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