

# Module 4: Expert Systems & Knowledge Engineering

## Expert System – Definition

- AI program that solves complex problems like a human expert.
- Uses a knowledge base and inference rules.
- Works in a specific domain (medical, finance, diagnosis).
- Assists humans, does not replace them.

## Characteristics of Expert Systems

- High accuracy and efficiency
- Fast response time
- Reliable and consistent
- Easy to understand interaction

## Components of Expert System

- User Interface – interaction with user
- Inference Engine – reasoning and decision making
- Knowledge Base – facts + rules

## Inference Engine Types

- Deterministic – conclusions are certain
- Probabilistic – conclusions based on probability
- Forward chaining – from facts to conclusion
- Backward chaining – from goal to facts

## Knowledge Base

- Stores domain-specific knowledge
- Factual knowledge – based on facts
- Heuristic knowledge – based on experience
- Uses IF–THEN rules

## Participants in Expert System

- Domain Expert – provides knowledge
- Knowledge Engineer – converts knowledge into rules
- End User – uses the system

## Why Expert Systems?

- No memory limitation
- Not affected by emotions
- Considers all facts
- High security and consistency

## **Advantages**

- High speed and accuracy
- Can work in risky environments
- Consistent performance

## **Limitations**

- Depends on correct knowledge
- Cannot learn on its own
- High development cost
- Domain specific

## **Applications**

- Medical diagnosis
- Finance and fraud detection
- Design and manufacturing
- Planning and scheduling

## **Types of Expert Systems**

- Rule-based systems
- Frame-based systems
- Fuzzy logic systems
- Neural network based systems
- Neuro-fuzzy systems

## **Knowledge Engineering**

- Process of acquiring, organizing and maintaining knowledge
- Main task: convert human knowledge into machine usable form

## **Knowledge Acquisition**

- Collecting knowledge from experts, data, documents
- Manual or automatic (machine learning)

## **Methods of Knowledge Acquisition**

- Interviews
- Observation
- Document analysis
- Machine learning
- Expert systems

## **Difficulties in Knowledge Acquisition**

- Knowledge is hard to extract
- Experts may be biased
- Data may be incomplete or noisy
- Time-consuming and costly

## **Machine Learning in Knowledge Acquisition**

- Learns patterns automatically from data
- Uses supervised, unsupervised, reinforcement learning
- Used in NLP, robotics, recommendation systems

## **Intelligent Agents**

- An agent perceives environment using sensors
- Acts using actuators
- Goal: maximize performance

## **Types of Intelligent Agents**

- Simple reflex agents
- Model-based reflex agents
- Goal-based agents
- Utility-based agents
- Learning agents

## **Multi-Agent Systems**

- Multiple agents work together
- Used in air traffic control, distributed systems
- Can be cooperative or competitive