ML_ASSISMENT_03

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?

Sol: Machine learning is the field of study that gives machines the ability to learn without being explicitly programmed.
Two machine learning applications in the business world - fraud Detection and spam detection.
Ethical concern is privacy and security.

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

Sol:
Human learning is a complex and multifaceted process that involves acquiring knowledge, skills, attitudes, and behaviors through various means. The process of learning can be categorized into three main approaches:

i. Under the Supervision of Experts:
This approach involves learning under the guidance and direct supervision of knowledgeable individuals who are experts in the subject matter. The learning process typically follows a structured curriculum or program:
- Instruction and Guidance.
- Feedback and Assessment.
- Practice and Application.
- Interaction.

ii. With the Assistance of Experts in an Indirect Manner:
In this approach, learners utilize resources and materials created by experts to facilitate their learning process. While learners are not directly supervised, they benefit from the expertise of others:

- Self-paced Learning
- Structured Resources (instructed path)
- Online Communities and Forums
- Independent Practice

iii. Self educated trained machine learning
Self-education involves learners taking responsibility for their own learning process.
- Curiosity and Exploration
- Critical Thinking
- Trial and Error
- Continuous Improvement

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

Sol:
1. Supervised machine learning :
   (i) Classification (example - male/female , yes/no)

(ii) Regression (example - income prediction , whether prediction , Market trends)

APPLICATION: image segmentation,medical diagnose,fraud Detection , speech recognition.

2. Unsupervised Machine Learning:
   i) Clustering (example - grouping customer according to their purchase)
   ii) Association (market basket analysis)

   APPLICATION: Network Analysis (analysis of text in copyright), Recommendation system, Anomaly detection.

3. Reinforcement learning :
   i)Positive Reinforcement (increasing the tendency that the required behavior would occur again by adding something.)
   ii)Negative Reinforcement (works exactly opposite to the positive RL. It increases the tendency that the specific behavior would occur again by avoiding the negative condition.)

   APPLICATION: Robotics , text mining , Video games.

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4. Examine the various forms of machine learning.

Sol:
1. Supervised machine learning :
   (i) Classification (example - male/female , yes/no)
   (ii) Regression (example - income prediction , whether prediction , Market trends)

   APPLICATION: image segmentation,medical diagnose,fraud Detection , speech recognition.

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   APPLICATION: Robotics , text mining , Video games.

4. Semi-Supervised
      Although Semi-supervised learning is the middle ground between supervised and unsupervised learning and operates on the data that consists of a few labels, it mostly consists of unlabeled data. As labels are costly, but for corporate purposes, they may have few labels. It is completely different from supervised and unsupervised learning as they are based on the presence & absence of labels.

   Application: To overcome the drawbacks of supervised learning and unsupervised learning algorithms, the concept of Semi-supervised learning is introduced. The main aim of semi-supervised learning is to effectively use all the available data, rather than only labeled data like in supervised learning. Initially, similar data is clustered along with an unsupervised learning algorithm, and further, it helps to label the unlabeled data into labeled data. It is because labeled data is a comparatively more expensive acquisition than unlabeled data.

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.

Sol:

The formal definition of Well posed learning problem is, "A computer program is said to learn from Experience E when given a task T, and some performance measure P. If it performs on T with a performance measure P, then it upgrades with experience E.

The three important components of a well-posed learning problem are **Task** , **Performance Measure**, **Experience**

Example: Face Recognition Problem: A facial recognition system device is capable of matching a human face from a digital image or a video frame against a database of faces. It works by locating and measuring facial characteristics from a given image and is often used to verify users through ID verification services. where,

T -> Predicting distinct sorts of faces.

P -> Ability to anticipate the largest number of different sorts of faces.

E -> train the system with as many datasets of varied facial photos as possible.

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

Sol: No,**machine learning is capable of solving all problems due to the following reason.**

1. **Reasoning Power:**
   One area where ML has not mastered successfully is reasoning power, a distinctly human trait.
   Algorithms available today are mainly oriented towards specific use-cases and are narrowed down when it comes to applicability. They cannot think as to why a particular method is happening that way or 'introspect' their own outcomes.

2. **Contextual Limitation:**
   If we consider the area of natural language processing (NLP), text and speech information are the means to understand languages by NLP algorithms. They may learn letters, words, sentences or even the syntax, but where they fall back is the context of the language. Algorithms do not understand the context of the language used.

3. **Scalability**:
   Although we see ML implementations being deployed on a significant basis, it all depends on data as well as its scalability. Data is growing at an enormous rate and has many forms which largely affects the scalability of an ML project. Algorithms cannot do much about this unless they are updated constantly for new changes to handle data. This is where ML regularly requires human intervention in terms of scalability and remains unsolved mostly.

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

Sol: Machine learning methods are:
- Supervised machine learning ,Common algorithms include
    1. Linear Regression,
    2. Decision Trees,
    3. Random Forests,
    4. Support Vector Machines (SVMs),
    5. Neural Networks.

- Unsupervised Machine Learning,
    1. Clustering: K-Means Algorithm
    2. Pca

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

Sol: Supervised machine learning :

(i) Classification (example - male/female , yes/no)

(ii) Regression (example - income prediction , whether prediction , Market trends)

APPLICATION: image segmentation,medical diagnose,fraud Detection , speech recognition.

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

Sol:

1. <u>Supervised Machine</u> Learning Supervised learning is the type of machine learning in which machines are trained using well "labeled" training data, and on the basis of that data, machines predict the output. The labeled data means some input data is already tagged with the correct output.

    Sample Application: Image Classification (classifying the image of animal - cat/ Dog/ Bird) into their respective categories.

2. <u>unsupervised learning</u> is a machine learning technique in which models are not supervised using training dataset. Instead, models itself find the hidden patterns and insights from the given data. Unsupervised learning cannot be directly applied to a regression or classification problem because unlike supervised learning, we have the input data but no corresponding output data.

    Sample Application:Group customers of an e-commerce platform into distinct segments based on their purchasing behavior.

10. Describe the machine learning process in depth. Make brief notes on any two of the following:
   1. **MATLAB is one of the most widely used programming languages.**
   2. **Deep learning applications in healthcare**
   3. **Study of the market basket**
   4. **Linear regression (simple)**

Sol:

1. <u>Study of the market basket:</u>
    market baskets, often referred to as market basket analysis or association rule mining, is a common application of unsupervised learning in the field of retail and business analytics. It involves analyzing the relationships between items that customers tend to purchase together in order to gain insights into consumer behavior, optimize product placement, and enhance marketing strategies.

    Market Basket Analysis:

    Objective: To discover associations or relationships between items frequently bought together in customer transactions.
    Approach:
       1. Data collection
       2. Data Processing
       3. Association Rule Mining : Apriori Algorithm
       4. Interpretation
       5. Insight and decision

2. <u>Linear regression:</u>
    Linear regression is an statistical method used to model the relationship between a dependent variable and one or more independent variable through linear equation to observe data.(ie. One independent variable)
    Equation : $y = \beta 0 + \beta \cdot x + \varepsilon$

Where:
1. y is dependable variable (prediction value)
2. ε is the error term, accounting for the variability in
3. B1 is the slope, indicating how much the predicted value of *y* changes for a one-unit change in x
4. β0 is the intercept, representing the predicted value of y when x is 0
5. *x* is the independent variable (the variable you're using to predict or explain *y*)

11. Make a comparison between:-

1. Generalisation and Abstraction

Generalization	abstraction
Meaning: ● Generalization refers to the process of extracting common features, patterns, or characteristics from a set of specific instances or examples. ● It involves identifying shared traits among different instances and creating a more general concept that can encompass those instances	**Meaning:** ● Abstraction involves focusing on the essential aspect of an object, system, or concept while ignoring irrelevant details ● It aims to represent complex realities in a simple manner.
Example: ● In machine learning, generalization refers to the model's ability to perform well on unseen data by learning patterns from the training data without memorizing it. A generalizing model can make accurate predictions for new, previously unseen examples.	**Example**: ● For example, an abstract class "Vehicle" might have subclasses like "Car" and "Bus," each with its specific attributes and method
Process: ● Generalization involves moving from the specific to the general. It's about deriving commonalities from individual instances to form a more general concept. (Inductive Knowledge , same bases science work)	**Process**: ● Abstraction involves creating a higher-level representation that captures the most important aspects while omitting lower-level or less relevant details.

2. Learning that is guided and unsupervised

Guided Learning	Unsupervised Learning
Meaning: ● **Supervised Machine** Learning Supervised learning is the type of machine learning in which machines are trained using well "labeled" training data, and on the basis of that data, machines predict the output. The labeled data means some input data is already tagged with the correct output.	**Meaning:** ● **unsupervised learning** is a machine learning technique in which models are not supervised using training dataset. Instead, models itself find the hidden patterns and insights from the given data. Unsupervised learning cannot be directly applied to a regression or classification problem because unlike supervised learning, we have the input data

	but no corresponding output data
Example: ● Sample Application: Image Classification (classifying the image of animal - cat/ Dog/ Bird) into their respective categories.	**Example**: ● Sample Application:Group customers of an e-commerce platform into distinct segments based on their purchasing behavior

3. Regression and classification

Regression	Classification
Meaning: ● Regression is a supervised learning task where the goal is to predict a continuous numerical value (output) based on input features. ● In other words, it's about modeling the relationship between the input variables and a continuous target variable.	**Meaning:** ● Classification is also a supervised learning task, but it deals with predicting a categorical label or class based on input features. The goal is to assign input data points to predefined categories.
Example: ● Regression: Predicting continuous values like prices, quantities, measurements	**Example**: ● Classification: Categorizing data into classes like spam/ham, disease/no disease, sentiment categories.