**Topic: AI systems**

Reading Time: 20 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words, to get the solid grip on topic.

**AI Systems**

Artificial Intelligence (AI) systems are computer programs designed to perform tasks that typically require human intelligence. These systems can analyze data, make decisions, and learn from experience. There are two main types of AI systems: **Expert Systems** and **Machine Learning**.

**1. Expert Systems**

**What is an Expert System?**

An expert system is a computer program that mimics human decision-making using AI. It is designed to solve complex problems in a specific field by using expert knowledge and inference rules.

**How Expert Systems Work**

Expert systems have three main components:

1.      **User Interface**

* This allows users to interact with the expert system.
* Users input information via dialogue boxes, command prompts, or other methods.
* The system asks questions with Yes/No answers based on previous responses.

2.      **Inference Engine**

* Acts like a search engine, examining the **knowledge base** to find relevant information.
* Gathers information by asking questions.
* Uses inference rules to draw conclusions and solve problems.

3.      **Knowledge Base**

* A collection of expert knowledge stored in the system.
* Contains facts, rules, and information gathered from experts or research sources.

4.      **Rules Base**

* A set of logical "IF-THEN" statements used by the inference engine to make decisions.
* Example Rule:

**IF** a bird has feathers AND can fly **THEN** it is likely a sparrow.

**Applications of Expert Systems**

Expert systems are widely used in various fields:

* **Oil and Mineral Prospecting** – Helps locate oil or minerals underground.
* **Medical Diagnosis** – Assists doctors in diagnosing diseases.
* **Fault Diagnostics** – Detects problems in machines and electronic devices.
* **Tax and Financial Calculations** – Used in financial decision-making and tax assessments.
* **Strategy Games (Chess, Go, etc.)** – Helps AI opponents make strategic moves.
* **Logistics** – Optimizes routes for parcel delivery.
* **Identification Systems** – Identifies plants, animals, and chemicals.

**Advantages of Expert Systems**

* Provide a high level of expertise in a specific area.
* Offer high accuracy and consistent results.
* Can store and analyze vast amounts of data.
* Provide traceable and logical solutions.
* Can handle multiple expertise areas in one system.
* Have fast response times, much quicker than human experts.
* Offer unbiased reporting based purely on facts.
* Can indicate the probability of a suggested solution being correct.

**Disadvantages of Expert Systems**

* Users need training to properly use the system.
* High setup and maintenance costs.
* Responses can feel "cold" and lack human empathy (especially in medical cases).
* The system is only as good as the information entered into it.
* Users may wrongly assume that expert systems are always correct.

**2. Machine Learning**

**What is Machine Learning?**

Machine Learning (ML) is a branch of AI that enables computers to learn from data and make predictions without being explicitly programmed. Instead of following fixed rules, ML models improve their accuracy over time by analyzing data.

**How Machine Learning Works**

1. **Training Data** – The system is fed large amounts of data related to a specific task.
2. **Learning Process** – The system detects patterns and learns from past experiences.
3. **Prediction/Decision Making** – Once trained, the system can make predictions on new data.
4. **Continuous Improvement** – The more data the system processes, the better its predictions become.

**Types of Machine Learning**

1. **Supervised Learning** – The model is trained on labeled data (i.e., data with known outputs). Example: Email spam detection.
2. **Unsupervised Learning** – The model finds patterns in unlabeled data. Example: Customer behavior analysis.
3. **Reinforcement Learning** – The system learns by trial and error, receiving rewards for good decisions. Example: AI in self-driving cars.

**Examples of Machine Learning Applications**

* **Spam Filters** – Identifies spam emails based on previous data.
* **Speech Recognition** – Converts spoken words into text (Siri, Google Assistant).
* **Face Recognition** – Detects and verifies faces in images.
* **Autonomous Vehicles** – Helps self-driving cars understand their surroundings.
* **Fraud Detection** – Identifies suspicious financial transactions.

**Advantages of Machine Learning**

* Can analyze vast amounts of data quickly.
* Learns from experience and improves accuracy over time.
* Reduces human effort in repetitive tasks.
* Can identify patterns and make decisions faster than humans.
* Useful in many industries, including healthcare, finance, and security.

**Disadvantages of Machine Learning**

* Requires a large amount of high-quality data to work well.
* Training AI models can be time-consuming and expensive.
* Can make mistakes if trained on biased or incorrect data.
* Lack of transparency in decision-making (often called the "black box" problem).

Needs continuous monitoring and updating.

**A-Rated Questions/Answers By Examiner**

**Q1. What is the main function of an expert system?**

**Answer:**An expert system mimics human decision-making by using a knowledge base, inference engine, and rules base to analyze data and provide expert-level solutions in a specific domain.

**Q2. What are the three main components of an expert system?**

**Answer:**

1. **User Interface** – Allows users to interact with the system.
2. **Inference Engine** – Processes queries and applies rules to reach conclusions.
3. **Knowledge Base** – Stores expert knowledge and facts.

**Q3. How does machine learning differ from expert systems?**

**Answer:**

* **Expert systems** follow fixed rules and rely on pre-programmed knowledge to make decisions.
* **Machine learning** improves over time by analyzing new data and learning patterns without explicit programming.

**Q4. What is the role of the inference engine in an expert system?**

**Answer:**The inference engine processes user inputs, searches the knowledge base, applies inference rules, and provides a solution or decision. It acts as the problem-solving part of the system.

**Q5. Give one example each of an application for expert systems and machine learning.**

**Answer:**

* **Expert System:** Medical diagnosis system that helps doctors identify diseases.
* **Machine Learning:** Spam detection system that filters unwanted emails based on past data.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6. What are some limitations of expert systems compared to human experts?**

**Q7. How does reinforcement learning differ from supervised and unsupervised learning?**

**Q8. Why is high-quality data important for machine learning models?**

**Q9. How do expert systems assist in medical diagnosis?**

**Q10. What are some ethical concerns related to machine learning?**

**6. Answer:**Expert systems lack common sense, human intuition, and adaptability to new or unforeseen situations. They also require accurate data input and maintenance to remain effective.

**7. Answer:**Reinforcement learning involves trial-and-error learning with rewards and penalties, whereas supervised learning uses labeled data for training, and unsupervised learning identifies patterns in unlabeled data.

**8. Answer:**High-quality data ensures accurate predictions, reduces bias, and prevents errors in AI decision-making. Poor data quality can lead to incorrect outcomes and unreliable AI performance.

**9. Answer:**Expert systems analyze patient symptoms and medical history using a knowledge base and inference engine to provide possible diagnoses and treatment recommendations.

**10. Answer:**Ethical concerns include bias in AI models, data privacy violations, potential job displacement, and the lack of transparency in AI decision-making (the "black box" problem).