Support Vector Machine (SVM) & Naive Bayes - Theoretical Q&A

1. What is a Support Vector Machine (SVM)?

SVM is a supervised machine learning algorithm used for classification and regression. It finds the optimal hyperplane that best separates different classes in the data.

2. What is the difference between Hard Margin and Soft Margin SVM?

Hard Margin SVM assumes data is perfectly linearly separable with no errors, while Soft Margin SVM allows some misclassifications for better generalization on noisy data.

3. What is the mathematical intuition behind SVM?

SVM aims to maximize the margin between classes. It finds the hyperplane that maximizes the distance to the nearest data points from each class.

4. What is the role of Lagrange Multipliers in SVM?

Lagrange Multipliers help transform the constrained optimization problem into an unconstrained dual problem for easier computation.

5. What are Support Vectors in SVM?

Support Vectors are the data points closest to the separating hyperplane. They are critical in defining the decision boundary.

6. What is a Support Vector Classifier (SVC)?

SVC is the classification version of SVM used to assign labels to data points.

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7. What is a Support Vector Regressor (SVR)?

SVR is a regression version of SVM that attempts to fit the best line within a threshold value.

8. What is the Kernel Trick in SVM?

The kernel trick transforms data into higher dimensions to make it linearly separable using functions like RBF, Polynomial, etc.

9. Compare Linear Kernel, Polynomial Kernel, and RBF Kernel.

Linear: Best for linearly separable data.

Polynomial: Good for complex data with curved boundaries.

RBF: Powerful for nonlinear data with radial characteristics.

10. What is the effect of the C parameter in SVM?

C controls the trade-off between maximizing margin and minimizing classification error. Smaller C gives a wider margin with more tolerance for errors.

11. What is the role of the Gamma parameter in RBF Kernel SVM?

Gamma defines how far the influence of a single training point reaches. Low gamma means 'far', high gamma means 'close'.

12. What is the Naive Bayes classifier, and why is it called 'Naive'?

Naive Bayes is a probabilistic classifier based on Bayes' Theorem assuming feature independence, hence called 'Naive'.

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13. What is Bayes' Theorem?

Bayes' Theorem calculates the probability of a hypothesis based on prior knowledge: P(A|B) = [P(B|A) * P(A)] / P(B).

14. Explain the differences between Gaussian Naive Bayes, Multinomial Naive Bayes, and Bernoulli

Gaussian: For continuous features.

Multinomial: For discrete counts (e.g., text).

Bernoulli: For binary features.

15. When should you use Gaussian Naive Bayes over other variants?

Use Gaussian Naive Bayes when features are continuous and normally distributed.

16. What are the key assumptions made by Naive Bayes?

It assumes all features are conditionally independent given the class label.

17. What are the advantages and disadvantages of Naive Bayes?

Advantages: Fast, works well with high-dimensional data.

Disadvantages: Assumes independence, which may not hold true.

18. Why is Naive Bayes a good choice for text classification?

It works well with high-dimensional sparse data and assumes word independence, which aligns well with the bag-of-words model.

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19. Compare SVM and Naive Bayes for classification tasks.

SVM is more powerful and accurate for complex boundaries but slower. Naive Bayes is faster and good for simple problems or text.

20. How does Laplace Smoothing help in Naive Bayes?

It handles zero probabilities by adding a small value to all counts, ensuring no zero probability for unseen features.