

# Ontology based expert systems – replication of human learning

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## 1. Introduction

This paper mainly focuses of the learning ability of the Expert Systems. This paper presents an elite system well known as Expert Systems, which tries to replicate the behavior of a 'Human Expert'. The expert systems work on the concept of 'Knowledge Base'. This knowledge base is developed by a 'Knowledge Engineer' after conducting a series of interviews with the 'Human Expert'. The 'Inference Engine' uses the facts from the 'Knowledge Base' in order to derive a solution to a problem. The performance of the Expert System fully depends on the quality of the Knowledge Base and the Inference Engine. The major issue to be considered under the development of the Expert systems is the ability to learn things by themselves. Expert Systems 'Replicate' the approach of human experts towards solving a problem, similarly the expert systems can also 'Replicate the behavior of Human Learning'. While learning a new fact humans use their existing knowledge and try to respond to the new fact accordingly. Similarly, an Expert System, if given a 'Baseline – A strict set Rules to follow' and the 'Ability to Derive a Relation between various Facts (An Ontology)' while learning, they can also 'derive' or 'learn' new facts the same way Human Experts learn or Expand their knowledge.

## 2. Expert systems

Expert Systems are special kind of software systems which aim to solve the problems to which human experts give better solutions.

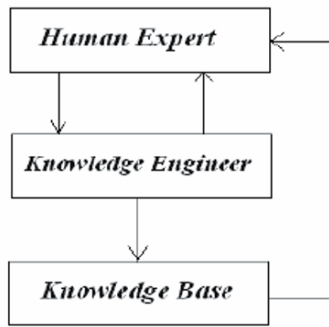
Expert Systems try to replicate the behavior of a human expert. Expert Systems work on the concept of special kind of databases known as Knowledge base. These Knowledge bases store facts about the domain of the expert system.

This Knowledge Base is designed by a Knowledge Engineer. The Knowledge base is designed by the knowledge engineer after detailed interview sessions with the human expert. A Knowledge Acquisition System is built to keep the Knowledge Base Complete Consistent and Correct.

### 2.1 Development of an expert system

First of all the Developer should understand the system should achieve. Initially the Knowledge Engineer conducts a series of interviews with the human expert in that particular domain and understands his ways of solving expert level problems.

Although the expert might give solution to a problem easily, he or she may find it difficult to explain how he or she gave the solution. It is the job of the Knowledge Engineer to extract all the essential details about the domain to build a proper Knowledge Base also it is his job to represent the knowledge in a proper format in the Knowledge Base for convenience of writing code. This task is extremely important because the performance of the expert system depends a lot on the quality of the Knowledge Base. This series of interviews goes on until the Knowledge Engineer feels he has acquired all the appropriate facts about the Domain. A major requirement of the end user is getting an explanation for the decisions taken by an Expert System. An Explanation System was introduced for an Expert System to give explanation of the decisions taken by it. To extract this kind of explanation, the Knowledge in the Knowledge Base is written in the form of rules i.e. in the form of if-then rules like "IF you want to score good marks then you have to study hard". Changing the Knowledge into rules is not a simple task because of the ambiguity and duplications of facts in the Knowledge Base; it is needed to be managed as



**Fig. 1** Development of a simple expert system

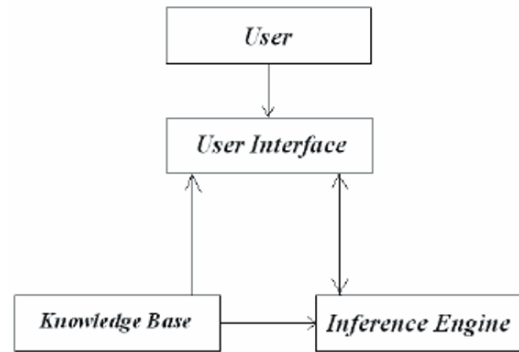
accurately as possible. Fig. 1 shows the development of an Expert System [1]

## 2.2 Architecture of an expert system

The Architecture of the Expert System reflects the Knowledge Engineers' understanding of the methods of representing knowledge and of how to perform intelligent decision making on basis of the Knowledge. The software architecture of the expert system is hardware independent. The end user communicates with the system with the help of a user interface which allows the user to enter facts about a particular situation and ask questions of the system. The system intern responds to the request via the user interface. The user interface is further connected to the Knowledge base and the inference engine. The user interface acquires a set of facts from the inference engine and the Knowledge Base. Like the Knowledge Base the Inference engine also contains a set of rules and facts. However the rules and facts in a knowledge base are restricted to a domain of particular expertise, while those of an inference engine contain the general control and search strategy employed by the expert system to arrive on a solution. The inference engine uses facts provided by the user and the knowledge base to generate new facts. This architecture replicates the thinking process of a human expert. Fig. 2 shows the architecture of an Expert System.

## 2.3 Knowledge base

The Knowledge base is the core part of the Expert System and for this reason the expert system is also known as a rule based system. If the expert system is considered as a production system, then the knowledge base is the set of production rules. The expertise concerning the problem area is represented by productions. In a rule based system he data is kept in the format if – a given condition is true then – perform the action corresponding to a given situation. The Expert System knowledge is represented in the form of a tree. It consists of a root frame and a number of sub-frames. The frame structure is organized in a hierarchical structure such that each frame has its respective rules, characteristics and parameters.



**Fig. 2** Architecture of a simple expert system

## 2.4 The inference engine

An inference Engine serves as the inference (the creation of knowledge from the existing fact) and control mechanism. The design of the inference engine determines the effectiveness and efficiency of the system. For a problem to be solved the inference engine loads only the required context about the problem and works for a solution for the problem. The inference engine extracts the required facts from the knowledge base about the given domain and also receives the facts to be worked on from the user through the user interface. When the inference engine extracts the solution it gives it to the user through the user interface. As the inference engine follows a systematic approach, it is able to deliver the most important explanation to the user for attaining a given solution.

## 2.5 Role of the knowledge engineer

The Knowledge Engineer plays the most important role in the development of the knowledge base. It is the responsibility of the knowledge engineer to accurately estimate the requirement of the user. The Knowledge Engineer conducts a series of interviews with the Human Expert to attain the accurate, complete, correct and consistent knowledge about the domain.

The knowledge engineer has to build small prototypes of the system to ensure proper functioning by testing it under various situations. There are a number of faults like semantic errors, experts' knowledge errors, syntax errors, inference engine errors, chain errors and so on. These errors are needed to be avoided by the Knowledge Engineer to ensure the creation of an ideal Knowledge Base.

## 3. Ontology

### 3.1 Creation of 'ontology'

Ontology is the "study of the kinds of things that exist" [7, 8]. Ontologism are a shared and common understanding of a domain that can be communicated between people and application systems [12]. In the artificial intelligence community, ontology refers to the *representation vocabulary*,