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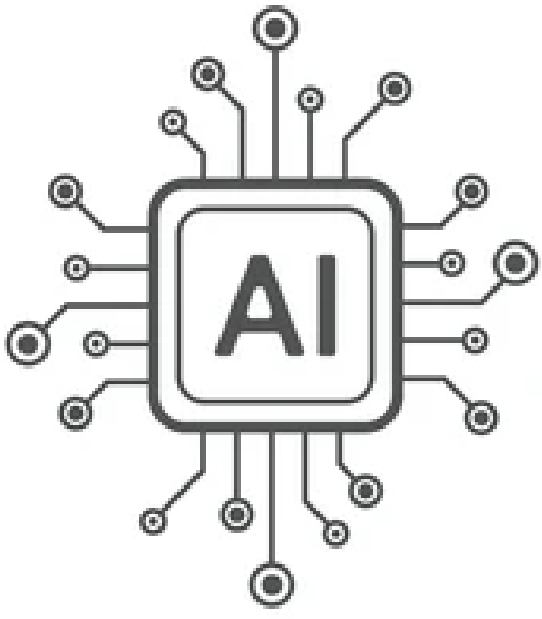

MACHINE LEARNING ALGORITHMS

Karn Singh

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Linear Regression

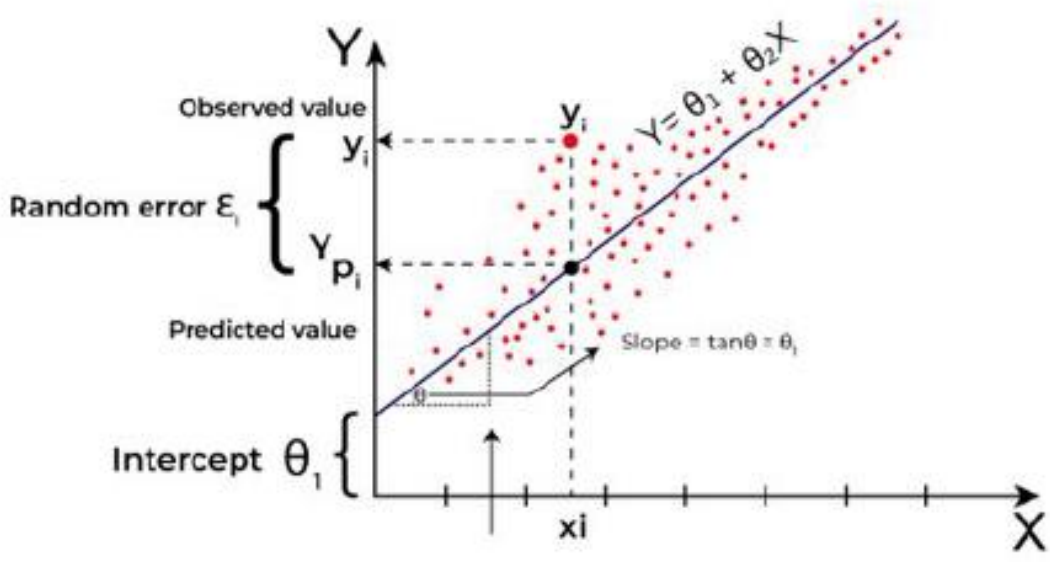
- **Overview**

  Linear regression is a foundational algorithm in machine learning, used for predicting a continuous variable.

- **Learning Objectives**
  - Understand the theory behind linear regression.
  - Learn to implement linear regression in Python.

- **Practice Questions**

  1. Implement linear regression to predict housing prices using a given dataset.
  2. How would you evaluate the performance of your linear regression model?



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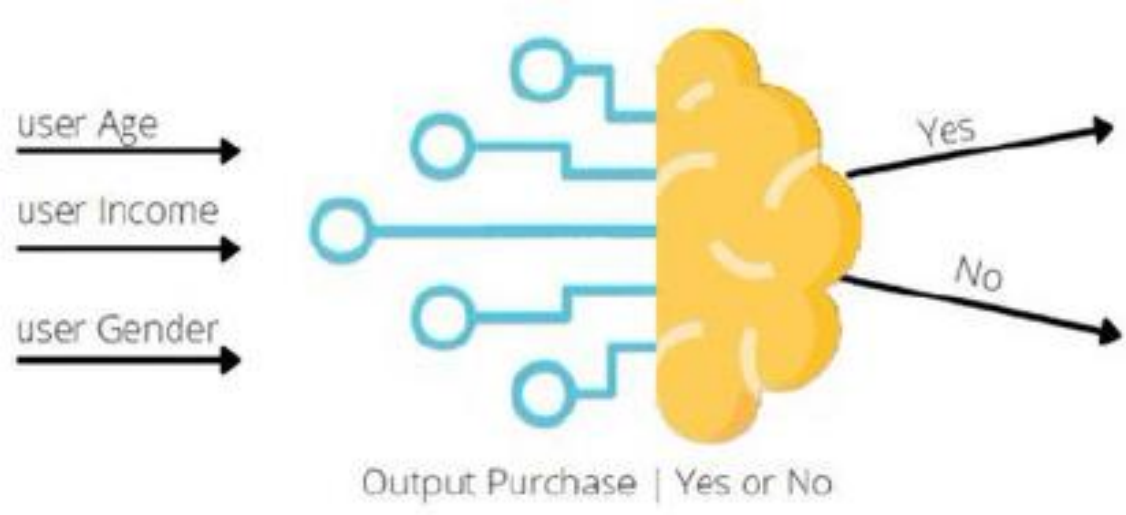
Logistic Regression

- **Overview**

  Logistic regression is used for binary classification problems, such as spam detection or predicting whether a customer will make a purchase.

- **Learning Objectives**
  - Grasp the concept of logistic regression and its difference from linear regression.
  - Practice implementing logistic regression on a binary classification problem.

- **Practice Questions**
  1. Use logistic regression to classify emails as spam or not spam.
  2. Discuss how changing the threshold value affects the model's performance.



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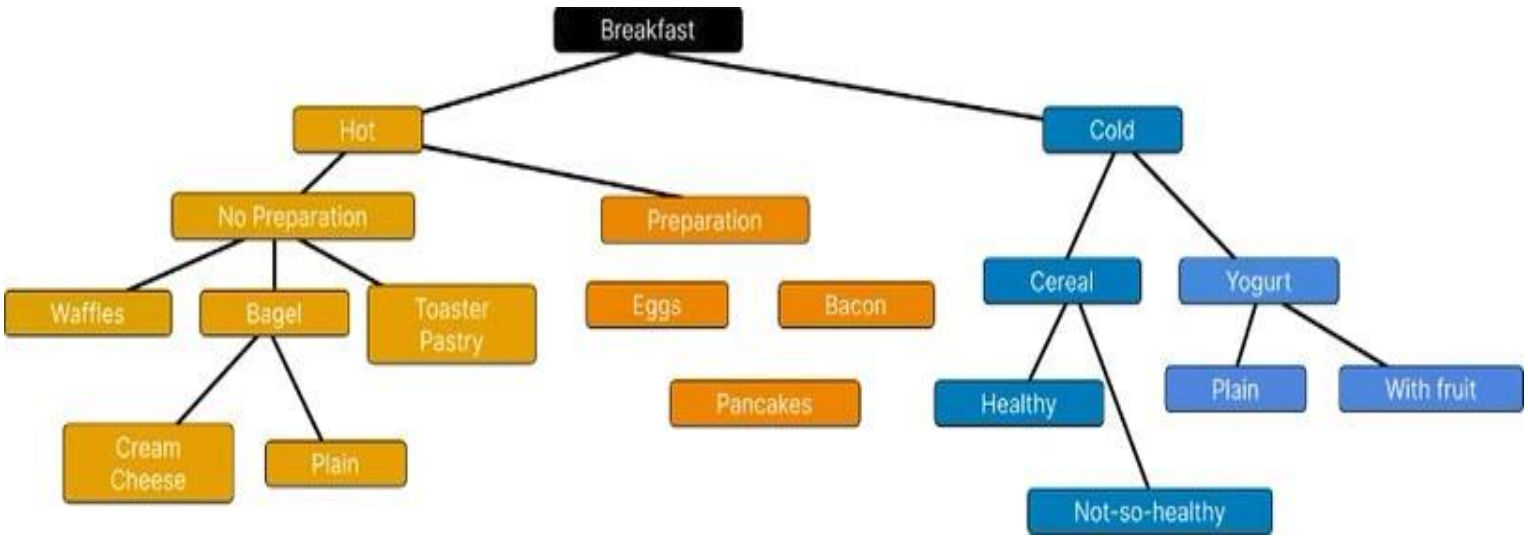
Decision Trees

- **Overview**

  Decision trees are powerful for both classification and regression tasks. They are intuitive and easy to interpret.

- **Learning Objectives**
  - Learn how decision trees are built, including the concepts of entropy and information gain.
  - Implement a decision tree on a classification problem.

- **Practice Questions**
  1. Create a decision tree to predict customer churn.
  2. How do decision trees handle overfitting?



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Random Forest

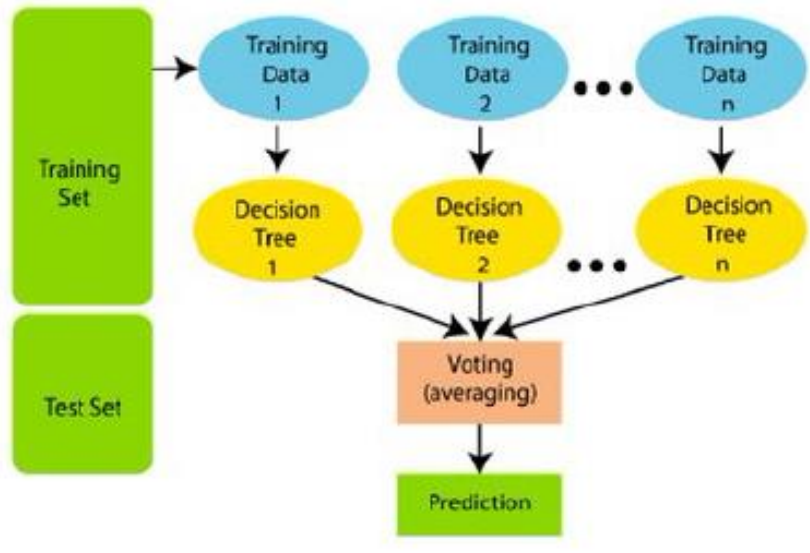
- **Overview**

  Random Forest is an ensemble learning method that operates by constructing multiple decision trees during training time.

- **Learning Objectives**
  - Understand the concept of ensemble learning and how random forests improve upon single decision trees.
  - Implement a random forest model to solve a problem.

- **Practice Questions**

1. Use a random forest to improve the model created on Day 3 for predicting customer churn.
2. Compare the performance of the decision tree and random forest models.



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Support Vector Machines

- **Overview**

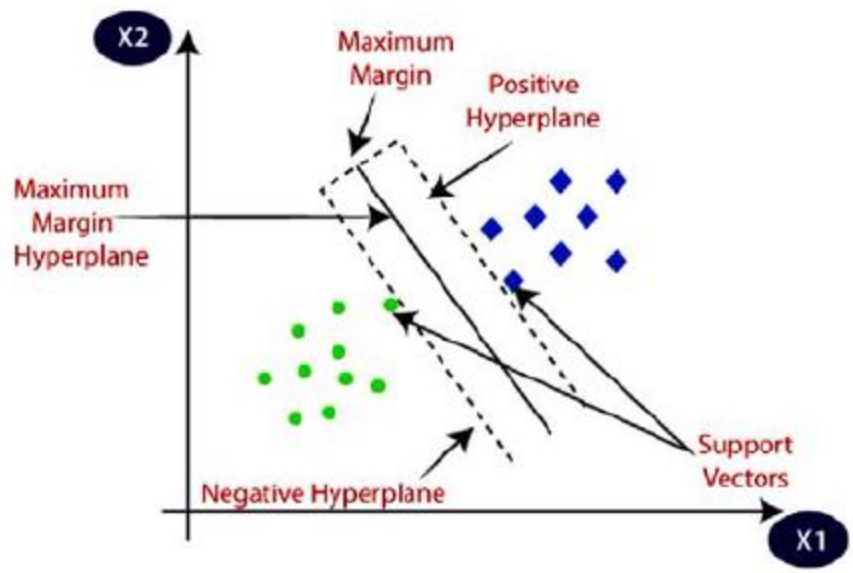
  SVMs are powerful for high-dimensional spaces and are used for classification and regression tasks.

- **Learning Objectives**
  - Learn the theory behind SVMs, including the kernel trick.
  - Practice implementing SVMs on a dataset.

- **Practice Questions**

  1.Implement an SVM to classify images of handwritten digits.

  2. Experiment with different kernels and compare their effects on the model's performance.



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K-Nearest Neighbors

- **Overview**

  KNN is a simple, instance-based learning algorithm where the class of a sample is determined by the majority class among its k nearest neighbors.

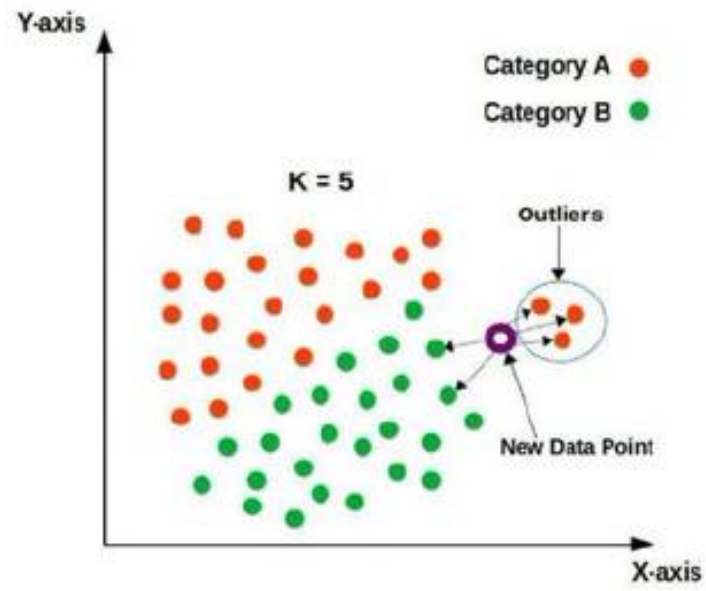
- **Learning Objectives**

  •Understand the KNN algorithm and its application.

  •Implement KNN for a classification problem.

- **Practice Questions**

1. Use KNN to classify patients as either having a disease or not based on their medical records.
2. How does the choice of 'k' affect the performance and how would you select it?



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Naive Bayes

- **Overview**

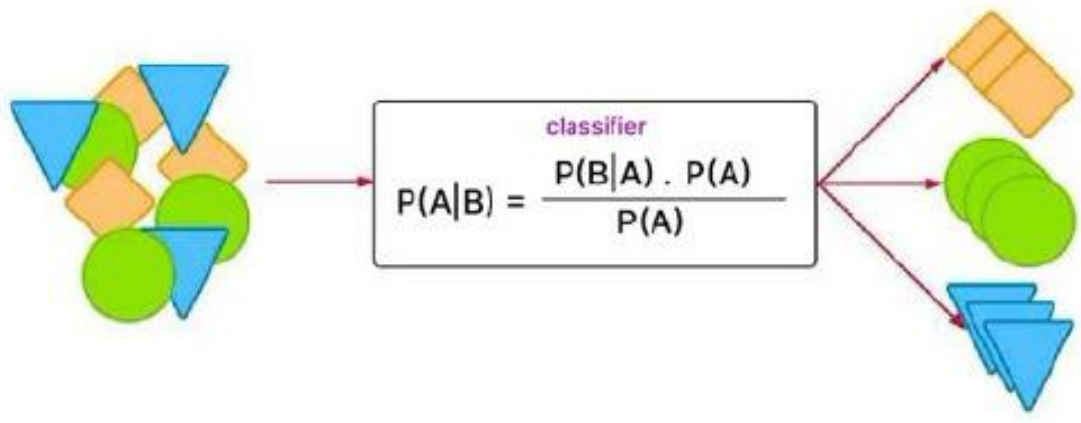
  Naive Bayes classifiers are a family of simple probabilistic classifiers based on applying Bayes' theorem with strong independence assumptions between the features.

- **Learning Objectives**

  - Learn about the theory and assumptions behind Naive Bayes.
  - Apply Naive Bayes to a text classification problem.

- **Practice Questions**

  1. Classify news articles into categories using Naive Bayes.
  2. Discuss the assumption of feature independence in Naive Bayes. Is it always valid?



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K-Means Clustering

- **Overview**

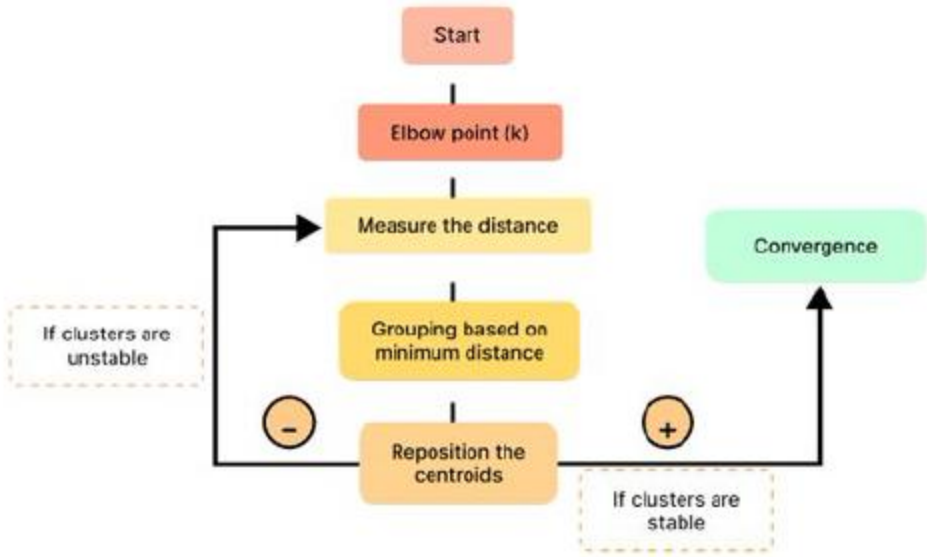
  K-Means is a type of unsupervised learning algorithm used for clustering.

- **Learning Objectives**

  - Understand the concept and algorithm behind K-Means clustering.
  - Implement K-Means to segment a dataset into clusters.

- **Practice Questions**

  1. Use K-Means to cluster customers based on their shopping habits.
  2. How do you determine the optimal number of clusters?



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Principal Component Analysis

- **Overview**

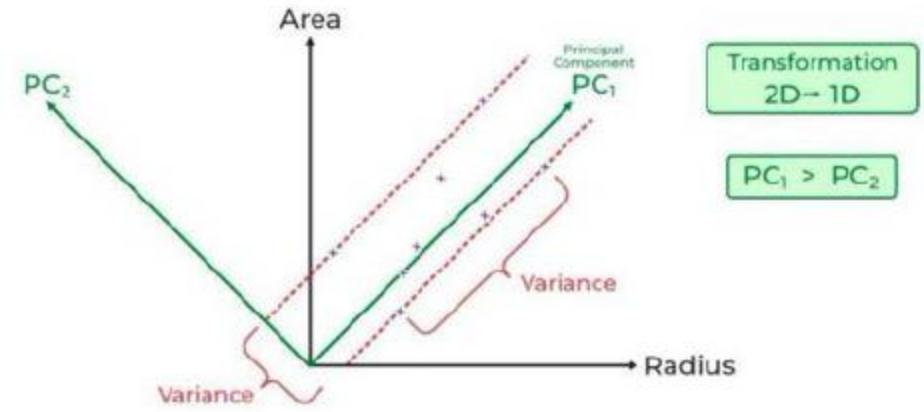
  PCA is a dimensionality reduction technique used to reduce the dimensionality of large datasets.

- **Learning Objectives**

  - Grasp the concept of dimensionality reduction and the algorithm behind PCA.
  - Apply PCA on a dataset and visualize the results.

- **Practice Questions**

  1. Implement PCA to reduce the dimensionality of a dataset containing images of faces.
  2. How does PCA affect the performance of a classifier trained on the reduced dataset?



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Gradient Boosting Machines

- **Overview**

  GBMs are a group of machine learning algorithms that use boosting techniques to improve prediction accuracy.

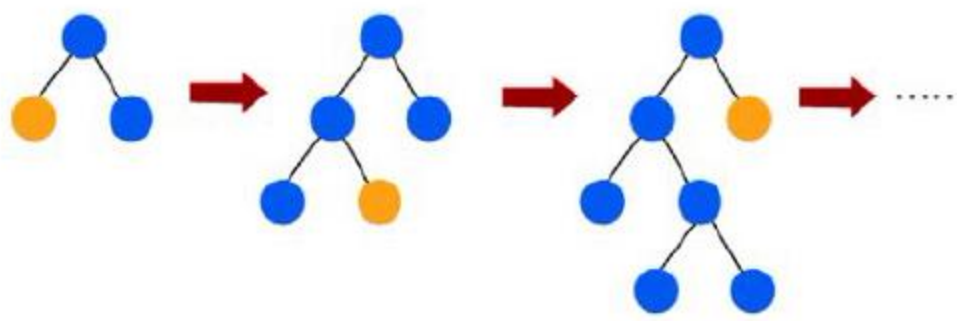
- **Learning Objectives**

  •Understand the principles of boosting and how GBMs build upon it to minimize loss.

  •Implement a GBM model to tackle a complex regression or classification problem.

- **Practice Questions**

  1. Apply a GBM model to improve prediction accuracy on a dataset used in previous days. Compare its performance against models like decision trees and random forests.
  2. Explore how changing parameters (such as learning rate, number of trees) affects the model's performance and overfitting.



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