Subject: MCA DMBI 1003

Unit-2

Knowledge Base Systems

&

Expert Systems

Made By: Priyanka Karale

Knowledge Base Systems

A knowledge-based system (KBS) is **a form of artificial intelligence (AI) that aims to capture the knowledge of human experts to support decision-making**. Examples of knowledge-based systems include expert systems, which are so called because of their reliance on human expertise.

Examples:

- Hypertext manipulation systems. ...
- Intelligent tutoring systems. ...
- Rule-based systems. ...
- Eligibility analysis systems. ...

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What are knowledge-based systems?

Knowledge-based systems (KBSes) are computer programs that use a centralized repository of data known as a knowledge base to provide a method for problem-solving. Knowledge-based systems are a form of artificial intelligence (AI) designed to capture the knowledge of human experts to support decision-making. An expert system is an example of a knowledge-based system because it relies on human expertise.

Components of Knowledge Base

- **Factual Knowledge:** The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge.
- **Heuristic Knowledge:** This knowledge is based on practice, the ability to guess, evaluation, and experiences.

Knowledge Representation: It is used to formalize the knowledge stored in the knowledge base using the If-else rules.

Knowledge Acquisitions: It is the process of extracting, organizing, and structuring the domain knowledge, specifying the rules to acquire the knowledge from various experts, and store that knowledge into the knowledge base.

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What is an Expert System?

An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.

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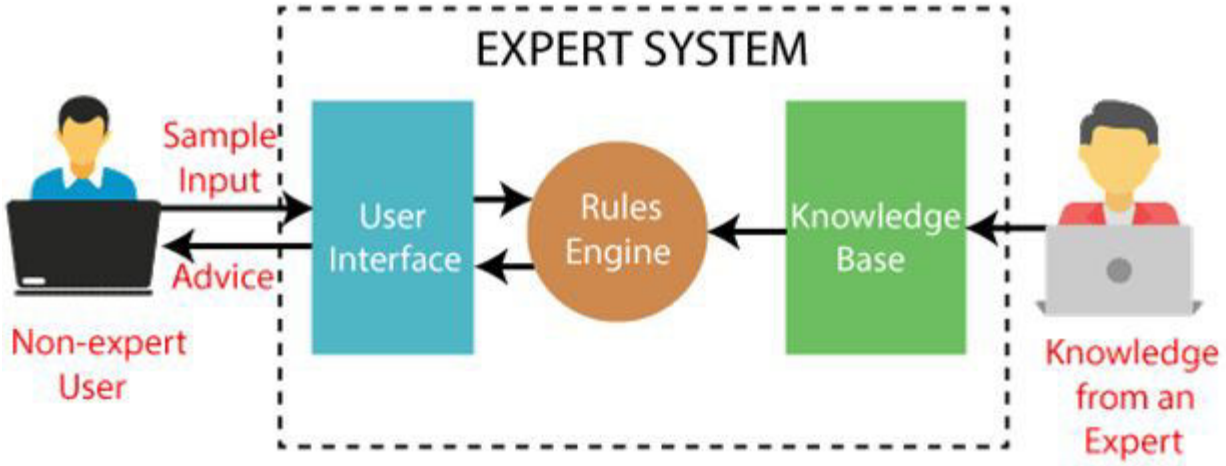
Block Diagram of Expert System



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How does an expert system work?

- Modern expert knowledge systems use machine learning and artificial intelligence to simulate the behavior or judgment of domain experts.

- These systems can improve their performance over time as they gain more experience, just as humans do.

What are the components (elements) of an expert system?

There are three main components of an expert system:

- **The knowledge base**
- **The inference engine**
- **The user interface**

The knowledge base:

- This is where the information the expert system draws upon is stored.
- Human experts provide facts about the expert system's particular domain or subject area are provided that are organized in the knowledge base.
- The knowledge base often contains a knowledge acquisition module that enables the system to gather knowledge from external sources and store it in the knowledge base.

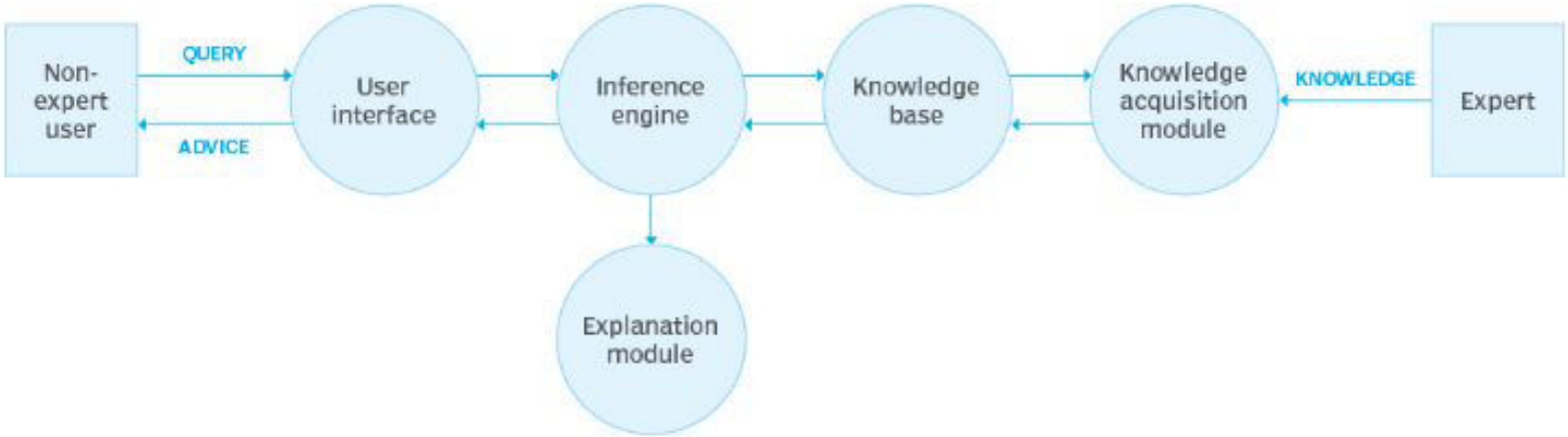
The inference engine:

- This part of the system pulls relevant information from the knowledge base to solve a user's problem.
- It is a rules-based system that maps known information from the knowledge base to a set of rules and makes decisions based on those inputs.
- Inference engines often include an explanation module that shows users how the system came to its conclusion.

The user interface:

- This is the part of the expert system that end users interact with to get an answer to their question or problem.

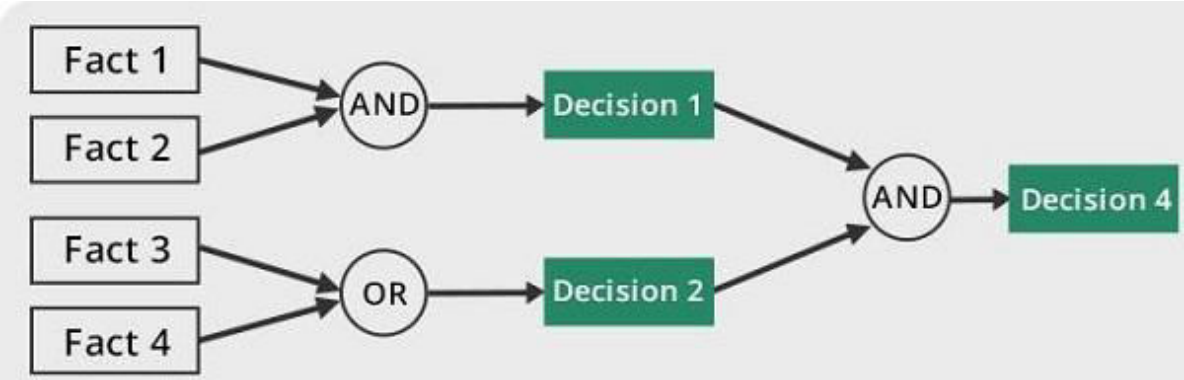
Architecture of an expert system



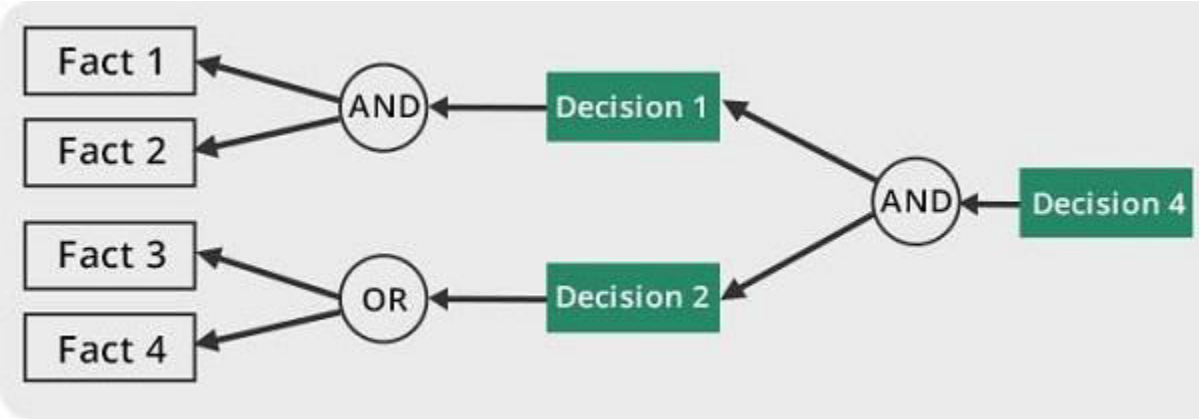
Expert systems accumulate experience and facts in a knowledge base and integrate them with an inference or rules engine -- a set of rules for applying the knowledge base to situations provided to the program.

The inference engine uses one of two methods for acquiring information from the knowledge base:

- **Forward chaining** reads and processes a set of facts to make a logical prediction about what will happen next. An example of forward chaining would be making predictions about the movement of the stock market.



- **Backward chaining** reads and processes a set of facts to reach a logical conclusion about why something happened. An example of backward chaining would be examining a set of symptoms to reach a medical diagnosis.



- An expert system relies on having a good knowledge base.
- Experts add information to the knowledge base, and non-experts use the system to solve complex problems that would usually require a human expert.
- The process of building and maintaining an expert system is called knowledge engineering.
- Knowledge engineers ensure that expert systems have all the necessary information to solve a problem.
- They use various knowledge representation methodologies, such as symbolic patterns, to do this.
- The system's capabilities can be enhanced by expanding the knowledge base or creating new sets of rules.

Applications of expert systems

- **Financial services,** where they make decisions about asset management, act as Robo-advisors and make predictions about the behavior of various markets and other financial indicators.
- **Mechanical engineering,** where they troubleshoot complex electromechanical machinery.
- **Telecommunications,** where they are used to make decisions about network technologies used and maintenance of existing networks.
- **Healthcare,** where they assist with medical diagnoses.
- **Agriculture,** where they forecast crop damage.
- **Customer service,** where they help schedule orders, route customer requests and solve problems.
- **Transportation,** where they contribute in a range of areas, including pavement conditions, traffic light control, highway design, bus and train scheduling and maintenance, and aviation flight patterns and air traffic control.

Comparison of Conventional & Expert Systems

The principal distinction between expert systems and traditional problem solving programs is the way in which the problem related expertise is coded

Conventional Systems

- In conventional applications, problem expertise is encoded in both program and data structures.
- Data is used more efficiently than knowledge.
- Conventional systems are not capable of explaining a particular conclusion for a problem. These systems try to solve in a straightforward manner.

Expert Systems

- In the expert system approach all of the problem related expertise is encoded in data structures only, none is in programs.
- The use of knowledge is vital.
- Expert systems are capable of explaining how a particular conclusion is reached and why requested information is needed during a process.

Conventional Systems

- The complex problems can't be solved efficiently
- conventional systems are unable to express symbolic representations for knowledge. They just simplify the problems in a straight forward manner and are incapable to express the "how, why" questions.
- The problem solving tools like mining algorithms & machine learning algorithms are absent
- All types of problems (where decision making is needed) can't be solved

Expert Systems

- The complex problems are solved more efficiently
- It uses the symbolic representations for knowledge i.e. the rules, different forms of networks, frames, scripts etc. and performs their inference through symbolic computations.
- The problem solving tools like mining algorithms & machine learning algorithms are present.
- The various types of problems are always solved by the experts in an expert system.

Data mining as a part Knowledge Discovery process

- In today's world, data is being generated from numerous sources of different types and in different formats, for example, economic transactions, biometrics, scientific, pictures and videos etc.
- The term KDD stands for Knowledge Discovery in Databases. It refers to the broad procedure of discovering knowledge in data and emphasizes the high-level applications of specific Data Mining techniques. It is a field of interest to researchers in various fields, including artificial intelligence, machine learning, pattern recognition, databases, statistics, knowledge acquisition for expert systems, and data visualization.

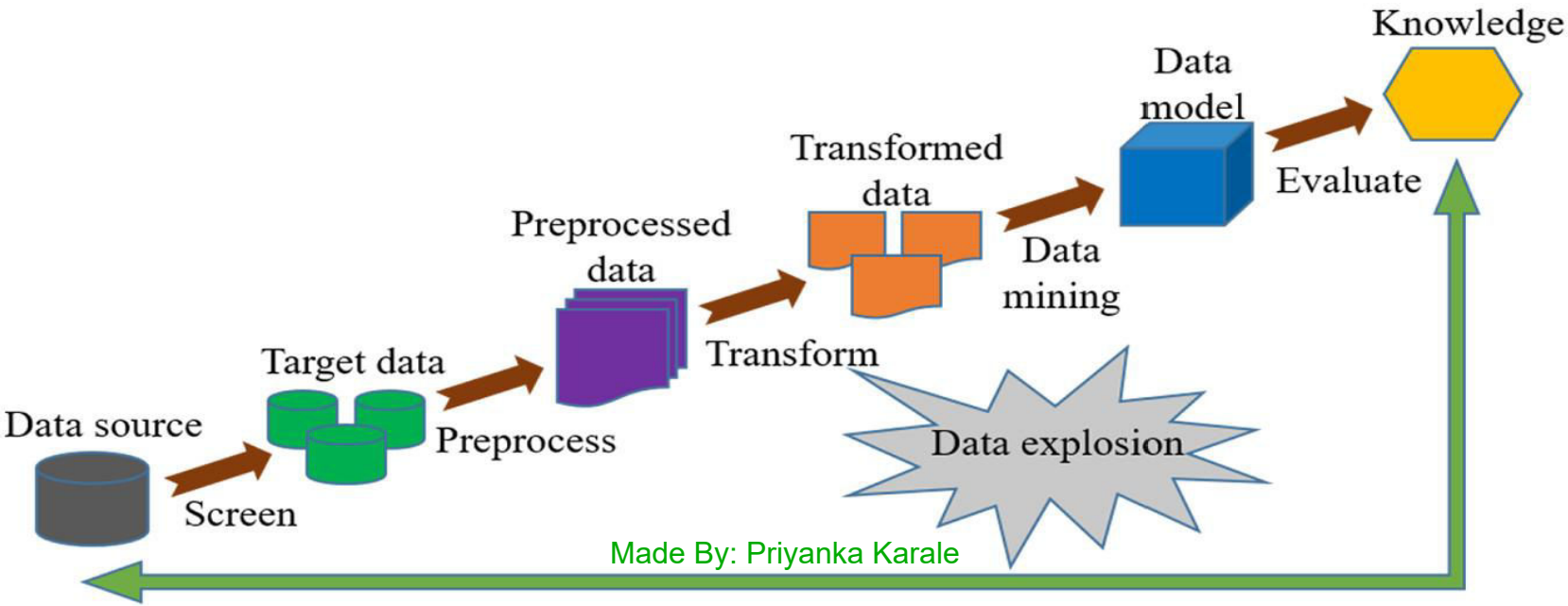
- The main objective of the KDD process is to extract information from data in the context of large databases. It does this by using Data Mining algorithms to identify what is deemed knowledge.

- The Knowledge Discovery in Databases is considered as a programmed, exploratory analysis and modeling of vast data repositories.KDD is the organized procedure of recognizing valid, useful, and understandable patterns from huge and complex data sets.

- Data Mining is the root of the KDD procedure, including the inferring of algorithms that investigate the data, develop the model, and find previously unknown patterns. The model is used for extracting the knowledge from the data, analyze the data, and predict the data.

- It utilizes several algorithms that are self-learning in nature to deduce useful patterns from the processed data.

- The process is a closed-loop constant feedback one where a lot of iterations occur between the various steps as per the demand of the algorithms and pattern interpretations.



What is Data mining?

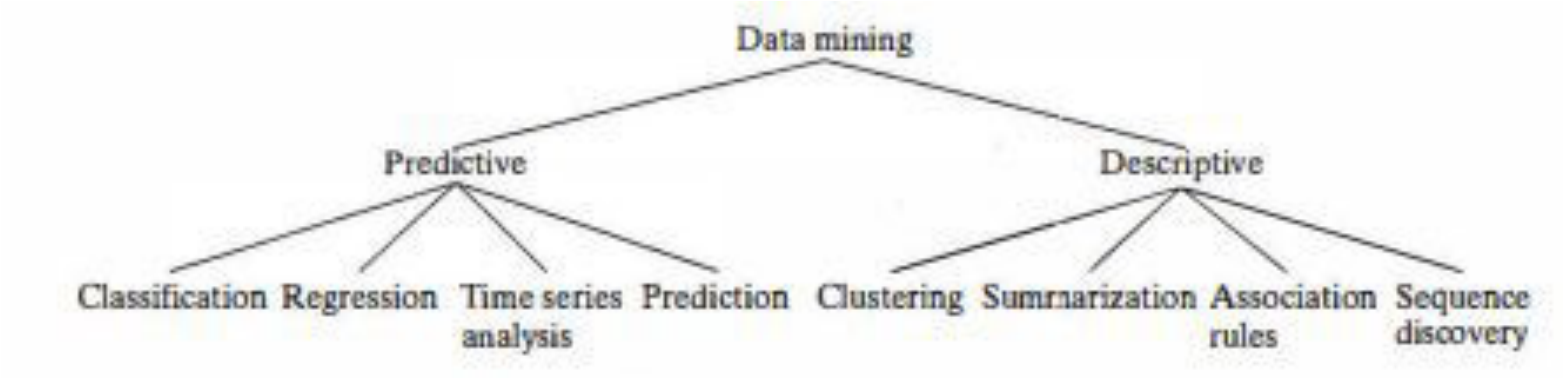
Data mining is the process of sorting through large data sets to identify patterns and relationships that can help solve business problems through data analysis. Data mining techniques and tools enable enterprises to predict future trends and make more-informed business decisions.

Why is data mining important?

Data mining is a crucial component of successful analytics initiatives in organizations. The information it generates can be used in business intelligence (BI) and advanced analytics applications that involve analysis of historical data, as well as real-time analytics applications that examine streaming data as it's created or collected.

Types of Data Mining Tasks

1. Predictive Data Mining
2. Descriptive Data Mining



Predictive & Descriptive Mining.

- Data mining is the process of sorting through large data sets to identify patterns and relationships that can help solve business problems through data analysis.

- The descriptive and predictive data mining techniques have huge applications in data mining; they are used to mine the types of patterns.

What is descriptive data mining?

- As the name suggests, descriptive mining "describe" the data.
- Once the data is captured, we convert it into human interpretable form.
- Descriptive analytics focus on answering "What has happened in the past?"
- Descriptive analytics is useful because it enables us to learn from the past.

What is Predictive data Mining?

- The term 'Predictive' means to predict something, so predictive data mining is the analysis done to predict the future event or other data or trends.
- Predictive data mining can enable business analysts to make decisions and add value to the analytics team efforts.
- Any retail shop may use algorithm-based tools to go through a customer database to look at the previous transactions to predict future transactions. In other words, the previous data may enable the shopkeeper to project what will happen in future in the business, enabling business people to plan accordingly.

Difference Between Descriptive and Predictive Data Mining:

Descriptive Mining:

- It determines, what happened in the past by analyzing stored data.
- It provides accurate data.
- Standard reporting, query/drill down and ad-hoc reporting.

Predictive Mining:

- It determines, what can happen in the future with the help past data analysis.
- It produces results does not ensure accuracy
- Predictive modelling, forecasting, simulation and alerts..

Descriptive Mining:

- It requires data aggregation and data mining
- Describes the characteristics of the data in a target data set.
- Methods(in general):
  - what happened?
  - where exactly is the problem?
  - what is the frequency of the problem?

Predictive Mining:

- It requires statistics and forecasting methods
- Carry out the induction over the current and past data so that predictions can be made.
- Methods(in general):
  - what will happen next?
  - what is the outcome if these trends continue?
  - what actions are required to be taken?

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Thank You! Unit 2 Ends

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