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Study on Expert System: A Focus On architecture

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ABSTRACT: An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.The performance of an expert system is based on the expert's knowledge stored in its knowledge base. The more knowledge stored in the KB, the more that system improves its performance. One of the common examples of an ES is a suggestion of spelling errors while typing in the Google search box.Before using any technology, we must have an idea about why to use that technology and hence the same for the ES. Although we have human experts in every field, then what is the need to develop a computer-based system

KEYWORDS: User Interface, Artificial intelligence, knowledge base.

I. INTRODUCTION

In this paper study of expert system **Artificial Intelligence** is a piece of software that simulates the behavior and judgment of a human or an organization that has experts in a particular domain is known as an expert system. It does this by acquiring relevant knowledge from its knowledge base and interpreting it according to the user's problem. The data in the knowledge base is added by humans that are expert in a particular domain and this software is used by a non-expert user to acquire some information. It is widely used in many areas such as medical diagnosis, accounting, coding, games etc.

An expert system is AI software that uses knowledge stored in a knowledge base to solve problems that would usually require a human expert thus preserving a human expert's knowledge in its knowledge base. They can advise users as well as provide explanations to them about how they reached a particular conclusion or advice. **Knowledge Engineering** is the term used to define the process of building an Expert System and its practitioners are called **Knowledge Engineers**. The primary role of a knowledge engineer is to make sure that the computer possesses all the knowledge required to solve a problem. The knowledge engineer must choose one or more forms in which to represent the required knowledge as a symbolic pattern in the memory of the computer.

It is important to stress to students that expert systems are assistants to decision makers and not substitutes for them. Expert systems do not have human capabilities. They use a knowledge base of a particular domain and bring that knowledge to bear on the facts of the particular situation at hand. The knowledge base of an ES also contains **heuristic knowledge -** rules of thumb used by human experts who work in the domain.

II. LITERATUREREVIEW

1950 Turing Test - a machine performs intelligently if an interrogator using remote terminals cannot distinguish its responses from those of a human. Result: General problem-solving methods.1960 AI established as research field. Result: Knowledge-based expert systems.1970 AI commercialization began. Result: Transaction processing and decision support systems using AI.1980 Artificial neural networks Result: Resembling the interconnected neuronal structures in the human brain.1990 Intelligent agents. Result: Software that performs assigned tasks on the users behalf

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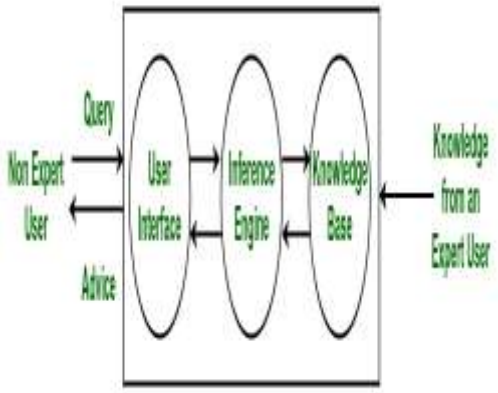
III. ARCHITECTURE OF AN EXPERT SYSTEM

Modern expert knowledge systems use machine learning and artificial intelligence to simulate the behavior or judgment of domain experts. These systems can improve their performance over time as they gain more experience, just as humans do.



Determining the characteristics of the problem. Knowledge engineer and domain expert work in coherence to define the problem the knowledge engineer translates the knowledge into a computer-understandable language. He designs an inference engine, a reasoning structure, which can use knowledge when needed. Knowledge Expert also determines how to integrate the use of uncertain knowledge in the reasoning process and what type of explanation would be useful.

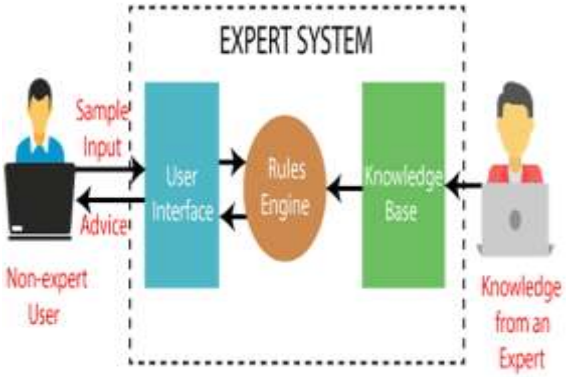
i. User interface

User interface provides interaction between user of the ES and the ES itself. It is generally Natural LanguageProcessing so as to be used by the user who is well-versed in the task domain. The user of the ES need not benecessarily an expert in Artificial Intelligence.

It explains how the ES has arrived at a particular recommendation. The explanation may appear in the followingforms −

- Natural language displayed on screen.
- Verbal narrations in natural language.
- Listing of rule numbers displayed on the screen.

The user interface makes it easy to trace the credibility of the deductions.



ii. Inference Engine

Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawlesssolution.In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from theknowledge base to arrive at a particular solution.In case of rule based ES, it −

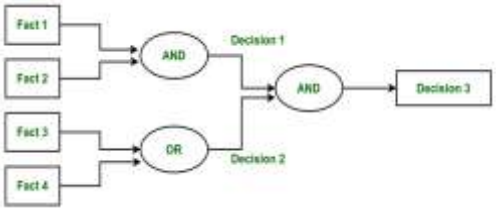
- Applies rules repeatedly to the facts, which are obtained from earlier rule application.
- Adds new knowledge into the knowledge base if required.
- Resolves rules conflict when multiple rules are applicable to a particular case.

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

a. Forward Chaining

The Inference Engine follows the chain of conditions and derivations and finally deduces the outcome. Itconsiders all the facts and rules, and sorts them before concluding to a solution.

This strategy is followed for working on conclusion, result, or effect. For example, prediction of share marketstatus as an effect of changes in interest rates.



It is a data-driven strategy. The inferencing process moves from the facts of the case to a goal (conclusion). The strategy is thus driven by the facts available in the working memory and by the premises that can be satisfied. The inference engine attempts to match the condition (IF) part of each

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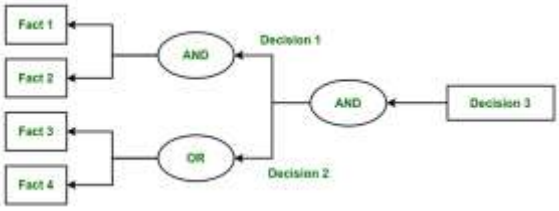
rule in the knowledge base with the facts currently available in the working memory. If several rules match, a conflict resolution procedure is invoked; for example, the lowest-numbered rule that adds new information to the working memory is fired. The conclusion of the firing rule is added to the working memory.

Forward-chaining systems are commonly used to solve more open-ended problems of a design or planning nature, such as, for example, establishing the configuration of a complex product.

b. Backward Chaining

On the basis of what has already happened, the Inference Engine tries to find out which conditions could havehappened in the past for this result. This strategy is followed for finding out cause or reason. For example,diagnosis of blood cancer in humans



The inference engine attempts to match the assumed (hypothesized) conclusion - the goal or subgoal state - with the conclusion (THEN) part of the rule. If such a rule is found, its premise becomes the new subgoal. In an ES with few possible goal states, this is a good strategy to pursue.

If a hypothesized goal state cannot be supported by the premises, the system will attempt to prove another goal state. Thus, possible conclusions are review until a goal state that can be supported by the premises is encountered.

Backward chaining is best suited for applications in which the possible conclusions are limited in number and well defined. Classification or diagnosis type systems, in which each of several possible conclusions can be checked to see if it is supported by the data, are typical applications.

iii. Knowledge Base

It contains domain-specific and high-quality knowledge. Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection ofhighly accurate and precise knowledge.

What is Knowledge?

The data is collection of facts. The information is organized as data and facts about the task domain.

Data,information, and **past experience** combined together are termed as knowledge. Components of Knowledge Base The knowledge base of an ES is a store of both, factual and heuristic knowledge.

a. Factual Knowledge –

It is the information widely accepted by the Knowledge Engineers and scholars inthe task domain.

b. Heuristic Knowledge –

It is about practice, accurate judgment, one's ability of evaluation, and guessing.

IV. KNOWLEDGE ACQUISITION PROCESS

The organization obtains knowledge by linking information together and identifying recurring patterns.The company considers this repetition of patterns as the basis for making various decisions. In short, this is the knowledge that organizations are looking for.Knowledge refers to discovering a particular pattern through the study and analysis of information and data. The organization can use these patterns as bases for making various decisions.

Steps of knowledge acquisition process

The organization transforms raw materials into knowledge so that they can be used and utilized. In short, the organization creates knowledge using raw materials.The knowledge acquisition process consists of five main steps. The following paragraphs explain these steps in more detail:

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a. Data gathering

Data gathering is the first step in knowledge acquiring. first, you to determine what data will be collected, how, and where this data is located. In other words, planning before anything else.

Determining the type of data required and the accuracy and correctness of this data significantly affect the quality and accuracy of the knowledge. Therefore, You should implement this step well.

Also, knowledge acquisition can depend on any data previously collected for another purpose. For example, you can rely on customer purchasing data. Or the financial statements of the organization. Etc.

b. Data Organizing

In the previous step, the data state is often not well organized. Therefore, the knowledge management team must rearrange the data to obtain valuable information from it in this step.For example, the data with a relationship are collected in one place, like collecting customer data from a specific geographic area. Collecting data for each age group of customers together, and so on.

Usually, the knowledge team stores the information in dedicated databases. Then, the knowledge team applies many different information technology methods to organize this data.

c. Summarizing

In this step, various statistics are extracted from databases. These statistics are presented in tables and graphs in multiple forms.It should be noted here that upon completion of this step, the raw data has been converted into information that can be used further.

d. Analyzing

The information is analyzed, looking for recurring patterns that can be considered a new characteristic or a new knowledge.For example, you might find that a particular age group of customers is interested in a specific product. For example, you can get a result that people between the ages of 8-28 are interested in buying video games. Another example, you notice that in a particular geographic region, the majority of customers are women. And so on.

e. Synthesizing

This step depends on joining statistics and patterns and coming out of them with fixed concepts that can be relied upon. These concepts are the knowledge you are looking for.

V. APPLICATIONS OF EXPERT SYSTEMS

Expert systems can be effective in specific domains or subject areas where experts are required to make diagnoses, judgments or predictions.These systems have played a large role in many industries, including the following:

- **Financial services :**

Where they make decisions about asset management, act as robo-advisors and make predictions about the behaviour of various markets and other financial indicators.

- **Mechanical engineering**

Where they troubleshoot complex electromechanical machinery.

- **Telecommunications**

Where they are used to make decisions about network technologies used and maintenance of existing networks.

- **Healthcare**

Where they assist with medical diagnoses.

- **Agriculture**

Where they forecast crop damage.

- **Customer service**

Where they help schedule orders, route customer requests and solve problems.

- **Transportation**

Where they contribute in a range of areas, including pavement conditions, traffic light control, highway design, bus and train scheduling and maintenance, and aviation flight patterns and air trafficcontrol.

- **Law**

Where automation is starting to be used to deliver legal services, and to make civil case evaluations and assess product liability.

VI. CONCLUSION

An Expert System is an interactive and reliable computer-based decision-making system which uses both facts and heuristics to solve complex decision-making problem.These systems can improve their performance over time as they gain more experience, just as humans do.

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