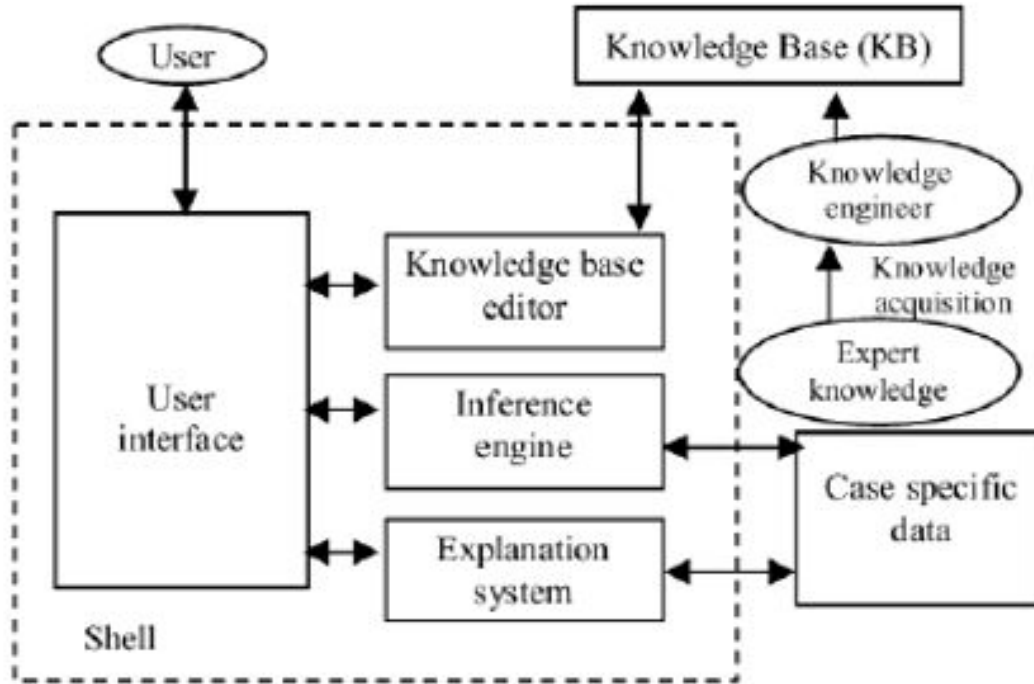


# Expert System



- An expert system is AI software that uses knowledge stored in a knowledge base to solve problems that would usually require a human expert thus preserving a human expert's knowledge in its knowledge base.
- They can advise users as well as provide explanations to them about how they reached a particular conclusion or advice.

# Expert System

**Knowledge Engineering** is the term used to define the process of building an Expert System and its practitioners are called **Knowledge Engineers**. The primary role of a knowledge engineer is to make sure that the computer possesses all the knowledge required to solve a problem.

- **MYCIN** —  
One of the earliest expert systems based on backward chaining. It can identify various bacteria that can cause severe infections and can also recommend drugs based on the person's weight.
- **PXDES** —  
It could easily determine the **type and the degree of lung cancer** in a patient based on the data.
- **CaDet** —  
It is a clinical support system that could **identify cancer in its early stages** in patients.
- **DXplain** —  
It was also a clinical support system that could **suggest a variety of diseases** based on the findings of the doctor.

# Components of Expert System

- **Knowledge Base** –  
The knowledge base represents facts and rules. It consists of knowledge in a particular domain as well as rules to solve a problem, procedures and intrinsic data relevant to the domain.
- **Inference Engine** –  
The function of the inference engine is to fetch the relevant knowledge from the knowledge base, interpret it and to find a solution relevant to the user's problem. The inference engine acquires the rules from its knowledge base and applies them to the known facts to infer new facts. Inference engines can also include an explanation and debugging abilities.
- **Knowledge Acquisition and Learning Module** –  
The function of this component is to allow the expert system to acquire more and more knowledge from various sources and store it in the knowledge base.
- **User Interface** –  
This module makes it possible for a non-expert user to interact with the expert system and find a solution to the problem.
- **Explanation Module** –  
This module helps the expert system to give the user an explanation about how the expert system reached a particular conclusion.

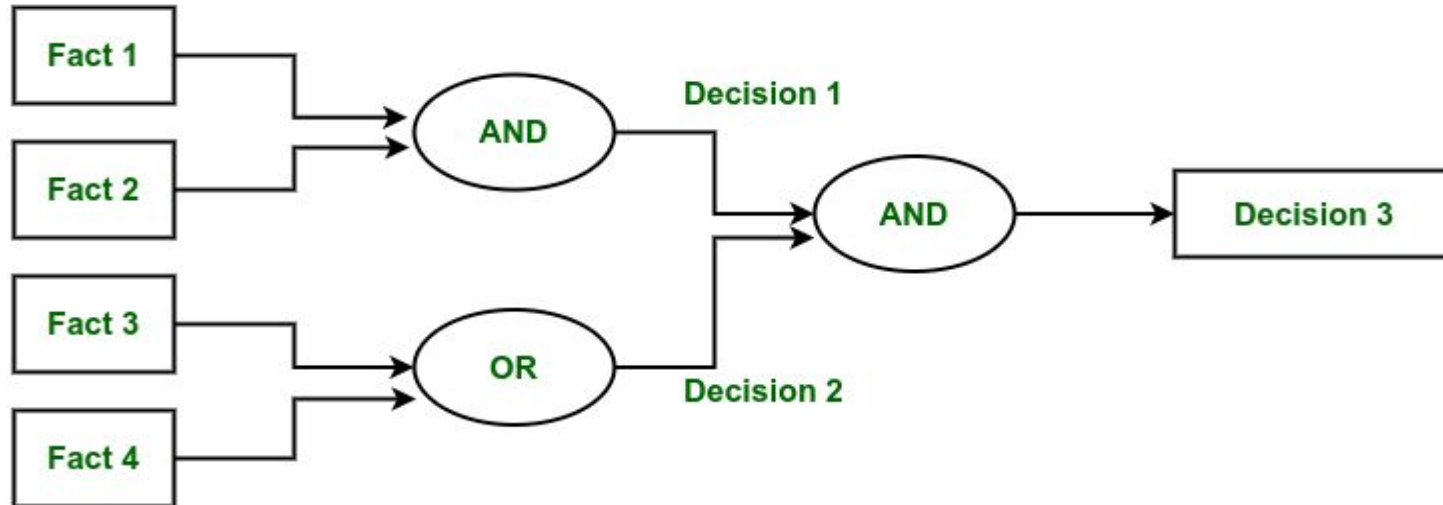
# Expert System

The Inference Engine generally uses two strategies for acquiring knowledge from the Knowledge Base, namely –

- Forward Chaining
- Backward Chaining

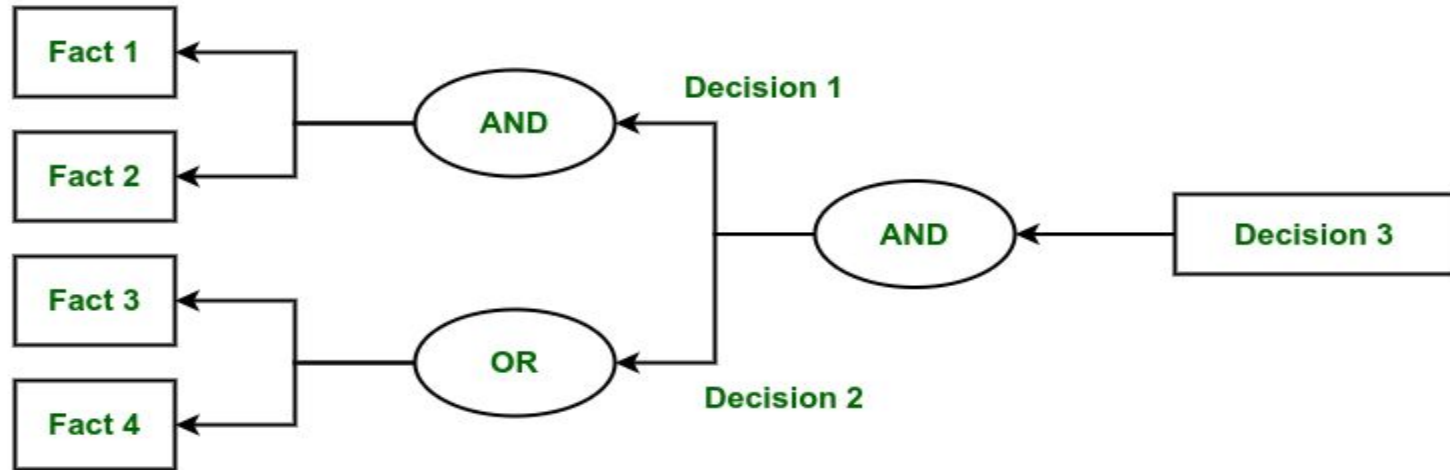
# Forward Chaining

- Forward Chaining is a strategic process used by the Expert System to answer the questions – **What will happen next.**
- This strategy is mostly used for managing tasks like **creating a conclusion, result or effect.**
- Example – prediction or share market movement status.



# Backward Chaining

- Backward Chaining is a strategy used by the Expert System to answer the questions – **Why this has happened.**
- This strategy is mostly used to find out the **root cause or reason behind it**, considering what has already happened.
- Example – diagnosis of stomach pain, blood cancer or dengue, etc.



# Characteristics of Expert System

- Human experts are perishable, but an expert system is permanent.
- It helps to distribute the expertise of a human.
- One expert system may contain knowledge from more than one human experts thus making the solutions more efficient.
- It decreases the cost of consulting an expert for various domains such as medical diagnosis.
- They use a knowledge base and inference engine.
- Expert systems can solve complex problems by deducing new facts through existing facts of knowledge, represented mostly as if-then rules rather than through conventional procedural code.
- Expert systems were among the first truly successful forms of artificial intelligence (AI) software.

# Limitations of Expert System

- Do not have human-like decision-making power.
- Cannot possess human capabilities.
- Cannot produce correct result from less amount of knowledge.
- Requires excessive training.



# Advantages of Expert System

- Low accessibility cost.
- Fast response.
- Not affected by emotions, unlike humans.
- Low error rate.
- Capable of explaining how they reached a solution.

# Disadvantages of Expert System

- Common sense is the main issue of the expert system.
- It is developed for a specific domain.
- It needs to be updated manually. It does not learn itself.
- Not capable to explain the logic behind the decision.

# Applications of Expert System

- Different types of medical diagnosis like internal medicine, blood diseases and show on.
- Diagnosis of the complex electronic and electromechanical system.
- Diagnosis of a software development project.
- Planning experiment in biology, chemistry and molecular genetics.
- Forecasting crop damage.
- Diagnosis of the diesel-electric locomotive system.
- Identification of chemical compound structure.
- Scheduling of customer order, computer resources and various manufacturing task.
- Assessment of geologic structure from dip meter logs.
- Assessment of space structure through satellite and robot.
- The design of VLSI system.
- Teaching students specialize task.
- Assessment of log including civil case evaluation, product liability etc.

# Development of Expert System

- Below are some steps to build MYCIN:
  - Firstly, ES should be fed with expert knowledge. In the case of MYCIN, human experts specialized in the medical field of bacterial infection, provide information about the causes, symptoms, and other knowledge in that domain.
  - The KB of the MYCIN is updated successfully. In order to test it, the doctor provides a new problem to it. The problem is to identify the presence of the bacteria by inputting the details of a patient, including the symptoms, current condition, and medical history.
  - The ES will need a questionnaire to be filled by the patient to know the general information about the patient, such as gender, age, etc.
  - Now the system has collected all the information, so it will find the solution for the problem by applying if-then rules using the inference engine and using the facts stored within the KB.
  - In the end, it will provide a response to the patient by using the user interface.