ML important questions

1.What is machine learning explain with help of diagram and example

Machine learning is a growing technology which enables computers to learn automatically from past data or experience without being explicitly programmed.

example: Machine learning is used in internet search engines, email filters to sort out spam, websites to make personalised recommendations, banking software to detect unusual transactions, and lots of apps on our phones such as voice recognition filters, intrusion detection

Machine Learning is said as a subset of artificial intelligence that is mainly concerned with the development of algorithms which allow a computer to learn from the data and past experiences on their own.

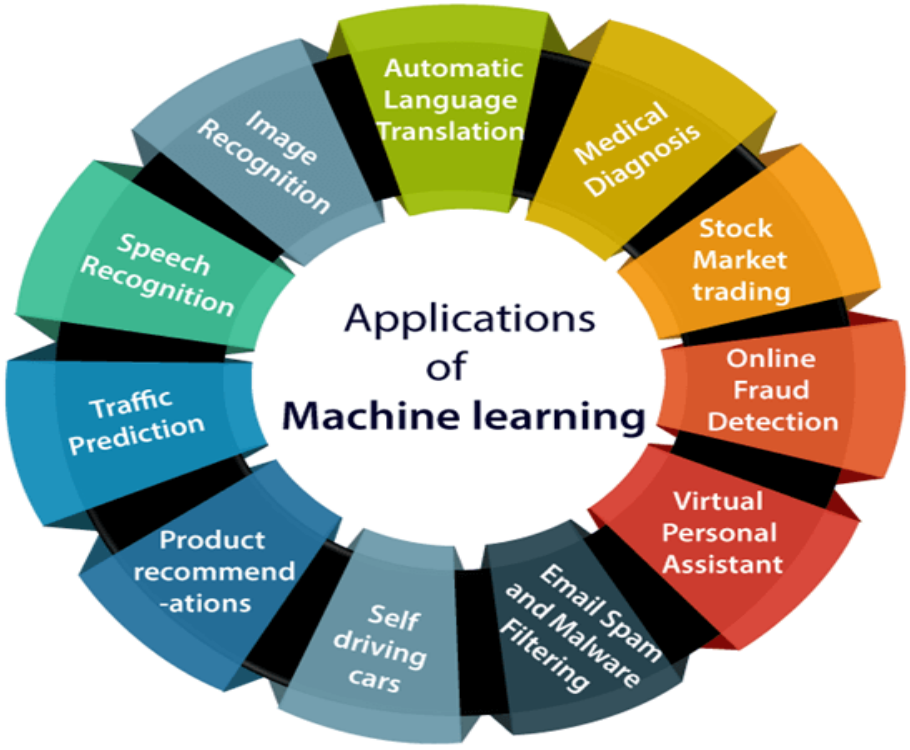
A machine has the ability to learn if it can improve its performance by gaining more data.

2. **Need of machine learning in day to day life also explain its applications in real life.**

- As a human, we have some limitations as we cannot access the huge amount of data manually, so for this, we need some computer systems and here comes the machine learning to make things easy for us.
- We can train machine learning algorithms by providing them the huge amount of data and let them explore the data, construct the models, and predict the required output automatically.

The importance of machine learning can be easily understood by its uses cases, Currently, machine learning is used in self-driving cars, cyber fraud detection, face recognition, and friend suggestion by Facebook, etc.

Machine learning is a buzzword for today's technology, and it is growing very rapidly day by day. We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc.



3. What are diff type of machine learning techniques ex supervise unsupervised reinforcement, explain its life cycle(ML).

At a broad level, machine learning can be classified into three types:

- Supervised learning
- Unsupervised learning
- Reinforcement learning

Supervised learning

Supervised learning is a type of machine learning method in which we provide sample labeled data to the machine learning system in order to train it, and on that basis, it predicts the output.

The system creates a model using labeled data to understand the datasets and learn about each data, once the training and processing are done then we test the model by providing a sample data to check whether it is predicting the exact output or not.

The goal of supervised learning is to map input data with the output data. The supervised learning is based on supervision, and it is the same as when a student learns things in the supervision of the teacher. The example of supervised learning is **spam filtering**.

Supervised learning can be grouped further in two categories of algorithms:

- **Classification**
- **Regression**

Regression

Regression algorithms are used if there is a relationship between the input variable and the output variable.

It is used for the prediction of continuous variables, such as Weather forecasting, Market Trends, etc.

Below are some popular Regression algorithms which come under supervised learning:

- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression

Classification

Classification algorithms are used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.

- Spam Filtering,
- Random Forest
- Decision Trees
- Logistic Regression
- Support vector Machines

Unsupervised learning

Unsupervised learning is a learning method in which a machine learns without any supervision.

The training is provided to the machine with the set of data that has not been labeled, classified, or categorized, and the algorithm needs to act on that data without any supervision.

The goal of unsupervised learning is to restructure the input data into new features or a group of objects with similar patterns.

In unsupervised learning, we don't have a predetermined result. The machine tries to find useful insights from the huge amount of data.

It can be further classifieds into two categories of algorithms:

- **Clustering**
- **Association**

  Clustering: Clustering is a method of grouping the objects into clusters such that objects with most similarities remains into a group and has less or no similarities with the objects of another group.

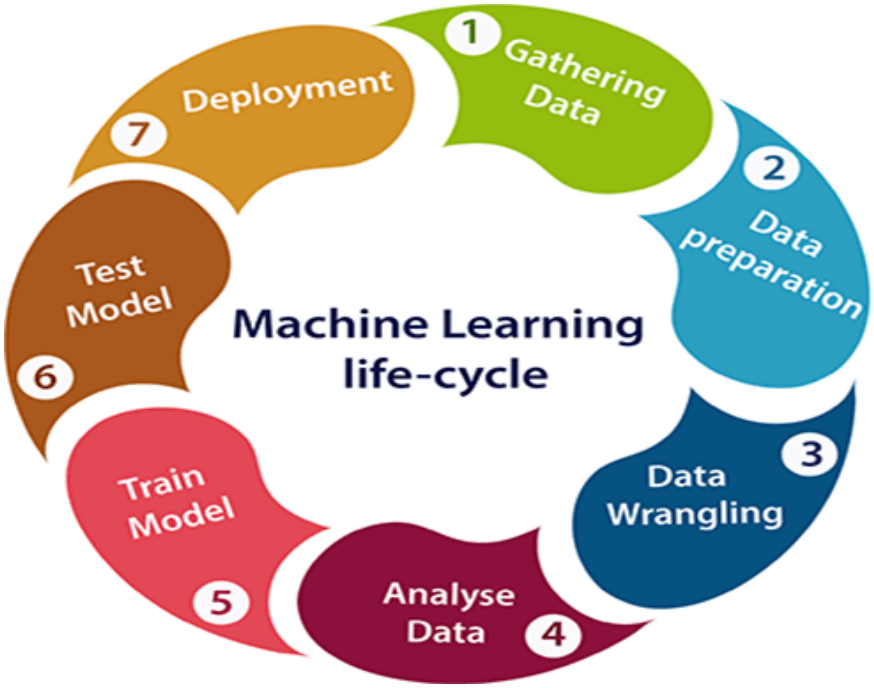
Cluster analysis finds the commonalities between the data objects and categorizes them as per the presence and absence of those commonalities.

Association

- An association rule is an unsupervised learning method which is used for finding the relationships between variables in the large database.
- It determines the set of items that occurs together in the dataset.
- Association rule makes marketing strategy more effective.
- Such as people who buy X item (suppose a bread) are also tend to purchase Y (Butter/Jam) item.
- A typical example of Association rule is Market Basket Analysis.

Reinforcement learning

- Reinforcement learning is a feedback-based learning method, in which a learning agent gets a reward for each right action and gets a penalty for each wrong action.
- The agent learns automatically with these feedbacks and improves its performance.
- In reinforcement learning, the agent interacts with the environment and explores it.
- The goal of an agent is to get the most reward points, and hence, it improves its performance.
- The robotic dog, which automatically learns the movement of his arms, is an example of Reinforcement learning.



Machine learning life cycle involves seven major steps, which are given below:

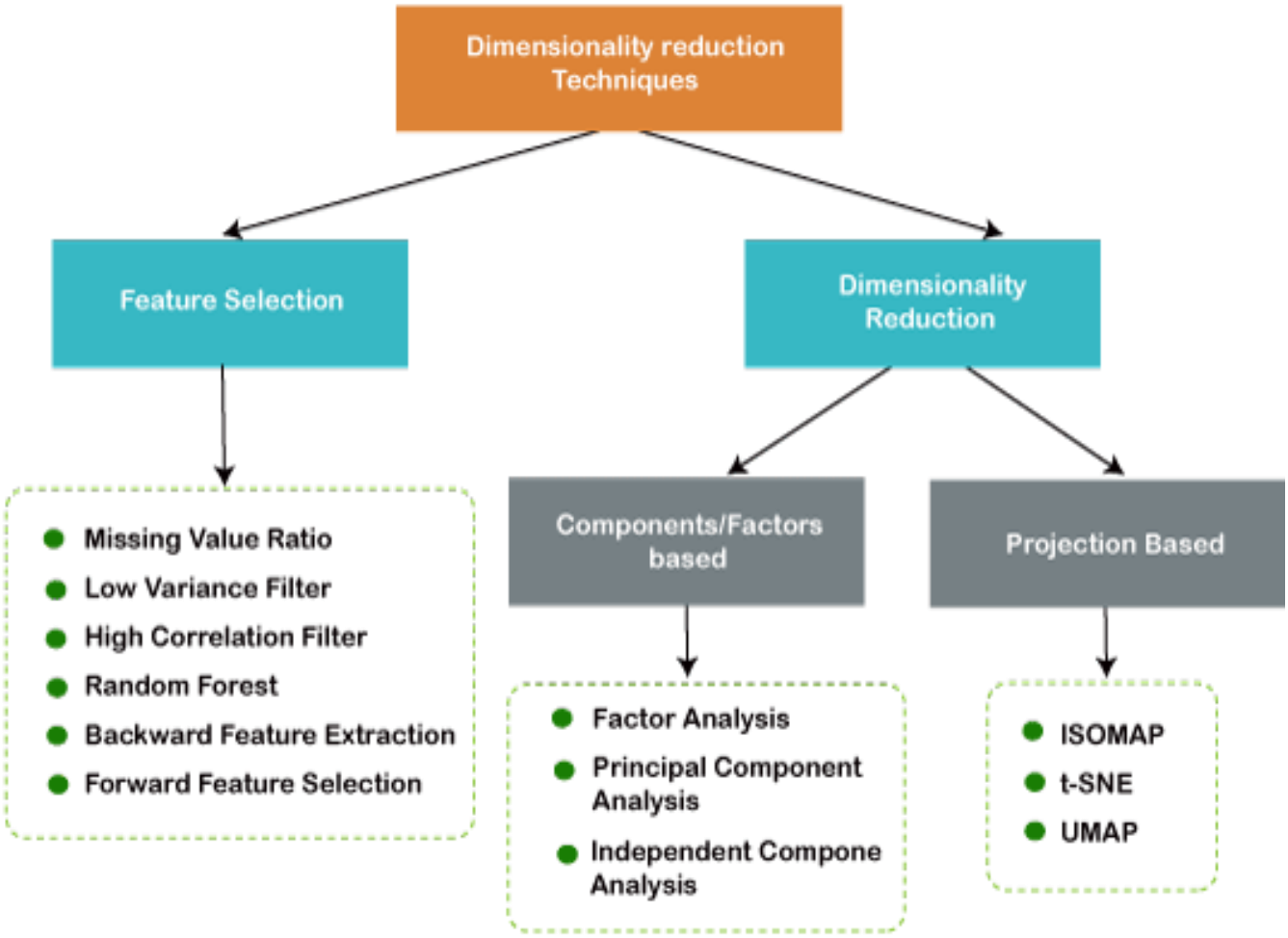
- **Gathering Data**
- **Data preparation**
- **Data Wrangling**
- **Analyse Data**
- **Train the model**
- **Test the model**
- **Deployment**
- In the complete life cycle process, to solve a problem, we create a machine learning system called "model", and this model is created by providing "training". But to train a model, we need data, hence, life cycle starts by collecting data.

Supervised Learning	Unsupervised Learning
Supervised learning algorithms are trained using labeled data.	Unsupervised learning algorithms are trained using unlabeled data.
Supervised learning model predicts the output.	Unsupervised learning model finds the hidden patterns in data.
In supervised learning, input data is provided to the model along with the output.	In unsupervised learning, only input data is provided to the model.
The goal of supervised learning is to train the model so that it can predict the output when it is given new data.	The goal of unsupervised learning is to find the hidden patterns and useful insights from the unknown dataset.

4. What is dimension reduction techniques in ML why we use it or what need of this?

Dimensionality reduction technique can be defined as, **"It is a way of converting the higher dimensions dataset into lesser dimensions dataset ensuring that it provides similar information."** These techniques are widely used in machine learning for obtaining a better fit predictive model while solving the classification and regression problems.

It is commonly used in the fields that deal with high-dimensional data, such as **speech recognition, signal processing, bioinformatics, etc. It can also be used for data visualization, noise reduction, cluster analysis**, etc.



The Curse of Dimensionality

Handling the high-dimensional data is very difficult in practice, commonly known as the *curse of dimensionality*. If the dimensionality of the input dataset increases, any machine learning algorithm and model becomes

more complex. As the number of features increases, the number of samples also gets increased proportionally, and the chance of overfitting also increases. If the machine learning model is trained on high-dimensional data, it becomes overfitted and results in poor performance.

Hence, it is often required to reduce the number of features, which can be done with dimensionality reduction.

Benefits of applying Dimensionality Reduction

Some benefits of applying dimensionality reduction technique to the given dataset are given below:

- By reducing the dimensions of the features, the space required to store the dataset also gets reduced.
- Less Computation training time is required for reduced dimensions of features.
- Reduced dimensions of features of the dataset help in visualizing the data quickly.
- **I**t removes the redundant features (if present) by taking care of multicollinearity.

Disadvantages of dimensionality Reduction

There are also some disadvantages of applying the dimensionality reduction, which are given below:

- Some data may be lost due to dimensionality reduction.
- In the PCA dimensionality reduction technique, sometimes the principal components required to consider are unknown.

Common techniques of Dimensionality Reduction

a. Principal Component Analysis
b. Backward Elimination
c. Forward Selection

d. Score comparison
e. Missing Value Ratio
f. Low Variance Filter
g. High Correlation Filter
h. Random Forest
i. Factor Analysis
j. Auto-Encoder

UNIT 2 Numerical chances high

5. How to represent a data set as a matrix explain with help of example

6.what is difference bw feature normalization and colon standardization explan with help of ex

Feature scaling is one of the most important data preprocessing step in machine learning. Algorithms that compute the distance between the features are biased towards numerically larger values if the data is not scaled.
Tree-based algorithms are fairly insensitive to the scale of the features. Also, feature scaling helps machine learning, and deep learning algorithms train and converge faster.

There are some feature scaling techniques such as Normalization and Standardization that are the most popular and at the same time, the most confusing ones.

Difference between Normalization and Standardization

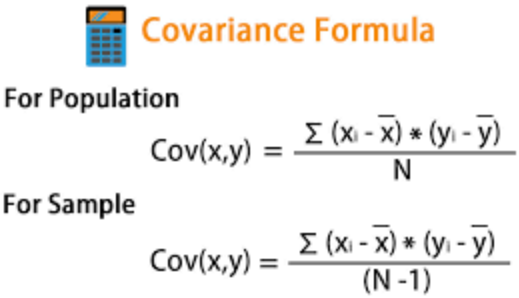
S.NO.	Normalization	Standardization

S.NO.	Normalization	Standardization
1.	Minimum and maximum value of features are used for scaling	Mean and standard deviation is used for scaling.
2.	It is used when features are of different scales.	It is used when we want to ensure zero mean and unit standard deviation.
3.	Scales values between [0, 1] or [-1, 1].	It is not bounded to a certain range.
4.	It is really affected by outliers.	It is much less affected by outliers.
5.	Scikit-Learn provides a transformer called `MinMaxScaler` for Normalization.	Scikit-Learn provides a transformer called `StandardScaler` for standardization.
6.	This transformation squishes the n-dimensional data into an n-dimensional unit hypercube.	It translates the data to the mean vector of original data to the origin and squishes or expands.
7.	It is useful when we don’t know about the distribution	It is useful when the feature distribution is Normal or Gaussian.
8.	It is a often called as Scaling Normalization	It is a often called as Z-Score Normalization.

7. How we can find covariance of data matrix, explain with numerical

Covariance

Covariance is only dependent upon sign. A positive value shows both variables in the same direction. Same as A negative value shows both are in opposite direction. Covariance is a measured use to determine how much variable change in randomly. The covariance is a product of the units of the two variables. The value of covariance lies between -∞ and +∞. The covariance of two variables (x and y) can be represented by cov(x,y).E[x] is the expected value or also called as means of sample 'x'.



Where,

- $\bar{x}$ = sample mean of x
- $\bar{y}$ = sample mean of y
- x_i and y_i = the values of x and y for ith record in the sample.
- N = is the no of records in the sample

Significance of the formula

- Numerator show, the quantity of variance in x multiplied by the quantity of variance in y.
- Unit of covariance shows, Unit of x multiplied by a unit of y
- Hence if we change the unit of variables, covariance also has new value but sign will remain the same.
- However if it is positive then both variables vary in the same direction else if it is negative then they vary in the opposite direction.

8. most imp - what is PCA and what is need of PCA and explain any technique for dimension reduction

Principal Component Analysis

Principal Component Analysis is an unsupervised learning algorithm that is used for the dimensionality reduction in machine learning. It is a statistical process that converts the observations of correlated features into a set of linearly uncorrelated features with the help of orthogonal transformation. These new transformed features are called the **Principal Components**. It is one of the popular tools that is used for exploratory data analysis and predictive modeling. It is a technique to draw strong patterns from the given dataset by reducing the variances.

PCA generally tries to find the lower-dimensional surface to project the high-dimensional data.

PCA works by considering the variance of each attribute because the high attribute shows the good split between the classes, and hence it reduces the dimensionality. Some real-world applications of PCA are ***image processing, movie recommendation system, optimizing the power allocation in various communication channels.*** It is a feature extraction technique, so it contains the important variables and drops the least important variable.

The PCA algorithm is based on some mathematical concepts such as:

- Variance and Covariance

- Eigenvalues and Eigen factors

Some common terms used in PCA algorithm:

- **Dimensionality:** It is the number of features or variables present in the given dataset. More easily, it is the number of columns present in the dataset.
- **Correlation:** It signifies that how strongly two variables are related to each other. Such as if one changes, the other variable also gets changed. The correlation value ranges from -1 to +1. Here, -1 occurs if variables are inversely proportional to each other, and +1 indicates that variables are directly proportional to each other.
- **Orthogonal:** It defines that variables are not correlated to each other, and hence the correlation between the pair of variables is zero.
- **Eigenvectors:** If there is a square matrix M, and a non-zero vector v is given. Then v will be eigenvector if Av is the scalar multiple of v.
- **Covariance Matrix:** A matrix containing the covariance between the pair of variables is called the Covariance Matrix.

Applications of Principal Component Analysis

- PCA is mainly used as the dimensionality reduction technique in various AI applications such **as computer vision, image compression, etc.**
- It can also be used for finding hidden patterns if data has high dimensions. Some fields where PCA is used are Finance, data mining, Psychology, etc.

https://www.gatevidyalay.com/tag/principal-component-analysis-numerical-example/

PCA- principle component analysis

NOTE- Do numerical based on PCA in 2nd unit.

Unit -3

9. Different types of Supervised Learning algorithms. Explain each with help of e.g.

10. What is K- Nearest Neighbors algorithm . How it works and explain with the help of e.g.

11. What is Naïve Bayes algorithm . How it works and explain with the help of e.g.

12. What is Decision Trees. How it works and explain with the help of e.g.

13. What is Regression. Explain its types with the help of e.g.

14.What is Support Vector Machine. Explain with the help of example and write its algorithm and application also.

NOTE= Do numerical based on Naïve-Bayes and Decision Tree or Linear Regression.