2.3. EXPERT SYSTEM (ES)

2.3.1. Introduction

- Expert system is a computer program that uses artificial intelligence to solve problems within a specialized domain that ordinarily requires human expertise. The first expert system was developed in 1965 by **Edward Feigenbaum** and **Joshua Lederberg** of **Stanford University in California, U.S. Dendral**, as their expert system was later known, was designed to analyze chemical compounds. Expert systems now have commercial applications in fields as diverse as medical diagnosis, petroleum engineering, and financial investing.
- Expert systems are a common form of artificial intelligence. They are used to assist humans in the decision-making process, but they don't replace humans. Many of the decision we make are based on past experience, but we have the added benefit of reasoning and intuition. Expert systems ask questions, then give you advice and reasons why you should take a certain course of action based on hard data, not on guesses. They don't make the final decision.
- Most of the problems an expert system helps resolve can in fact be solved by a human. But since the computer is faster or safer, businesses choose to use them instead.
- **According to Professor E. Feigenbaum,** "An Expert System is an intelligent computer program that uses knowledge and inference procedures to solve problems those are difficult enough to require significant human expertise for their solution. Knowledge necessary to perform at such a level, plus the inference procedures used, can be thought of as a model of the expertise of the best practitioners of the field."
- **According to Gaschnig, Reboh and Reiter,** "Expert systems are interactive computer programs incorporating judgement, rules of thumb, intuition and other expertise to provide knowledgeable advice about a variety of tasks."
- Expert systems, like human experts, are experts only in their field and as such are highly domain specific. Unlike human experts, once set up they need not be expensive, they can be easily and cheaply replicated and they do not grow old and start making errors.

Figure illustrates the basic concept of a **knowledge-based expert system**. The user supplies facts or other information to the expert system and receives expert advice or expertise in response. Internally, the expert system consists of two main components. The knowledge base contains

the knowledge with which the inference engine draws conclusions. These conclusions are the expert system's responses to the user's queries for expertise.

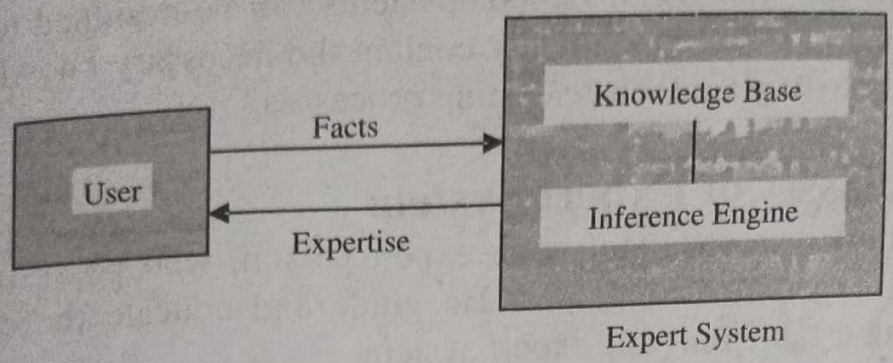

Figure 2.3: Expert System

2.3.2. Need of Expert System

1) Need for diagnosis of a problem situation or variance (audit, troubleshooting, etc.).
2) Need to understand the nature of a given situation.
3) Need to predict the outcome of a current or future event.
4) Need to control or govern a particular activity or process.
5) Need to prescribe a solution or course of action.
6) Need to evaluate and assess a prior event or process.

2.3.3. Features of Expert System

Some important features of expert systems are as below.

1) **High-Level Expertise:** The most useful feature of an expert system is the high-level expertise it provides to aid in problem solving. This expertise can represent the best thinking of the top experts in the field, leading to problem solutions that are imaginative, accurate, and efficient.

2) **Predictive Modeling Power:** Another useful feature of an expert system is its predictive modeling power. The system can act as an information processing theory or model of problem solving in the given domains providing the desired answers for a given problem situations and showing how they would change for new situation.

   The experts system can explain in detail how the new situation led to the change. This lets the user evaluate the potential effect of new facts or data and understand their relationship to the solution.

3) **Institutional Memory:** The corpus of knowledge that defines the proficiency of an expert system can also provide an additional feature, an institutional memory. When key people leave, their expertise is retained. This is important in business and especially critical in military and government with their rapid turnovers and frequent personnel shifts.

4) **Ability to Provide a Training Facility:** A final feature of an expert system is its ability to provide a training facility for key personnel and important staff members. Experts systems can be designed to provide such training, since they already contain the necessary knowledge and the ability to explain their reasoning processes.

2.3.4. Classes of Expert System

1) **Consultant:** A consultant is an expert person, who possesses a high level of expertise in the area. He guide and educate the executives regarding establishing the expert system.
2) **Expert Interface or Intelligent Front End:** This consultant is an expert on using some complex computer system or operation and assists an inexperience user to use the established expert system.
3) **Assistant:** These people have a lower level of expertise than those persons, which undertake routine job and leaves the executives to make final difficult decisions. This is the easiest and cheapest class of expert system to build and has importance in business.
4) **Idiot Servant:** These workers have a small amount of intelligence, low level of expertise, and a great deal of information. The work of this class is to use its limited expertise to decide what information it should retrieve and offer to its user. The most common **example** of this class is maintenance expert, which retrieves detailed information on part of a machine as and when they are required.

2.3.5. Functions of Expert System

1) **Design:** Conceive the form and substance of a new device, object, system, or procedure.
2) **Diagnosis:** Determine the nature or cause of an observed condition.
3) **Instruction:** Impart knowledge or skill.
4) **Interpretation:** Explain or analyze observations.
5) **Monitoring:** Observe a process, compare actual with expected observations, and indicate system status.
6) **Negotiation:** Propose, assess, and prioritize agreements between parties
7) **Planning:** Devise actions to achieve goals.
8) **Prediction:** Reason about time, forecast the future.
9) **Reconfiguration:** Alter system structure to maintain or improve performance
10) **Regulation:** Respond to commands and adjust control parameters to maintain stability and performance.