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Analytical Study on Artificial Intelligence Techniques to Achieve Expert Systems

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ABSTRACT: In this paper the author wants to describe the use of AI (Artificial Intelligence) in various aspects of ES (Expert System). AI is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving. There is a class of computer programs, known as expert systems that aim to mimic human reasoning. The techniques and methods used to build these programs are the outcome of efforts in a field of computer science known as the AI.

Keywords: AI, ES, ESS & AST

I. INTRODUCTION

Artificial Intelligence is the capability of computers or programs to operate in ways believed to mimic human thought processes, such as reasoning and learning.AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems. This mainly concerned with the one of the major branche of AI, that is expert systems. Building an expert system is known as the knowledge engineering and its practitioners are called knowledge engineers. He must also ensure that the computer can use the knowledge efficiently by selecting the reasoning methods. The practice of knowledge engineering is described later. We first describe the components of expert systems. An expert system is a computer program, with a set of rules encapsulating knowledge about a particular problem domain (i.e., medicine, chemistry, finance, flight, et cetera). These rules prescribe actions to take when certain conditions hold, and define the effect of the action on deductions or data [1][4].

An expert system is a computer program that is designed to hold the accumulated knowledge of one or more domain experts.

There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users. Expert systems that record the knowledge needed to solve a problem as a collection of rules stored in a knowledge based are called rule based system

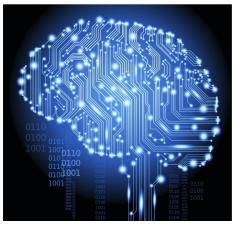


Fig. 2.

Major Branches of AI

- Expert system**:** Programming computers to make the decisions in real life situations. (ex: expert system help doctors in diagnosing the diseases)
- Robotics : Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots.
- Neural system: Computer that can act like or simulate the functioning of the brain
- Learning system**:** Computer changes how it reacts or functions to the feedback provided to it [4].

II. EXPERT SYSTEM ARCHITECTURE

An expert system is typically consist of two major components, the Knowledge base and the Expert System Shell. Knowledge base contains domain-specific and high-quality knowledge. Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge. The Expert System Shell is a

problem-independent component housing facilities for creating, editing, and executing rules. A software architecture for an expert system is illustrated in Fig. 2.

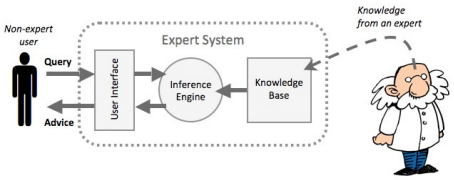


Fig. 2. Expert System Process.

The shell portion includes software modules whose purpose it is to,

- Advising
- Instructing and assisting human in decision making
- Demonstrating
- Deriving a solution
- Diagnosing
- Explaining
- Interpreting input
- Predicting results
- Justifying the conclusion
- Suggesting alternative options to a problem [3]

A. Knowledge Base Editor

The Knowledge base editor is a normal text editor, a graphical editor, or the combination of these two types. It provides facilities that enable a subject matter expert to compose and add rules to the Knowledge-base.

B. Client Interface

The Client Interface processes requests for service from system-users and with the help of application layer. Client Interface logic routes these requests to an appropriate shell program unit. For example, when a subject matter expert wishes to create or edit a rule, they use the Client Interface to dispatch the *Knowledge-base Editor*. Other service requests might schedule a rule, or a group of rules, for execution by the Rule Engine.

C. Rule Translator

Rules that are made by subject matter experts, are not directly executable. They must first be converted from their human-language to a form that can be interpreted by the Rule Engine. Converting rules from one form to another form is a function performed by the Rule Translator.

The translation of rules from original form to a machine-readable form requires parsing the textual representation to obtain a data structure referred to as an Abstract Syntax Tree (AST). The AST representation of rules is the memory-resident data structure that guides execution of the inference engine when it comes time to apply a rule. The AST is an abstract data type designed to make its interpretation by the Rule Engine easy and efficient. This abstract data type is very

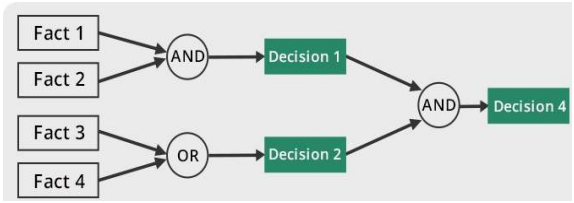
expressive and permits the construction of very complex and powerful rules. There is a third form in which rules may be expressed. A rule AST is converted into an equivalent form for storage in the Knowledge-base. The way in which this information represented in the Knowledge-base depends on the storage technology [1][3][5].

D. Inference Engine

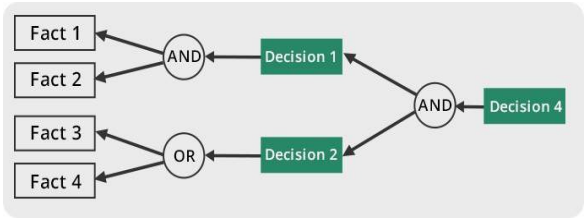
Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct solution .In case of knowledge-based ES, the Inference Engine acquires the knowledge and manipulates the knowledge from the knowledge base to arrive at a particular solution. Inference Engine uses the following strategies –

- Forward Chaining
- Backward Chaining

Forward Chaining. It is the strategy of an expert system to get the answer of question " What can happen next ? ". Here, the Rule Engine follows the chain of conditions and derivations and finally produce the outcome. It considers all the facts and rules, and sorts them before concluding to a particular solution.



Backward Chaining. In this strategy the expert system find out the answer "Why this happen". On the basis of what has already happened, the Rule Engine tries to find out which conditions could have happened in the past for this result. This strategy is followed for finding out cause or reason. For example, diagnosis of heart problem in humans [3][4].



E. Rule Object Classes

The Rule Object Classes containing the container for the object supporting classes.

- AST Construction
- Rule Editing
- Knowledge Based Representation

- Conversion from metadata to AST and from AST to metadata.

III. CONSTRUCTING AN EXPERT SYSTEM

The construction of an expert system is less challenging than anyone think, given the almost magical powers attributed to this class of programs. The task is made easier because of the reasons,

- Large portions of the Rule Translator can be generated automatically using lexical analyzer and parser generators, and
- Text editors (e.g., TextPad) can be purchased, inexpensively, and integrated into the Expert System Shell.[3][4]

The steps that are used for the construction of the expert system are in figure 3.

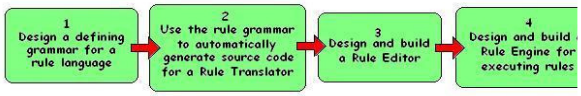


Figure - - Construction steps

Fig. 3.

IV. CHARACTERSTICS OF A EXPERT SYSTEM

-An expert system is built to perform at a human expert level in a narrow, specialised domain. Thus, the most important characteristic of an expert system is its high-quality performance.

-No matter how fast the system can solve a problem; the user will not be satisfied if the result is wrong!

-On the other hand, the speed of reaching a solution is very important. Even the most accurate decision or diagnosis may not be useful if it is too late to apply, for instance, in an emergency, when a patient dies or a nuclear power plant explodes.

-Expert systems apply **heuristics** to guide the reasoning and thus reduce the search area for a solution.

-A unique feature of an expert system is its **explanation capability**. It enables the expert system to review its own reasoning and explain its decisions.

-Expert systems employ **symbolic reasoning** when solving a problem. Symbols are used to represent different types of knowledge such as facts, concepts and rules.

-We should be aware that **an expert is only a human and thus can make mistakes**, and therefore, an expert system built to perform at a human expert level also should be "allowed" to make mistakes.

-In expert systems, knowledge is separated from its processing (knowledge base and inference engine are split up). A conventional program is a mixture of knowledge and the control structure to process this knowledge.

When an expert system shell is used, a knowledge engineer or an expert simply enters rules in the knowledge base. Each new rule adds some new knowledge and makes the expert system smarter

V. EXPERT SYSTEM COMPARISON

Human Experts	*Expert Systems*	*Conventional Programs*
Use knowledge in the form of rules of thumb or heuristics to solve problems in a narrow domain.	Process knowledge expressed in the form of rules and use symbolic reasoning to solve problems in a *narrow domain*.	Process data and use algorithms, a series of well-defined operations, to solve general numerical problems.
In a human brain, knowledge exists in a compiled form.	Provide a *clear separation of knowledge from its processing*.	Do not separate knowledge from the control structure to process this knowledge.
Capable of explaining a line of reasoning and providing the details.	*Trace the rules fired* during a problem-solving session and *explain how* a particular conclusion was reached and *why* specific data was needed.	Do not explain how a particular result was obtained and why input data was needed.
Human Experts	*Expert Systems*	*Conventional Programs*
Use inexact reasoning and can deal with incomplete, uncertain and fuzzy information.	Permit *inexact reasoning* and can deal with incomplete, uncertain and fuzzy data.	Work only on problems where data is complete and exact.
Can make mistakes when information is incomplete or fuzzy.	*Can make mistakes* when data is incomplete or fuzzy.	Provide no solution at all, or a wrong one, when data is incomplete or fuzzy.
Enhance the quality of problem solving via years of learning and practical training. This process is slow, inefficient and expensive.	Enhance the quality of problem solving by adding new rules or adjusting old ones in the knowledge base. When new knowledge is acquired, *changes are easy* to accomplish.	Enhance the quality of problem solving by changing the program code, which affects both the knowledge and its processing, making changes difficult.

VI. ADVANTAGES

- Smarter artificial intelligence can replace human jobs, freeing people for other works by automating manufacturing and transportation.
- Self writing, self modifying and learning softwares can relief programmers of the burdensome tasks of specifying functions of the different programs.
- Artificial intelligence will be used as cheap labour, then there must be increament in profits for corporation.
- Artificial intelligence can make deployment easier and less resource intensive.
- Compared to traditional programming techniques, expert-system approaches provide the added flexibility (and hence easier modifiability) with the ability to model rules as data rather than as code. In situations where an organization's IT department is overwhelmed by a software-development backlog, rule-engines, by facilitating turnaround, provide a means that can allow organizations to adapt more readily to changing needs.
- In practice, modern expert-system technology is employed as an adjunct to the traditional programming techniques, and this hybrid approach allowed the combination of the strengths of both

approaches. Thus, rule engines allow control through programs (and user interfaces) written in a traditional language, and also incorporate necessary functionality such as inter-operability with existing database technology [4-6].

VII. DISADVANTAGE

-Rapid advances in AI could lead to massive structural unemployment.
-Unpredictable and unseen impacts of new features.
-An expert system or rule-based approach is not optimal for all problems, and considerable knowledge is required to apply in any of the systems.
-Ease of rule creation and rule modification can be double-edged. A system can be sabotaged by a non-knowledgeable user who can easily add worthless rules or rules that conflict with existing ones. Reasons for the failure of many systems include the absence of (or neglect to employ diligently) facilities for system audit, detection of possible conflict, and rule lifecycle management (e.g. version control, or thorough testing before deployment). The problems to be addressed here are as much technological as organizational [4-5].

VIII. APPLICATIONS

- Introduction to Machine Learning Approaches
- Fuzzy Logic Improves Decision Support Software
- Shell Programming in Expert Systems Applications
- Smart Home Appliances for Better Quality of Life – Combining artificial intelligence with home automation in smart home appliances results in an improved quality of life for many, including the elderly and disabled.
- Voice Recognition Software for Disabled Students – Disabled students are often at a disadvantage in the classroom. Voice recognition software improves communication, enables note-taking, and increases participation.
- Teaching Special Needs Children with Autism – Robots are acting as therapy assistants to help parents and therapists in teaching special needs children with autism [4-5].

IX. SCOPE AND FUTURE

According to many of the experts, faster than the majority of us think or are prepared for. "we will have both the hardware and the software to achieve human level artificial intelligence with the broad intelligence of human including our emotional intelligence by the year 2029". If that sounds like something from a scary movie ("Terminator" may come to mind). Its not to worry, such super machines will also have morals and respect us as their creators (the people in scary movies rarely think that anything bad will happen to them either). He also believes that humans themselves will be healthier, smarter, and more capable in the near future by merging with our new upcoming technology. For example, tiny robots implanted in our brains will work directly with our neurons to make us smarter (this may call to mind some other movies). AI began as an attempt to answer some of the most fundamental questions about human existence by understanding the nature of intelligence, but it has grown into a scientific and technological field affecting many aspects of commerce and society. Even as AI technology becomes integrated into the fabric of everyday life, AI researchers always remain focused on the upcoming challenges of automating intelligence. Work is progressing on developing systems that converse in natural language, that perceive and respond to the surroundings, and that encode and provide useful access to all of human knowledge and expertise [2][4].

X. CONCLUSION

Its now the time to sit and think upon for the future of artificial intelligence in expert systems whether as to go with traditional technologies methods or to adapt the new science of artificial intelligence. The overall motivation behind this paper is to modernize our ancestral or traditional methods so as to bring in a rapid change in the growth of highly developed and developing expert systems so as to cater the needs of growing population. The development process may be incremental but the overall concept requires a paradigm shift in the way we think about modernization of production that is based more on needs and novel ways of meeting them rather than modifying the existing techniques.

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