Concept of learning

Learning denotes changes in a system that enable the system to do the same task more efficiently next time or we can say generalize the experience in a way that allows to improve your performance on the task. Types of learning:

- **Supervised learning** generates a function that maps inputs to desired outputs (also called labels, because they are often provided by human experts labeling the training examples). For example, in a classification problem, the learner approximates a function mapping a vector into classes by looking at input-output examples of the function.
- **Unsupervised learning** models a set of inputs, like clustering. See also data mining and knowledge discovery.
- **Semi-supervised learning** combines both labeled and unlabeled examples to generate an appropriate function or classifier.
- **Reinforcement learning** learns how to act given an observation of the world. Every action has some impact in the environment, and the environment provides feedback in the form of rewards that guides the learning algorithm.
- **Transduction,** or *transductive inference*, tries to predict new outputs on specific and fixed (test) cases from observed, specific (training) cases.
- **Learning to learn** learns its own inductive bias based on previous experience.

Knowledge Acquisition

Knowledge acquisition is the expanding the capabilities of a system or improving its performance at some specified task. So we can say knowledge acquisition is the goal oriented creation and refinement of knowledge. The acquired knowledge may consist of various facts, rules, concepts, procedures, heuristics, formulas, relationships or any other useful information. Knowledge can be acquired from various sources like, domain of interests, text books, technical papers, databases, reports. The terms of increasing levels of abstraction, knowledge includes data, information and Meta knowledge. Meta knowledge includes the ability to evaluate the knowledge available, the additional knowledge required and the systematic implied by the present rules.

Rote Learning

This strategy does not require the learning system to transform or infer knowledge. It is the simplest form of learning. It requires the least amount of inference and is accomplished by simply copying the knowledge in the same form that it will be used directly into the knowledge base. It includes learning my imitation, simple memorization and learning by being performed. For example we may use this type of learning when we memorize multiplication tables. In this method we store the previous computed values, for which we do not have for recomputed them later. Also we can say rote learning is one type of existing or base learning.

For example, in our childhood, we have the knowledge that “sun rises in the east”. So in our later stage of learning we can easily memorize the thing. Hence in this context, a system may simply memorize previous solutions and recall them when confronted with the same problem. Generally access of stored value must be faster than it would be to recompute. Methods like hashing, indexing and sorting can be employed to enable this. One drawback of rote learning is it is not very effective in a rapidly changing environment. If the environment does change then we must detect and record exactly what has changed. Also this technique must not decrease the efficiency of the system. We must be able to decide whether it is worth storing the value in the first place.

Learning from Discovery

Using this strategy, the learning system must either induce class descriptions from observing the environment or manipulate the environment to acquire class descriptions or concepts. This is an unsupervised learning technique. It requires the greatest amount of inferencing among all of the different forms of learning. From an existing knowledge base, some new forms of discovery of knowledge may formed. The learning discovery process is very important in the respect of constructing new knowledge base.

Learning by Analogy

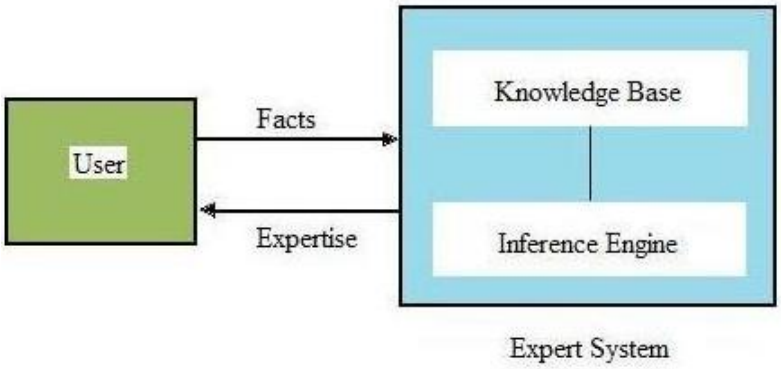
It is a process of learning a new concept or solution through the use of similar known concepts or solutions. We make frequent use of analogical learning. The first step is inductive inference, required to find a common substructure between the problem domain and one of the analogous domains stored in the learner’s existing knowledge base. This form of learning requires the learning system to transform and supplement its existing knowledge from one domain or problem area into new domain. This strategy requires more inferencing by the learning system than previous strategies. Relevant knowledge must be found in the systems existing knowledge by using induction strategies. This knowledge must then be transformed to the new problem using deductive inference. Example of learning by analogy may include the driving technique of vehicles. If we know the driving procedure of a bike, then when we will drive a car then some sort of previous learning procedures we may employ. Similarly for driving a bus or truck, we may use the procedure for driving a car.

Expert System

Expert system is an artificial intelligence program that has expert-level knowledge about a particular domain and knows how to use its knowledge to respond properly. Domain refers to the area within which the task is being performed. Ideally the expert systems should substitute a human expert. Edward Feigenbaum of Stanford University has defined expert system as ―an intelligent computer program that uses knowledge and inference procedures to solve problems

that are difficult enough to require significant human expertise for their solutions.‖ It is a branch of artificial intelligence introduced by researchers in the Stanford Heuristic Programming Project.

The expert systems is a branch of AI designed to work within a particular domain. As an expert is a person who can solve a problem with the domain knowledge in hands it should be able to solve problems at the level of a human expert. The source of knowledge may come come from a human expert and/or from books, magazines and internet. As knowledge play a key role in the functioning of expert systems they are also known as knowledge-based systems and knowledge-based expert systems. The expert‘s knowledge about solving the given specific problems is called knowledge domain of the expert.



Applications of Expert System

There are several major application areas of expert system such as agriculture, education, environment, law manufacturing, medicine power system etc. Expert system is used to develop a large number of new products as well as new configurations of established products. When established products are modified to include an expert system as a component or when an established product item is replaced with an expert system, the expert system supported entity is called intelligent. Expert systems are designed and created to facilitate tasks in the fields of accounting, medicine, process control, financial service, production, education etc. The foundation of a successful expert system depends on a series of technical procedures and development that may be designed by certain related experts.

Expert Systems are for everyone

Everyone can find an application potential in the field of expert systems. Contrary to the belief that expert systems may pose a threat to job security, expert systems can actually help to create opportunities for new job areas. No matter which is of business one is engages in, expert systems can fulfill the need for higher productivity and reliability of decisions. Some job opportunities offered by the expert system are listed below:

- Basic Research
- Applied Research
- Knowledge Engineering
- The development of Inference engine
- Training
- Sales and marketing

Expert System in Education

In the field of education, many of the expert system's application are embedded inside the Intelligent Tutoring System (ITS) by using techniques from adaptive hypertext and hypermedia. Most of the system usually will assist student in their learning by using adaptation techniques to personalize with the environment prior knowledge of student and student's ability to learn. Expert system in education has expanded very consistently from microcomputer to web based and agent based technology. Web based expert system can provide an excellent alternative to private tutoring at any time from any place where internet is provided. Agent based expert system will help users by finding materials from the web based on the user's profile. Expert system also had tremendous changes in the applying of methods and techniques. Expert system are beneficial as a teaching tools because it has equipped with the unique features which allow users to ask question on how, why and what format. When it is used in the class environment, surely it will give many benefit to student as it prepare the answer without referring to the teacher. Besides that, expert system is able to give reasons towards the given answer. Expert system had been used in several fields of study including computer animation, computer science and engineering, language teaching business study etc.

Expert system in Agriculture

The expert system for agriculture is same as like other fields. Here also the expert system uses the rule based structure and the knowledge of a human expert is captured in the form of IF-THEN rules and facts which are used to solve problems by answering questions typed at a keyboard attached to a computer. For example, in pest control, the need to spray, selection of a chemical to spray, mixing and application etc. The early, state of developing the expert systems are in the 1960's and 1970's were typically written on a mainframe computer in the programming language based on LISP. Some examples of these expert systems are MACSYMA developed at the Massachusetts Institute of Technology (MIT) for assisting individuals in solving complex mathematical problems. Other examples may be MYCIN, DENDRAL, and CALEX etc. The rises of the agricultural expert system are to help the farmers to do single point decisions, which to have a well planning for before start to do anything on their land. It is used to design an irrigation system for their plantation use. Also some of the other functions of agricultural expert system are:

- To predict the extreme events such as thunderstorms and frost.
- To select the most suitable crop variety.
- Diagnosis of liver stock disorder and many more.

Expert System for a particular decision problem

The expert system can be used as a standalone advisory system for the specific knowledge domain. It also can provide decision support for a high level human expert. The main purposes, the rises of the expert system are as a delivery system for extension information, to provide management education for decision makers and for dissemination of up-to-date scientific information in a readily accessible and easily understood form, to agricultural researchers, advisers and farmers. By the help of an expert system, the farmers can produce a more high quality product to the citizen.

Expert System for Text Animation (ESTA)

The idea behind creating an expert system is that it can enable many people to benefit from the knowledge of one person – the expert. By providing it with a knowledge base for a certain subject area, ESTA can be used to create an expert system for the subject:

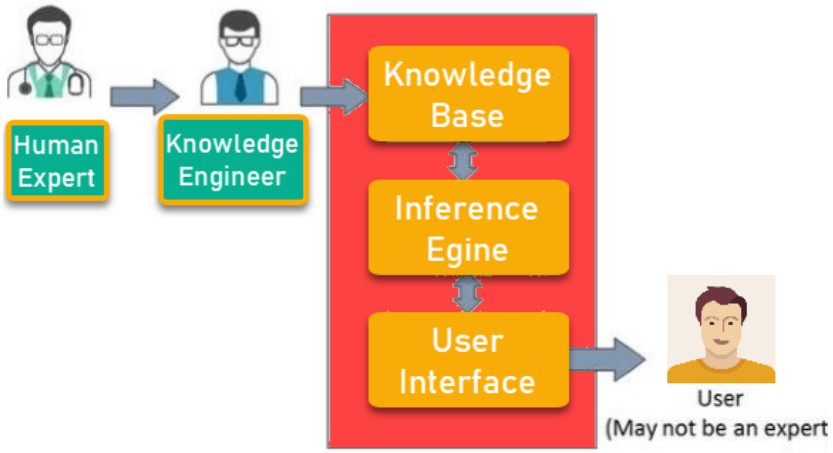
ESTA + Knowledge base = Expert System

Each knowledge base contains rules for a specific domain. A knowledge base for an expert system to give tax advice might contain rules relating marital status, mortgage commitments and age to the advisability of taking out a new life insurance policy. ESTA has all facilities to write the rules that will make up a knowledge base. ESTA has an inference engine which can use the rules in the knowledge base to determine which advice is to be given to the expert system user. ESTA also features the ability for the expert system user to obtain answers to questions such as "how" and "why". ESTA is used by a knowledge engineer to create a knowledge base and by the expert system user to consult a knowledge base. Knowledge representation in ESTA is based on the items like sections, parameters, title.

Components of Expert Systems

The components of ES include −

- Knowledge Base
- Inference Engine
- User Interface



The expert System consists of the following given components:

User Interface

The user interface is the most crucial part of the expert system. This component takes the user's query in a readable form and passes it to the inference engine. After that, it displays the results to the user. In other words, it's an interface that helps the user communicate with the expert system.

Inference Engine

The inference engine is the brain of the expert system. Inference engine contains rules to solve a specific problem. It refers the knowledge from the Knowledge Base. It selects facts and rules to apply when trying to answer the user's query. It provides reasoning about the information in the knowledge base. It also helps in deducting the problem to find the solution. This component is also helpful for formulating conclusions.

Knowledge Base

The knowledge base is a repository of facts. It stores all the knowledge about the problem domain. It is like a large container of knowledge which is obtained from different experts of a specific field.

Thus we can say that the success of the Expert System mainly depends on the highly accurate and precise knowledge.

Categories of Expert Systems

Category	**Problem Addressed**
Interpretation	- inferring situation descriptions from observations
Prediction	- inferring likely consequences of given situations
Diagnosis	- inferring system malfunctions from observations
Design	- configuring objects under constraints
Planning	- developing plans to achieve goals
Monitoring	- comparing observations to plans and flagging exceptions
Debugging	- Prescribing remedies for malfunctions
Repair	- executing a plan to administer a prescribed remedy
Instruction	- diagnosing, debugging, and correcting student performance
Control	- interpreting, predicting, repairing and monitoring systems behavior

The Development Process of An Expert System

By the definition, an expert system is a computer program that simulates the thought process of a human expert to solve complex decision problems in a specific domain. The expert system's knowledge is obtained from expert sources which are coded into most suitable form. The process of building an expert system is called knowledge engineering and is done by a knowledge engineer. The knowledge engineer is a human with a background in computer science and AI and he knows how to build expert systems. A knowledge engineer also decides how to represent the knowledge in an expert system and helps the programmers to write the code. Knowledge engineering is the acquisition of knowledge from a human expert or any other source. The different stages in the development of an expert system are illustrated in figure.

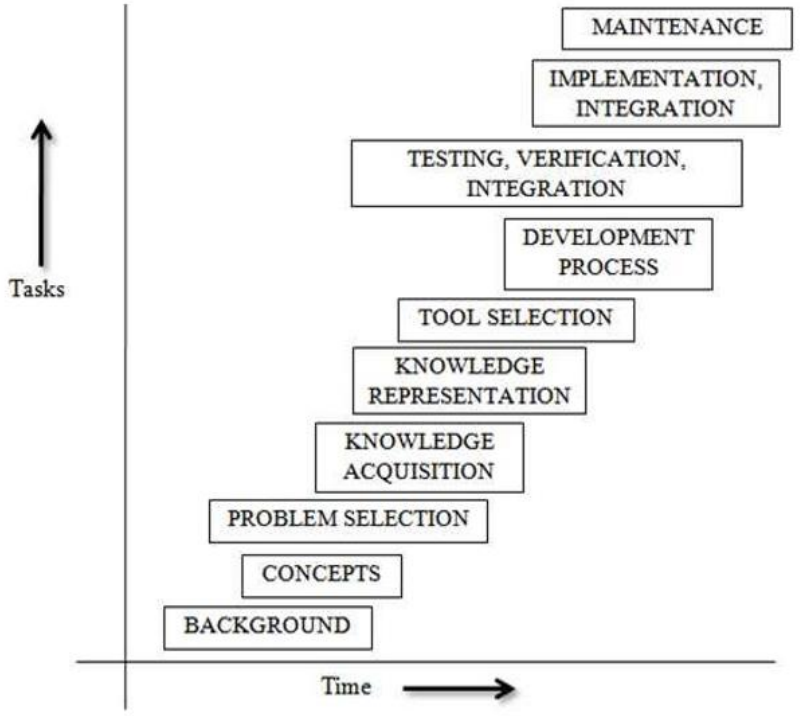


Figure Hierarchy of expert system development process

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.