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Expert System and Research Aspects in Artificial Intelligence

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Abstract: This paper deals with the study of expert system architecture and its applications in various fields. The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise. Expert systems have incorporated such heuristic rules and increasingly have the ability to learn from experience. Expert systems remain aids to, rather than replacements for, human experts.
Keywords: Knowledge engineer, Expert System shell, Mycin.

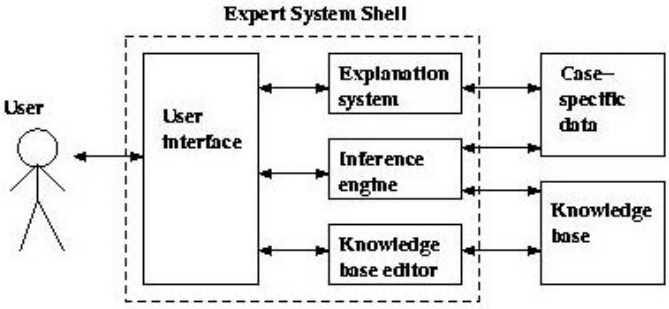
I. INTRODUCTION

AI programs that achieve expert level competence in solving problems in particular task area by use of knowledge base about that particular task area is known as expert system. Facts for a knowledge base must be acquired from human experts through interviews and observations. This knowledge is then usually represented in the form of "if-then" rules (production rules): "If some condition is true, and then the following inference can be made (or some action taken)." The knowledge base of a major expert system includes thousands of rules.

A. Expert System Architecture

Expert system architecture has following components

1) I/O Interface
2) Inference Engine
3) Knowledge base
4) Editor
5) Explanation Module
6) Working memory
7) Case history file and learning module



Expert System Architecture

B. I/O Interface

User interface provides interaction between user and the expert system itself. It is generally Natural Language Processing so as to be used by the user who is well-versed in the task domain. The user of the ES need not be necessarily an expert in Artificial Intelligence. It explains how the expert system has arrived at a particular recommendation. The explanation may appear in the following forms −

1) Natural language displayed on screen.
2) Verbal narrations in natural language.
3) Listing of rule numbers displayed on the screen.

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C. Inference Engine

Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.
In case of rule based expert system, it −

1) Applies rules repeatedly to the facts, which are obtained from earlier rule application.
2) Adds new knowledge into the knowledge base if required.
3) Resolves rules conflict when multiple rules are applicable to a particular case.

To recommend a solution, the Inference Engine uses the following strategies −

1) Forward Chaining: it starts with data available and then concludes a desired goal.
2) Backward Chaining: it starts with list of goals and works backward if there is data which will allow it to conclude these goals.

D. Knowledge base

The knowledge base is a store of both, factual and heuristic knowledge.

1) *Factual Knowledge* − It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
2) *Heuristic Knowledge* − It is about practice, accurate judgments, one's ability of evaluation, and guessing.

Knowledge representation is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules.

E. Editor

Knowledge base editor which help the expert or knowledge engineer to easily update and check the knowledge base. The success of any expert system majorly depends on the quality, completeness, and accuracy of the information stored in the knowledge base.
The knowledge base is formed by readings from various experts, scholars, and the Knowledge Engineers. The knowledge engineer is a person with the qualities of empathy, quick learning, and case analyzing skills.
He acquires information from subject expert by recording, interviewing, and observing him at work, etc. He then categorizes and organizes the information in a meaningful way, in the form of IF-THEN-ELSE rules, to be used by interference machine. The knowledge engineer also monitors the development of the expert system.

F. Explanation Module

Almost all expert systems also have an explanation subsystem ,which allows the program to explain its reasoning to the user.

G. Working memory

The case specific data includes both data provided by the user and partial conclusions (along with certainty measures) based on this data

H. Case history file and learning module

This component is used to assist in building and refining knowledge base.

I. Expert system shell

Shell is nothing but an expert system without knowledge base. A shell provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility. Using shells to write expert systems generally greatly reduces the cost and time of development.

J. Mycin

Mycin was an expert system developed at Stanford in the 1970s. Its job was to diagnose and recommend treatment for certain blood infections. Mycin represented its knowledge as a set of IF-THEN rules with certainty factors. The following is an English version of one of Mycin's rules:
IF the infection is pimary-bacteremia
AND the site of the culture is one of the sterile sites
AND the suspected portal of entry is the gastrointestinal tract
THEN there is suggestive evidence (0.7) that infection is bacteroid.
The 0.7 is roughly the certainty that the conclusion will be true given the evidence. If the evidence is uncertain the certainties of the bits of evidence will be combined with the certainty of the rule to give the certainty of the conclusion.

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Mycin was written in Lisp, and its rules are formally represented as Lisp expressions. Mycin is a (primarily) goal-directed system, using the basic backward chaining reasoning strategy. There were many other developments from the MYCIN project. For example, EMYCIN was really the first expert shell developed from Mycin. A new expert system called PUFF was developed using EMYCIN in the new domain of heart disorders. And system called NEOMYCIN was developed for training doctors, which would take them through various example cases, checking their conclusions and explaining where they went wrong.

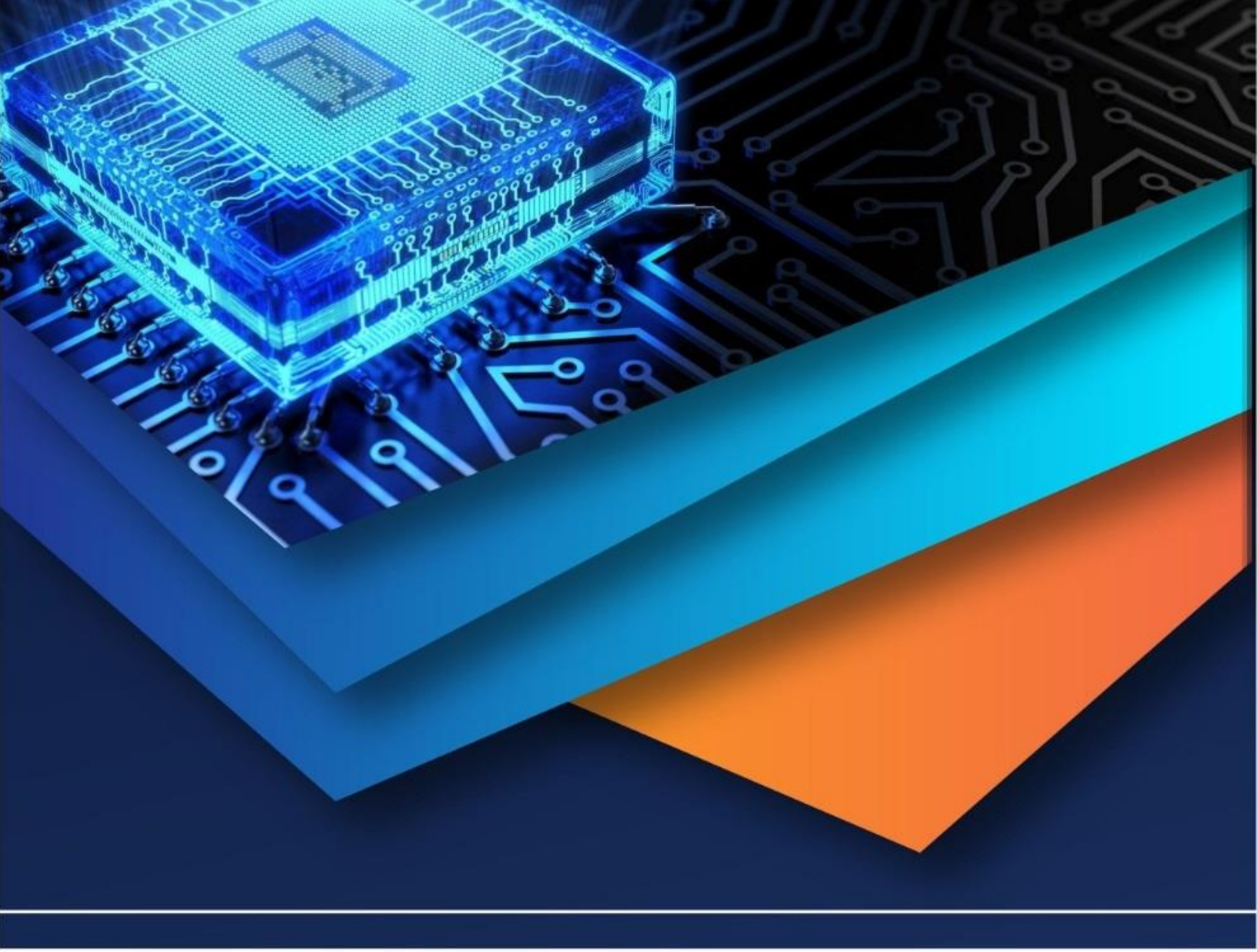
II. CONCLUSION

It is concluded that Expert system is one of the prominent research domains of AI. Research is being going on to develop expert systems in various fields. This is the biggest challenge to develop expert system that understand the environment and update itself with latest technology. Knowledge gathers from subject matter experts and then codifying this knowledge is also require proper trained knowledge engineer.

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