Expert System

Expert System Architecture, Expert System Shell, Knowledge Acquisition

Expert System

- The Expert System began to emerge as a university research system in 1970.
- Application domains of expert systems include law, chemistry, healthcare, biology, engineering, etc.

Expert System

- An expert system is a set of programs that manipulate and encode knowledge to solve a problem in a specific domain that normally requires human expertise.
- The expert system knowledge must be obtained from specialist or other source of expertise such as text, journal, article and databases.
- Once a sufficient body of expert knowledge has been acquired,it must be encoded in some form, loaded into a knowledge base, then tested and refined continually throughout the life of the system.

Characteristic of Expert System

- Expert systems use knowledge rather than data to control the solution process.
- The knowledge is encoded and maintained as an entity separate from the control program.
- Expert systems are capable of explaining how a particular conclusion was reached add why requested information is needed during the conclusion.
- Expert systems use symbolic representation for knowledge and perform their inference through the symbolic computation that are closely resemble manipulations of natural language.

History of Expert System

- The first expert system to be completed was DENDRAL, developed at Standford University in the late 1960's.
- DENDRAL was capable of determining the structure of a chemical compound given a specification of the compound's constituent element and mass spectrometry data obtained from samples of the compound.
- Meta-DENDRAL is a learning component for DENDRAL which was capable to learn from the positive samples.

History of Expert System

- After DENDRAL, the development of $MYCIN$ began at Standford University. $MYCIN$ is an expert system that diagnoses infectious blood disease and determine a recommended list of therapies for the patient.
- $EMYCIN$ was the expert system shell for the $MYCIN$. It is used to build several expert systems.
- Initially $MYCIN$ contained 200 rules. This number gradually increased to more than 600 rules by the early 1980.

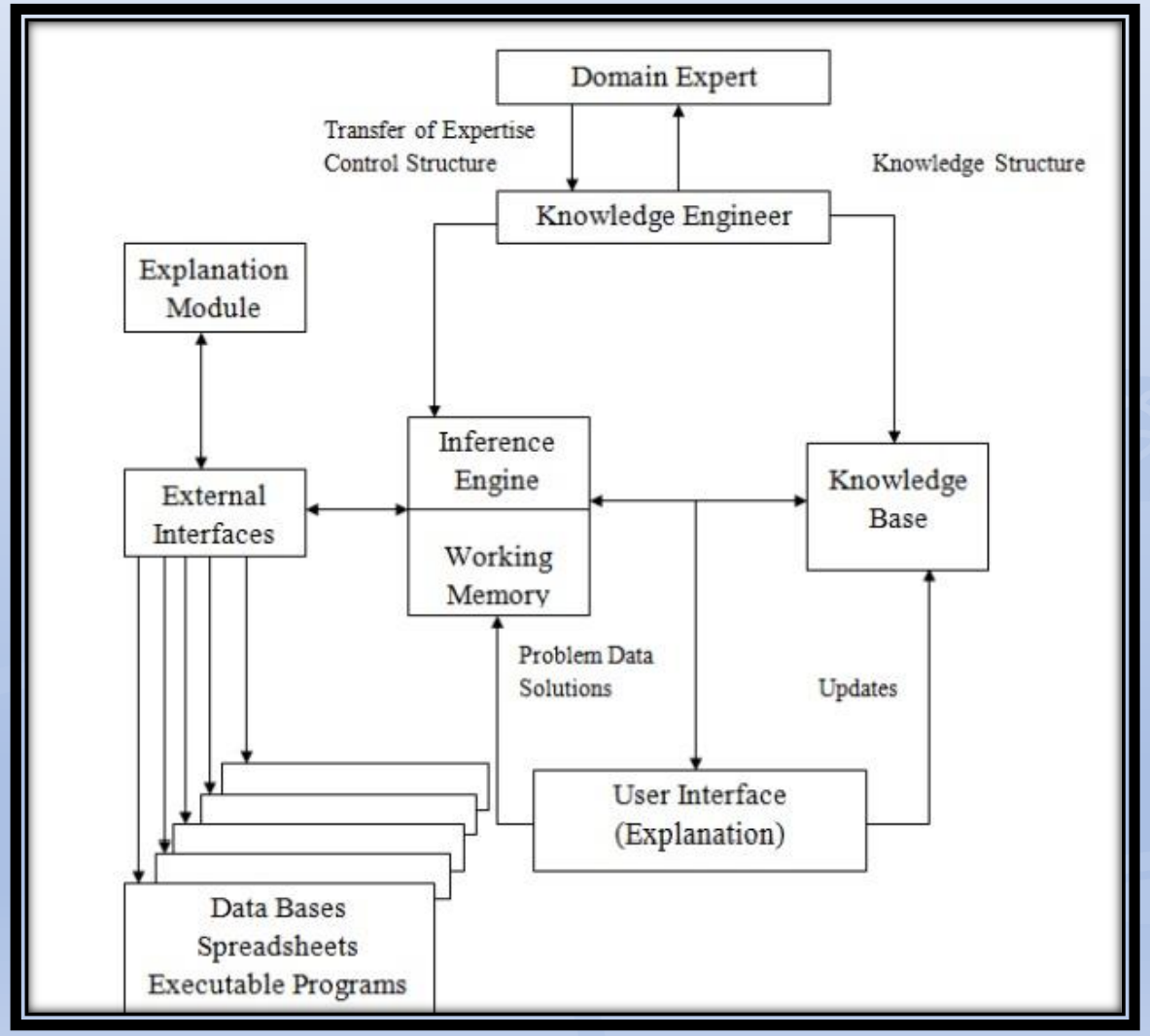
Applications

- Teaching students specialized tasks
- Diagnosis software development project
- Forecasting crop damage
- Different type of medical diagnosis

Rule based System Architecture

- The most common form of architecture used in expert systems also called the rule based system.
- This type of system encode the knowledge using production rule($A \rightarrow B$).
- Each rule represents a small chunk of knowledge relating to the given domain expertise.

Rule based System Architecture



Rule-based Architecture

- Knowledge Base: The knowledge base contains facts and rules about some specialized domain. Prolog or LISP can be used to encode knowledge in the KB.
- Inference Process: The inference engine accepts user input quieries and responds to questions through the I/O interface and this dynamic information with the static knowledge stored in the KB.
- The inference process is carried out recursively in 3 stages match, select and execute.

Rule-based Architecture

- Explanation Module: provides the user with an explanation of the reasoning process when required.
- It traces the chain of rules fired during a consultation with user.
- Learning Module: The learning module and history file are not common components of expert systems. When they are provided, they are used to assist in building and refining the knowledge.

Nonproduction System Architechture

- Less Common architectures are those based on nonproduction rule representation scheme.
- Instead of rules, the system employs more structured representation schemes like associative networks, Frames, decision trees, etc.
  - Semantic Network Architecture
  - Frame Architecture
  - Balackboard Architecture
  - Neural Network Architecture

Knowledge Acquisition

- The success of a knowledge-based system lies in the quality and extent of knowledge available to the system.
- Acquiring and validating a large corpus of consistent, correlated knowledge is not a trivial program.
- Knowledge acquisition is the process of adding new knowledge to a knowledge base and refining or improving knowledge that was previously acquired.

Knowledge Acquisition

- Acquired knowledge may consists of facts, rules, concepts, procedure, formulas, relation or other information. Source of knowledge may include
- Expert in the domain of interest
- Text book
- Journal
- Database
- The environment

Types of Learning

- We learn knowledge through different methods, depending on the type of material to be learned, the amount of knowledge we already posses, and the environment in which the learning take place. The learning methods can be classified as
- Memorization
- Direct Instruction
- Analogy
- Induction
- Deduction

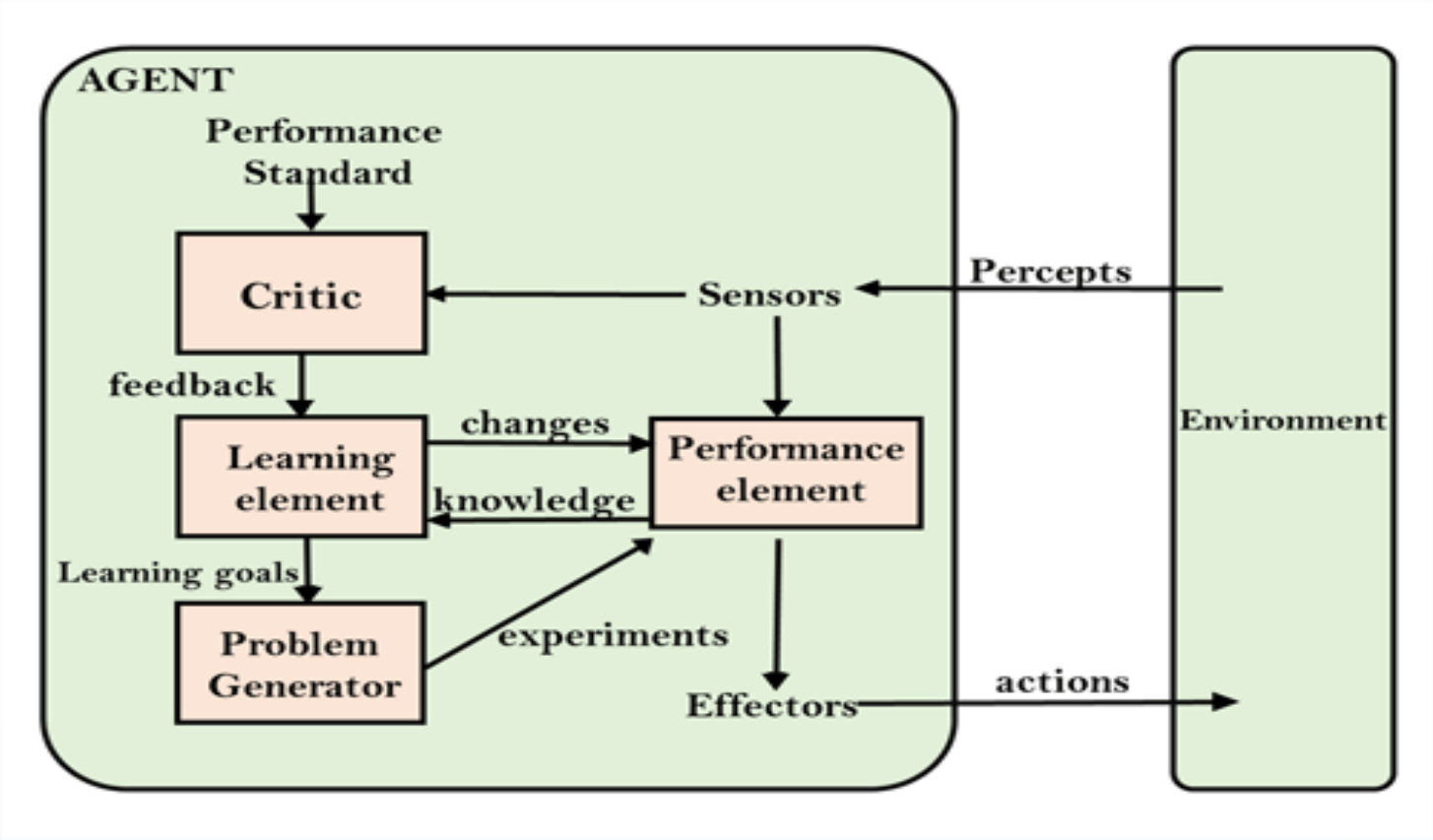
Types of Learning

- Rote Learning: Simply copying knowledge in the form that it will be used directly in the knowledge base. It requires the least amount of inference.
- Direct Instruction: It requires more inference than rote learning. The knowledge must be transformed into an operational form before being integrated into the knowledge base.
- Analogical Learning: New concepts learn from the similar type of concepts or problems.

Types of Learning

- Inductive Learning: formulating a general concept after seeing a number of instances or examples of the concepts. This form of learning requires inductive inference a form of invalid but useful inference.
- Deductive Learning: Requires more inference than other methods. It is accomplished through a sequence of deductive inference steps using known facts.
- Sometimes learning methods are classified as weak method and knowledge-rich method.

General learning Model



General learning Model

- The environment regarded as either a form of nature which produces random stimuli.
- Inputs to the learner component may be physical stimuli of some type or descriptive symbolic training examples. The information conveyed to the learner component is used to create and modify knowledge structure in the knowledge base.

General learning Model

- The performance component produces a response describing its actions in performing the task.
- The critic module evaluate the response.
- Feedback, indicating whether or not the performance was acceptable, is then sent by the critic module to the learner component for its subsequent use in modifying the structure in the knowledge base.

Performance Measures

- Generality: it is a measure of case with which the method can be adopted to different domain application.
- Efficiency: the average time required to construct the target knowledge structure from some specified initial structure.
- Robustness: is the learning system to function with reliable feedback and with a variety of training.

Performance Measures

- Efficacy: it measure the overall power of the system. It is a combination of the factors generality efficiency and robustness.
- Ease of Implementation: it refers to the complexity of the programs and data structure and the resources required to develop the given learning system.

Expert System Shell

An expert system shell contains the basic components of expert system. A shell is associated with a prescribed method for building applications by configuring and instantiating these components.

Shell Components:

- The knowledge acquisition
- The knowledge base
- The reasoning the explanation
- The user interface