the problem domain.

4. ADVANTAGES

The motivation to use expert systems must lie in the benefits obtained. What then are the possible benefits? These would depend on individual situations but the general advantages summarised by Morris⁵ are listed below:

1. Experts can be freed from routine tasks and made available for more exciting, creative and demanding work.

2. Expertise can be pooled when more than one expert contributes to the system development. The pooling exercise can assist in the refinement of the procedures and help to make them more consistent.
3. Knowledge can be safeguarded, developed and distributed. Enormous sums of money are spent on training individuals, yet all their knowledge and expertise is lost when they die or leave the company. Expert systems offer a way of capturing this expertise and knowledge and at the same time making it available to other people.
4. Expertise can be available. Since expert systems provide explanations for advice given they can be used 24 hours a day without the presence of the expert.
5. Expert systems can be used for training purposes. The problem-solving and explanation capabilities of expert systems are particularly useful in training situations. Training can also be distributed throughout a company and done on an individual basis at times suited to the employee.
6. Expert systems can provide a standardised approach to problem solving.
7. The development of an expert system offers the expert with an opportunity to critically assess and improve his problem-solving behaviour.
8. The performance of non-experts can be improved over a period of time and they may eventually even reach expert status.
9. In many situations, expert systems can provide solutions to problems far more quickly than a human expert.
10. Expert systems have the potential for saving companies a vast amount of money, thus increasing profits.

5. APPLICATION IN LIBRARY AND INFORMATION SYSTEMS

Expert systems have been used successfully in economic and industrial sectors, and increasingly they are being employed in service

sectors including medical health care. Against this background, it is not surprising that the library and information services (LIS) sector may also explore the potentials of expert systems. Today the technology can boast a wide range of application areas in the field of library and information systems, some of which are discussed below:

5.1 Administration

Library administration must deal with complex problems on a day-to-day basis. Problems with budgeting, staff, and planning are just a few of the difficulties they face every day. During budget cuts, the administrator must determine what items to cut and by how much. Should staff be reduced? Should serials be cancelled? Will there be any money to buy books or equipment? An expert system could be helpful in assisting the administrator in making these decisions. One could develop a system composed of the heuristics (rules-of-thumb) that librarians use to make these decisions.

5.2 Staff Management

In hiring, promoting and placement of the staff, an expert system might be useful. By using criteria such as qualifications required for the job and experience, an expert system could be used to assist in the hiring process. An expert system could be developed to determine which staff members should receive raises, disciplined, or dismissal.

5.3 Planning

An expert system using information from patterns and material usage could help plan for remodelling or new facilities. The system would help the administrator to determine where the circulation desk should be located, where the copy machine should be placed, and where the OPAC terminals would get the most use.

5.4 Technical Services

More efforts have been in developing expert system applications for technical services. The focus of research efforts are witnessed in the

areas of cataloguing, classification and collection development.

5.5 Cataloguing

Expert systems have been developed to create MARC record⁶ and to apply some of the rules in AACR-2 for cataloguing. Roy Chang⁷ developed a cataloguing expert system based on the rules in AACR-2. He determined that its usefulness was limited because the system had no means of interpreting the rules. In this opinion 'cataloguing problems today are too widespread for employing an expert system'.

5.6 Classification

Classification is also a difficult area for an expert system. While there are guides to determine classification numbers and subject headings, there are no strict rules available, and the relationship between objects and classes are often ambiguous. Research is progressing in the development of systems for assigning subject headings and class numbers^{8,9}.

5.7 Collection Development

There are only two possible responses when one considers new materials for acquisition or old materials for discarding; yes or no. With only two possible responses, it is easier to develop an expert system. There has been at least one successful attempt at building expert system for collection development at Applied Physics Library¹⁰.

5.8 Reference Service

Expert systems would be useful for assisting patrons in locating materials and information. Expert systems may prompt the user for the type of information needed and display materials that may contain it.

6. CONCLUSION

The usefulness of expert systems in library and information systems will depend on increasing power and efficiency of hardware and software. To be able to offer expert system services to their clients, libraries will have to be involved in the following areas:

- ⊕ Development of prototype systems.
- ⊕ Development of knowledge representation schemes.
- ⊕ Experimentation with knowledge-based indexing, abstracting, and classification.
- ⊕ Experimentation with specialised development environments for specific domains of knowledge.

As knowledge based expert systems become more acceptable in the library community, libraries will begin to develop, purchase and maintain interactive knowledge-based expert systems for their clients.

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