

# Artificial Intelligence

## Lecture 30

### Experts Systems in AI



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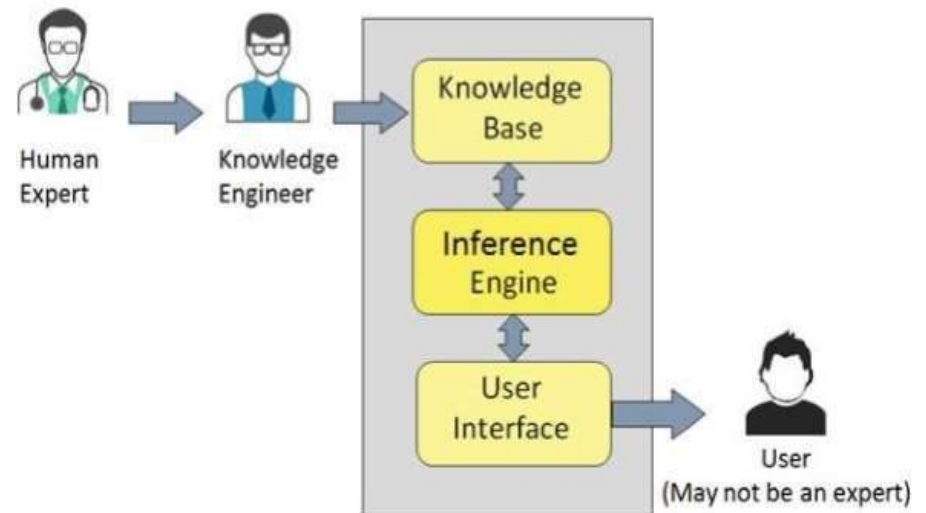
# Lecture Outlines

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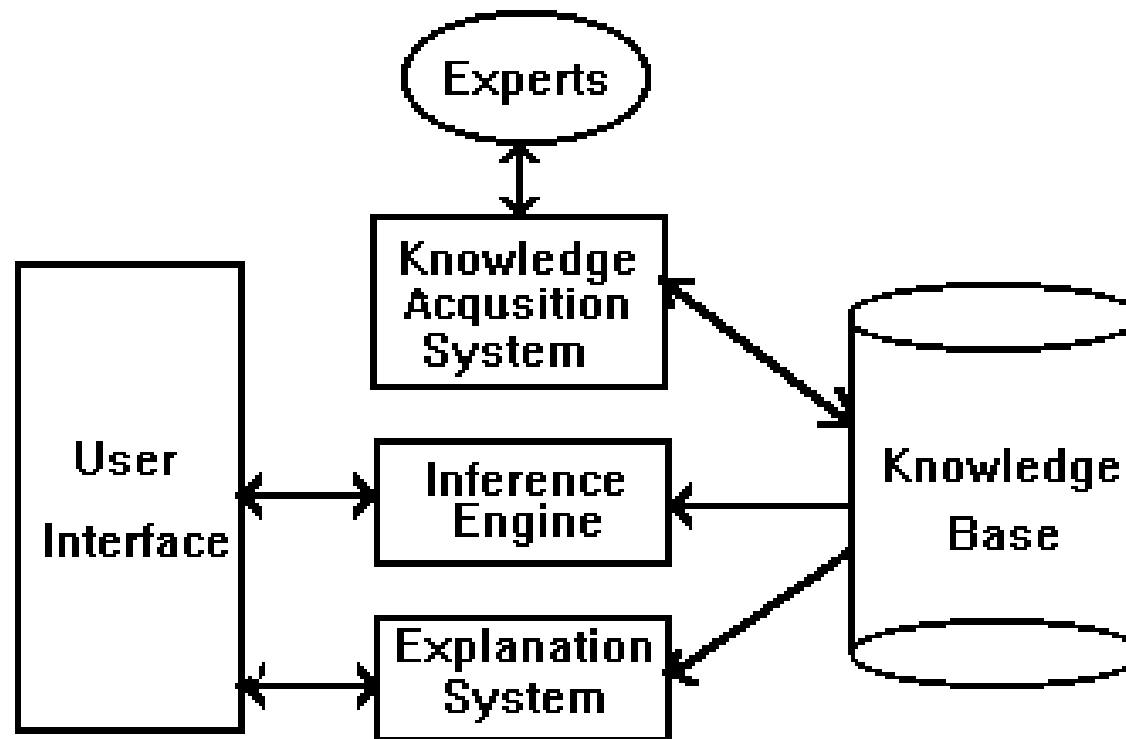
- **Structure of an Expert System**
  - **To be continued...**

# Components of Expert Systems

- The components of ES include –
  - **Knowledge Base**
    - Components of Knowledge Base
    - Knowledge representation
    - Knowledge Acquisition
    - Knowledge Engineering
  - **Inference Engine**
    - Inference Mechanisms:  
Forward and Backward Chaining
  - **User Interface**
  - Explanation subsystem
  - Blackboard
  - Knowledge refinement subsystem



# Structure of an Expert System



**Architecture of a typical Expert System**



# Knowledge Base...

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- The **knowledge base** is the collection of facts and rules which describe all the knowledge about the problem domain. 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.
- The power of problem solving is primarily the consequence of the knowledge base and secondarily on the inference method employed.
- The design of knowledge representation scheme impacts the design of the inference engine, the knowledge updating process, the explanation process and the overall efficiency of the system.
- Therefore the selection of the knowledge representation scheme is one of the most critical decision in ES design.



# Knowledge Base...

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- **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 Base...

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- **Knowledge Representation**

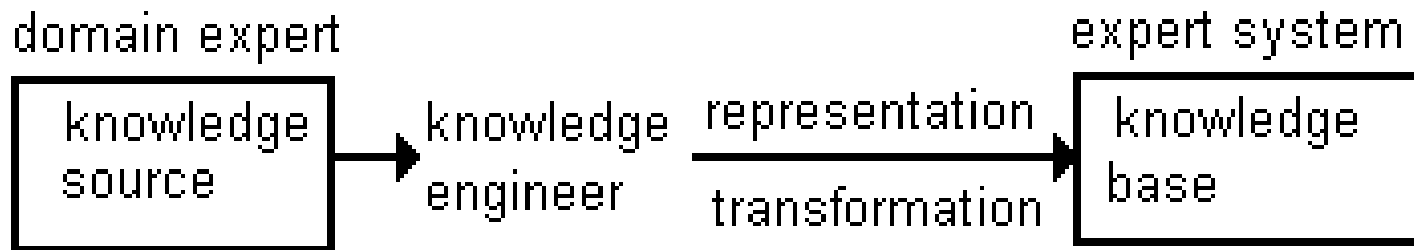
- It is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules.

- **Knowledge Engineering**

- Knowledge engineering is the process of acquiring specific domain knowledge and building it into the knowledge base. Knowledge extraction can be done by
  - interviews, observation of the expert at work, evaluation of the material used by the expert.
- This process is termed **knowledge acquisition**. It involves problem definition, implementation, and refinement as well as representing facts and relations acquired from an expert.

# Knowledge Base

- Thus, the knowledge base is formed by readings from various experts, scholars, and the **Knowledge Engineers**. The knowledge engineer is a person with the qualities of empathy, quick learning, and case analyzing skills.
- The knowledge engineer also monitors the development of the Expert System (ES).



## Knowledge Engineering





# Inference Engine...

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- Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.
  - **In case of knowledge-based ES**, the Inference Engine –
    - Acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.
  - **In case of rule based ES**, , the Inference Engine –
    - 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.
- It controls the reasoning involved when the system is run.



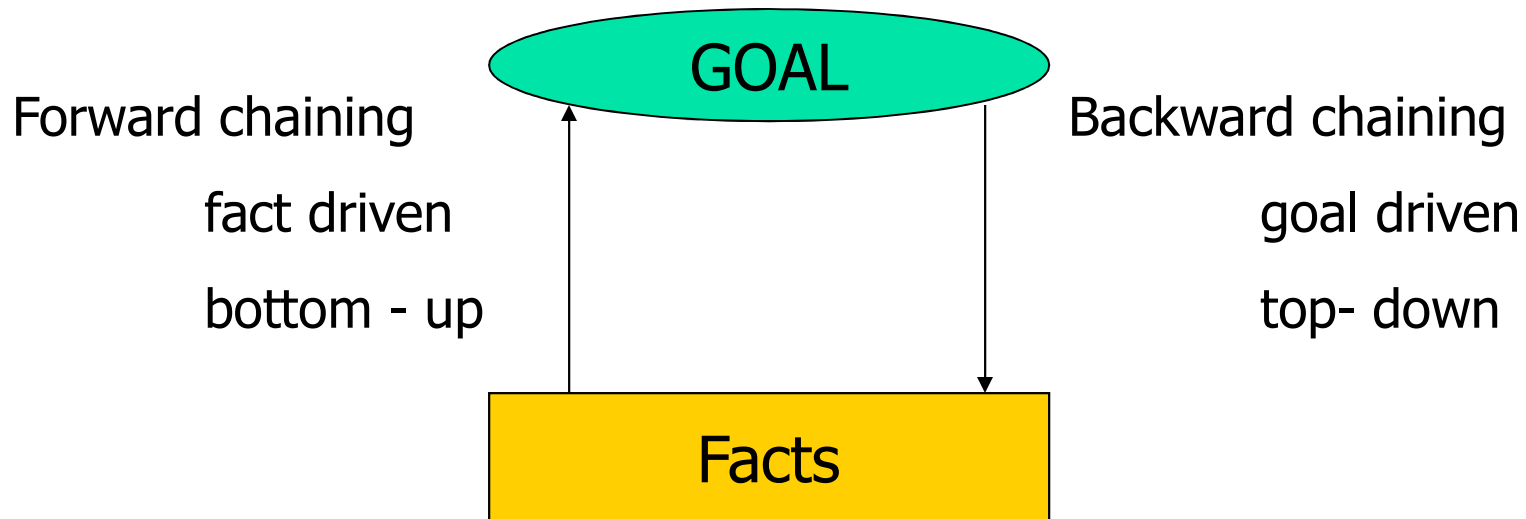
# Inference Engine...

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- It has its own mechanism for interpreting the stored knowledge (in the appropriate form), and for sequencing the steps involved in reaching conclusions.
- **Inference** here means any of the methods by which the system reaches conclusions/solutions.
- To recommend a solution, the Inference Engine uses the following **strategies/mechanisms** –
  - Forward Chaining
  - Backward Chaining

# Inference Engine...

- **Inference Mechanisms**
- The selection of the inference paradigm strongly influences the overall performance of the ES



Expert Systems



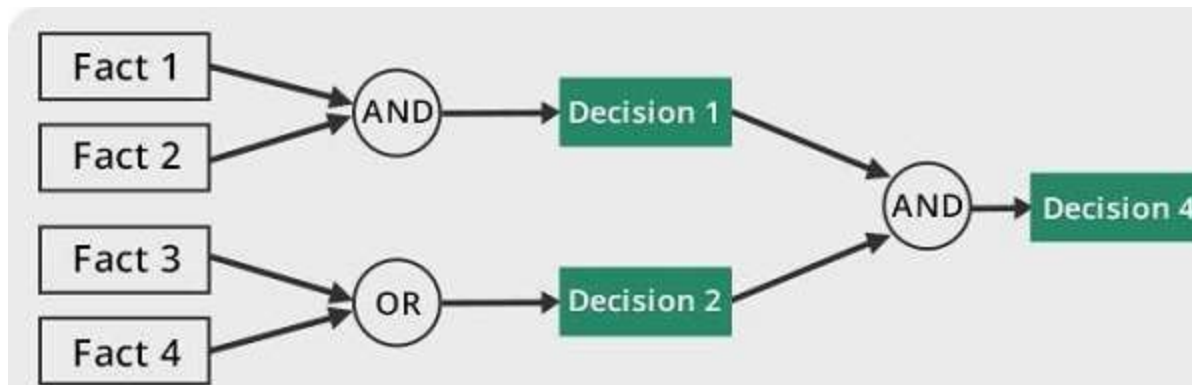
# Inference Engine...

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- **Inference Mechanisms: 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 derivations and finally deduces the outcome.
- It considers all the facts and rules, and sorts them before concluding to a solution.

# Inference Engine...

- **Inference Mechanisms: Forward Chaining**
- 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.





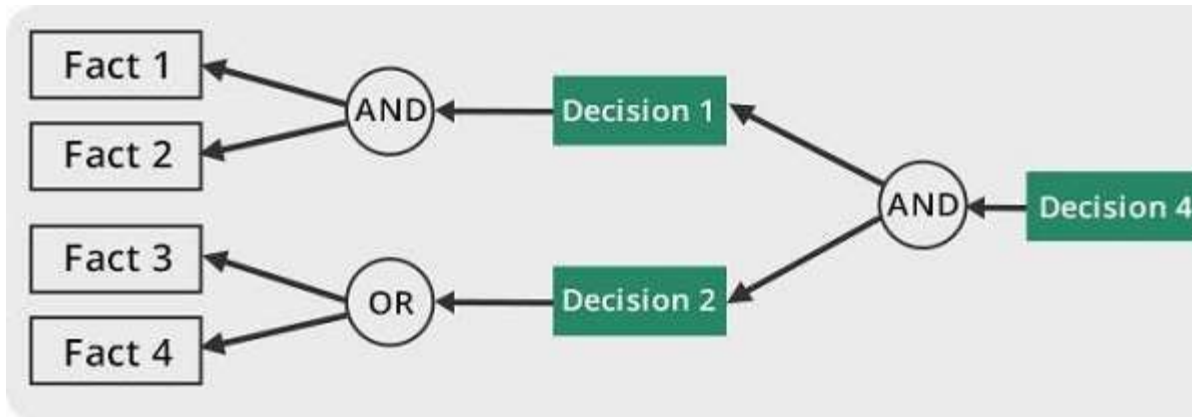
# Inference Engine...

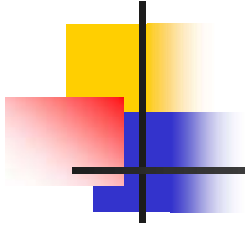
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- **Inference Mechanisms: Backward Chaining**
  - With this strategy, an expert system finds out the answer to the question, **“Why this happened?”**
  - On the basis of what has already happened, the Inference Engine tries to find out which conditions could have happened in the past for this result.

# Inference Engine

- **Inference Mechanisms: Backward Chaining**
- This strategy is followed for finding out cause or reason.
- For example, diagnosis of blood cancer in humans.





# Expert Systems

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**TO BE CONTINUED...**