

**CSE: Artificial Intelligence**

**Lab Assignment**

**Submitted by: Enamul Haque**

**Submitted to: Minowar Hossain**

**ID : 201631046089**

**Batch 46th**

**Bangladesh University**

# **How to build expert system in Artificial Intelligence**

## **What are Expert Systems?**

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.

### **Characteristics of Expert Systems**

- High performance
- Understandable
- Reliable
- Highly responsive

### **Capabilities of Expert Systems**

The expert systems are capable of –

- 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

## **Components of Expert Systems**

The components of ES include –

- Knowledge Base
- Inference Engine
- User Interface

Let us see them one by one briefly –

### **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 of highly 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.

- **Factual Knowledge** – It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
- **Heuristic Knowledge** – It is about practice, accurate judgement, one's ability of evaluation, and guessing.

## **Knowledge representation**

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

## **Knowledge Acquisition**

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,

He acquires information from subject expert by recording,

## **Inference Engine**

Use of efficient procedures and rules by the Inference Engine is

In case of knowledge-based ES, the Inference Engine acquires and

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-

- Forward Chaining
- Backward Chaining

## **Forward Chaining**

It is a strategy of an expert system to answer the question, “What can happen next?”

Here, the Inference Engine follows the chain of conditions and

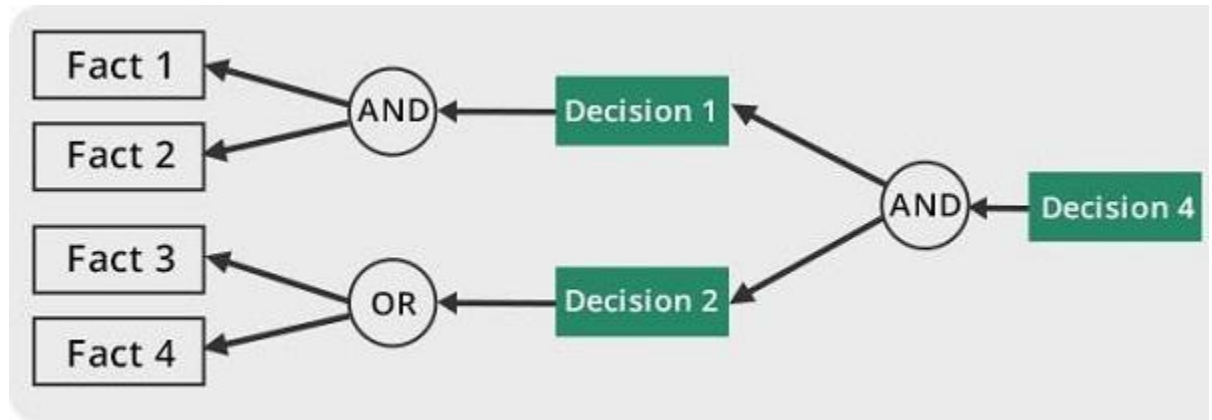
This strategy is followed for working on conclusion, result, or effect. For example, prediction of share market status as an effect of changes in interest rates.

## **Backward Chaining**

With this strategy, an expert system finds out the answer to the question, “Why this happened?”

On the basis of what has already happened, the Inference 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 blood cancer in humans.



## User Interface

User interface provides interaction between user of the ES and the ES 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 ES has arrived at a particular recommendation. The explanation may appear in the following forms –

- 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.

## Requirements of Efficient ES User Interface

- It should help users to accomplish their goals in shortest possible way.
- It should be designed to work for user's existing or desired work practices.
- Its technology should be adaptable to user's requirements; not the other way round.
- It should make efficient use of user input.

## Expert Systems Limitations

No technology can offer easy and complete solution. Large systems are costly, require significant development time, and computer resources. ESs have their limitations which include –

- Limitations of the technology
- Difficult knowledge acquisition
- ES are difficult to maintain

## Applications of Expert System

- **In designing and manufacturing domain**

It can be broadly used for designing and manufacturing physical devices such as camera lenses and automobiles.

- **In the knowledge domain**

These systems are primarily used for publishing the relevant knowledge to the users. The two popular ES used for this domain is an advisor and a tax advisor.

- **In the finance domain**

In the finance industries, it is used to detect any type of possible fraud,

suspicious activity, and advise bankers that if they should provide loans for business or not.

- **In the diagnosis and troubleshooting of devices**

In medical diagnosis, the ES system is used, and it was the first area where these systems were used.

- **Planning and Scheduling**

The expert systems can also be used for planning and scheduling some particular tasks for achieving the goal of that task.

## **Expert System Technology**

There are several levels of ES technologies available. Expert systems technologies include –

- **Expert System Development Environment – The ES development environment includes hardware and tools. They are –**
  - Workstations, minicomputers, mainframes.
  - High level Symbolic Programming Languages such as LISt Programming (LISP) and PROgrammation en LOGique (PROLOG).
  - Large databases.
- **Tools – They reduce the effort and cost involved in developing an expert system to large extent.**
  - Powerful editors and debugging tools with multi-windows.
  - They provide rapid prototyping
  - Have Inbuilt definitions of model, knowledge representation, and inference design.



- Shells – A 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.

For example, few shells are given below –

- Java Expert System Shell (JESS) that provides fully developed Java API for creating an expert system.
- *Vidwan*, a shell developed at the National Centre for Software Technology, Mumbai in 1993. It enables knowledge encoding in the form of IF-THEN rules.

## **Development of Expert Systems: General Steps**

The process of ES development is iterative. Steps in developing the ES include –

### **Identify Problem Domain**

- The problem must be suitable for an expert system to solve it.
- Find the experts in task domain for the ES project.
- Establish cost-effectiveness of the system.

### **Design the System**

- Identify the ES Technology
- Know and establish the degree of integration with the other systems and databases.
- Realize how the concepts can represent the domain knowledge best.

## **Develop the Prototype**

From Knowledge Base: The knowledge engineer works to –

- Acquire domain knowledge from the expert.
- Represent it in the form of If-THEN-ELSE rules.

## **Test and Refine the Prototype**

- The knowledge engineer uses sample cases to test the prototype for any deficiencies in performance.
- End users test the prototypes of the ES.

## **Develop and Complete the ES**

- Test and ensure the interaction of the ES with all elements of its environment, including end users, databases, and other information systems.
- Document the ES project well.
- Train the user to use ES.

## **Maintain the System**

- Keep the knowledge base up-to-date by regular review and update.
- Cater for new interfaces with other information systems, as those systems evolve.

## **Benefits of Expert Systems**

- Availability – They are easily available due to mass production of software.
- Less Production Cost – Production cost is reasonable. This makes them affordable.
- Speed – They offer great speed. They reduce the amount of work an individual puts in.
- Less Error Rate – Error rate is low as compared to human errors.
- Reducing Risk – They can work in the environment dangerous to humans.
- Steady response – They work steadily without getting motional, tensed or fatigued.