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CASE STUDIES OF EXPERT SYSTEM & RESEARCH ASPECTS IN ARTIFICIAL INTELLIGENCE

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ABSTRACT

An expert system is a computer program that represents and reasons with knowledge of some specialist subject with a view to solving problems or giving advice. An Expert System is a problem solving and decision making system based on knowledge of its task and logical rules or procedures for using knowledge. Both the knowledge and the logic are obtained from the experience of a specialist in the area. To solve expert-level problems, expert systems will need efficient access to a substantial domain knowledge base, and a reasoning mechanism to apply the knowledge to the problems they are given. They will generally build upon the ideas of knowledge representation, production rules, search, and so on.Often we use an expert system shell which is an existing knowledge independent framework into which domain knowledge can be inserted to produce a working expert system. This paper introduces introduction, structure, new tools and applications of expert system. In this paper advantages and limitations of expert system. This paper also outlined current research trends which are going on expert system.

Keywords: Knowledge base,Inference Engine,PUFF,DENDRAL,MYCIN

I. INTRODUCTION

An Artificial Intelligence System created to solve problems in a particular domain is called an Expert System. An expert system is a knowledge intensive program to solve the problem in a domain that require considerable amount of technical expertise. An expert system is computer program that simulates the judgment and behavior of a human or an organization that has expert knowledge and experience in a particular field. Expert systems are an emerging technology ,past applications range from MYCIN, used in the medical field to diagnose of bacterial infection and effectively handles uncertain data, XCON/RI,used to configure computer systems. Dendral,does the inferring process of structure elucidation of chemical compounds. Expert systems are typically very domain specific.

The developer of such a system must limit his or her scope of the system to just what is needed to solve the target problem. Special tools or programming languages are often needed to accomplish the specific objectives of the system.

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II. EXPERT SYSTEM ARCHITECTURE

Expert system derives complex decisions from the combination of factual and heuristic knowledge. In order for the computer to be able to retrieve and effectively use heuristic knowledge, the knowledge must be organized in an easily accessible format that distinguishes among data, knowledge, and control structures.

The process of building expert systems is often called knowledge engineering. The knowledge engineer is involved with all components of an expert system:

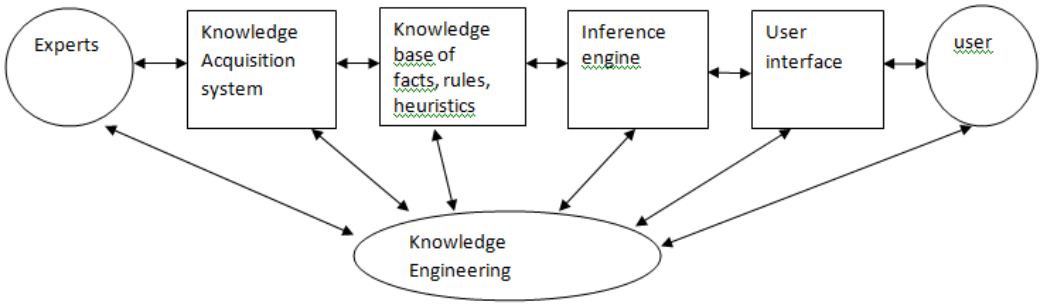

Figure 1

Building expert systems is generally an iterative process. The components and their interaction will be refined over the course of numerous meetings of the knowledge engineer with the experts and users.

So the fundamental modules of expert system are:

1. **Knowledge base** a core module of expert system. It is a warehouse of domain specific knowledge, consists of problem-solving rules, procedures, and intrinsic data relevant to the problem domain. A knowledge base is created by knowledge engineers, who translate the knowledge of real human experts into rules and strategies. These rules and strategies can change depending on the prevailing problem scenario. The knowledge base constitutes the problem-solving rules, facts, or intuition that a human expert might use in solving problems in a given problem domain. The knowledge base is usually stored in terms of if–then rules(production rules used in MYCIN,DENDRAL,XON).There are many others ways of representing the knowledge ie logic, semantic nets, frames ,conceptual dependency, production rules and scripts.
2. **WORKING MEMORY** refers to task-specific data for the problem under consideration.
3. **INFERENCE ENGINE** is a generic control mechanism that act as "rule interpreter" applies the axiomatic knowledge in the knowledge base to the task-specific data to arrive at some solution or conclusion.

Recall the steps in the basic Recognize Act Cycle:

1. Match the premise patterns of the rules against elements in the working memory. Generally the rules will be domain knowledge built into the system, and the working memory will contain the case based facts entered into the system, plus any new facts that have been derived from them.
2. If there is more than one rule that can be applied, use a conflict resolution strategy to choose one to apply. Stop if no further rules are applicable.

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3. Activate the chosen rule, which generally means adding/deleting an item to/from working memory. Stop if a terminating condition is reached, or return to step 1.Early production systems spent over 90% of their time doing pattern matching, but there is now a solution to this efficiency problem

EXAMPLES OF EXPERT SYSTEM:

1965	DENDRAL	Stanford analyze mass spectrometry
1965	MacSyma	MIT symbolic mathematics
1972	MYCIN	Stanford Diagonsis of blood diseases
1978	Digitalis	MIT Digitalis therapy
1979	PUFF	Stanford pulmonary diseases
1982	XCON	DEC Computer configuration
1986	ACES	Aerospace satellite diagnosis
1986	Delta GE	diagnosis of diesel locomotives
1992	Max NYNEX	Telephone network troubleshooting

Figure 2

2.1 Uses of Expert Systems

1. Experts systems have vast quantity of domain specific knowledge.
2. Expert system plays three major role:Role of a problem solver,tutor and archive.
3. Experts systems are always available and can be used anywhere, any time.
4. Cost effective
5. Expert System has increased accessibility than human experts.
6. Expert system are highly advantageous in interdisciplinary domains.
7. Expert System are easy to develop and modify
8. Human experts are not 100% reliable or consistent as moods may lead to a default assumptions or irrelevant.

2.2 Limitation of present Expert Systems

1. Limited domain specific knowledge.
2. Lack of knowledge representation mechanism.
3. User has to describe the problem in formal language only.
4. Systems are not always up to date.
5. Lack of understanding as “no common-sense”.
6. Experts needed to setup and maintain system.
7. Possibility of error as they don’t learn reason and cannot refine its own knowledge base as it needs knowledge engineering.
8. Development cost may be too high as lot of recourses is needed today.

2.3 Expert System Applications

1. PUFF: Expert System for the interpretation of pulmonary function tests for patients with lung disease.PUFF was probably the first AI system to have been used in clinical practice.It was developed by Stanford University and Pacific Presbyterian Medical Center (Janice Aikins, John Kunz, Ted Shortliffe, Robert Fallat) PUFF can diagnose the presence and severity of lung disease and produce reports for the patient's file.

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PUFF was the first system developed using EMYCIN (Essential MYCIN, van Melle, 1979). It included the domain-independent features of MYCIN:

- rule interpreter
- explanation
- knowledge acquisition.

This provided a mechanism for representing domain-specific knowledge in the form of production rules, and for performing consultations in that domain. PUFF was originally written in Interlisp using the SUMEX-AIM computer facility and had to be rewritten in BASIC before it could be installed at PMC. PUFF does not require direct interaction with a physician, avoiding the human engineering problem.

Knowledge Representation: there are 75 clinical paramenters (representing pulmonary function test results such as "total lung capacity" and "residual volume").

Control Structure: PUFF is primarily a goal-directed, backward chaining system employing some 400 production rules. If it cannot conclude the value for a parameter, it asks the user. A pulmonary physiologist reviews the PUFF report, and if necessary modifies it on-line before printing it out. The report was found not to require modification in 85% of cases. Modifications, where made, often consisted of comments such as "This is consistant with last visit".

The PUFF basic knowledge base was incorporated into the commercial "Pulmonary Consult" product. Several hundred copies were sold in the 1980s and used around the world.

2.SHYSTER is a legal expert system derieved from the “Shyler” a slang word for Who acts in a disreputable, unethical, or unscrupulous way, especially in the practice of law and politics. SHYSTER is a specific example of a general category of legal expert systems, broadly defined as systems that make use of artificial intelligence (AI) techniques to solve legal problems.It was developed at the Australian National University in Canberra in 1993. It was written as the doctoral dissertation of James Popple under the supervision of Robin Stanton . Although SHYSTER attempts to model the way in which lawyers argue with cases, it does not attempt to model the way in which lawyers decide which cases to use in those arguments. SHYSTER is of a general design, permitting its operation in different legal domains. It was designed to provide advice in areas of case law that have been specified by a legal expert using a bespoke specification language. Its knowledge of the law is acquired, and represented, as information about cases. It produces its advice by examining, and arguing about, the similarities and differences between cases. SHYSTER was tested in four different and disparate areas of case law.

3. PROSPECTOR This expert system help in evaluation of the mineral potential of a geological site or region.PROSPECTOR: consultation system to assist geologists working in mineral exploration. It was developed by Hart and Duda of SRI International attempts to represent the knowledge and reasoning processes of experts in the geological domain. It is intended user is an exploration geologist in the early stages of investigating a possible drilling site

4. **MYCIN**: MYCIN was developed at Stanford University in the mid-1970s. It was designed to aid physicians in the diagnosis and treatment of meningitis and bacteremia infections. MYCIN was strictly a research system. Medical system for diagnosing blood disorders.

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5.**DESIGN ADVISOR**: The Expert Design Advisor (EDA) is a decision-aided toolset for use by systems engineers in facilitating the development of large, complex systems involving Mission Critical Computing Resources (MCCR).Gives advice to designers of processor chips.

6.Dendral: It was an influential pioneer project in artificial intelligence (AI) of the 1960s, and the computer software expert system that it produced. Its primary aim was to study hypothesis formation and discovery in science. For that, a specific task in science was chosen: help organic chemists in identifying unknown organic molecules, by analyzing their mass spectra and using knowledge of chemistry. It was done at Stanford University by Edward Feigenbaum, Bruce G. Buchanan, Joshua Lederberg, and Carl Djerassi, along with a team of highly creative research associates and students. It began in 1965 and spans approximately half the history of AI research .The software program Dendral is considered the first expert system because it automated the decision-making process and problem-solving behavior of organic chemists.

III. EXPERT SYSTEM USED IN INDIA

1. **Indian Institute of Horticultural Research Institute, Bangalore:** The first software for use by the grape cultivators was prepared by the Indian Institute of Horticultural Research Institute, Bangalore. This spontaneous response made them to undertake similar software for providing guidance to mushroom cultivators, which became extremely popular and a large number of growers using it regularly for getting solutions to their problems. The Institute has launched into an effort to give a comprehensive package of practices of about 148 horticulture crops for cultivation in the 4 Southern states of Kerala, Tamilnadu, Karnataka and Andhra Pradesh.

2.**AGREX** Center for Informatics Research and Advancement, Kerala has prepared an Expert System called AGREX to help the Agricultural field personnel give timely and correct advice to the farmers. These Expert Systems find extensive use in the areas of fertilizer application, crop protection, irrigation scheduling, diagnosis of diseases in paddy and post harvest technology of fruits and vegetables.

3.**Farm Advisory System:** Punjab Agricultural University, Ludhiana, has developed the Farm Advisory System to support agri-business management. The conversation between the system and the user is arranged in such a way that the system asks all the questions from user one by one which it needs to give recommendations on the topic of farm Management. The inputs are encouraging and acceptance by farmers is very good.

4. **TDP Technologies Pvt. Ltd**. In Chennai is using MYCIN technique for diagnosing blood disorders..

5. **Tata Memorial Hospital** in Mumbai is using PUFF for diagnosis of respiratory conditions.

IV. FUTURE PROSPECTIVE

Research is being going on to developing such an expert system, who can understand emotions of people, can reason ,create new innovations itself and not only intelligent but judge the intelligence of human being. To develop such type of system that can understand the environment, maintain, update itself such expert system can be possible if there are large knowledge base and good knowledge representation techniques.

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