1.Explain the term machine learning, and how does it work? Explain two machine learning applications in the business world. What are some of the ethical concerns that machine learning applications could raise?

2. Describe the process of human learning:

i. Under the supervision of experts

ii. With the assistance of experts in an indirect manner

iii. Self-education

3. Provide a few examples of various types of machine learning.

4. Examine the various forms of machine learning.

5. Can you explain what a well-posed learning problem is? Explain the main characteristics that must be present to identify a learning problem properly.

6. Is machine learning capable of solving all problems? Give a detailed explanation of your answer.

7. What are the various methods and technologies for solving machine learning problems? Any two of them should be defined in detail.

8. Can you explain the various forms of supervised learning? Explain each one with an example application.

9. What is the difference between supervised and unsupervised learning? With a sample application in each region, explain the differences.

10. Describe the machine learning process in depth.

a. Make brief notes on any two of the following:

MATLAB is one of the most widely used programming languages.

ii. Deep learning applications in healthcare

iii. Study of the market basket

iv. Linear regression (simple)

11. Make a comparison between:-

1. Generalization and abstraction

2. Learning that is guided and unsupervised

3. Regression and classification

**Answers**

**1. Machine Learning (ML)**

* **Definition**: ML is a field of AI where algorithms learn patterns from data to make predictions or decisions without explicit programming.
* **How it works**:
  1. Collect data
  2. Preprocess and select features
  3. Train a model on the data
  4. Evaluate and fine-tune
  5. Make predictions on new data
* **Business applications**:
  1. Customer churn prediction
  2. Recommendation engines (e.g., Amazon, Netflix)
* **Ethical concerns**: Bias in decision-making, privacy issues, lack of transparency, potential job displacement.

**2. Human Learning Process**

i. **Under supervision**: Learning directly with expert guidance (e.g., classroom teaching).  
ii. **Indirect assistance**: Learning with guidance but independently (e.g., online courses with feedback).  
iii. **Self-education**: Learning independently without external guidance (e.g., reading books, experimenting).

**3. Examples of ML types**

* Supervised learning (e.g., spam detection)
* Unsupervised learning (e.g., customer segmentation)
* Reinforcement learning (e.g., robot navigation)
* Semi-supervised learning (e.g., medical diagnosis with few labeled cases)

**4. Forms of ML**

* **Supervised learning**: Learns from labeled data (classification, regression)
* **Unsupervised learning**: Finds patterns in unlabeled data (clustering, dimensionality reduction)
* **Reinforcement learning**: Learns through trial and error with rewards/penalties
* **Semi-supervised learning**: Combines labeled and unlabeled data
* **Online learning**: Learns continuously as new data arrives

**5. Well-posed learning problem**

* **Definition**: A problem where:
  1. The task is clearly defined
  2. Performance measure is specified
  3. Training experience/data is available
* **Characteristics**: Clear input/output, measurable performance, sufficient data for learning.

**6. Can ML solve all problems?**

* **No**. ML requires sufficient, relevant data, clear objectives, and measurable outcomes. It struggles with tasks requiring deep reasoning, creativity, or understanding without data.

**7. Methods & technologies for ML**

* **Decision trees**: Split data based on features to make predictions.
* **Neural networks**: Layers of interconnected nodes learn complex patterns.
* **Support Vector Machines (SVM)**: Finds a hyperplane that separates data classes.
* **k-Nearest Neighbors (kNN)**: Predicts based on similarity to nearby points.

**Detailed examples**:

1. **Decision Tree**: Used for customer credit scoring; splits customers into low/high risk.
2. **Neural Network**: Used for image recognition; learns hierarchical features to classify objects.

**8. Forms of Supervised Learning**

* **Classification**: Predict category (e.g., email spam/not spam)
* **Regression**: Predict continuous value (e.g., house price prediction)
* **Multi-class classification**: Predict more than two categories (e.g., digit recognition 0–9)
* **Example applications**:
  + Classification → Fraud detection
  + Regression → Stock price prediction

**9. Supervised vs Unsupervised Learning**

| **Aspect** | **Supervised** | **Unsupervised** |
| --- | --- | --- |
| Data | Labeled | Unlabeled |
| Goal | Predict output | Find patterns/structure |
| Example | Spam detection | Customer segmentation |

**10. Machine Learning Process**

1. Define problem
2. Collect & preprocess data
3. Feature engineering
4. Split data (train/validation/test)
5. Train model
6. Evaluate performance
7. Tune hyperparameters
8. Deploy model

**Brief notes on selected topics**:

* **Deep learning in healthcare**: Used for medical image analysis, disease prediction, personalized treatment.
* **Linear regression**: Simple model predicting continuous outcomes; e.g., predicting sales from advertising spend.

**11. Comparisons**

1. **Generalization vs Abstraction**:
   * Generalization → Applying learned knowledge to new data
   * Abstraction → Simplifying complex concepts into key features
2. **Guided vs Unsupervised learning**:
   * Guided → Uses labeled data and supervision
   * Unsupervised → Finds patterns without labeled data
3. **Regression vs Classification**:
   * Regression → Predicts continuous values
   * Classification → Predicts discrete categories