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Assignment No:

Aim: Implement support vector machine

Theory:

Support vector machine (svm) is a powerful machine learning algorithm used for linear or nonlinear classification, regression and even outlier detection tasks. SVMs can be used for a variety of Tasks, such as text classification, image classification, spam detection, handwriting identification, gene expression analysis, face detection, and anomaly detection. SVMs are adaptable and efficient in a variety of applications because they can manage high-dimensional data and nonlinear relationships SVM algorithms are very effective as we try to find the maximum separating hyperplane between the different classes available in the target feature.

Support vector machine (svm) is a supervised machine learning algorithm used for both classification and regression. It's best suited for classification. The main objective of the svm algorithm is to find the optimal plane in an N-dimensional space that can separate the data points in the different classes in the feature space. The hyperplane tries that the margin between the closest points of different classes should be as maximum as possible. The dimension of the hyperplane depends upon the number of features. If the number of input features is two, then the hyperplane is just a line. If the number of input features is three, then the hyperplane becomes a 2-D plane. It becomes difficult to image when the number of features exceeds three.

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Terminologies:

Hyperplane: Hyperplane is the decision boundary that is used to separate the data points of different classes in a feature space. In the case of linear classifications, it will be a linear equation i.e. $wx+b=0$

Support vectors: Support vectors are the closest data points to the hyperplane, which makes a critical role in deciding the hyperplane and margin.

Margin: margin is the distance between the support vector and hyperplane. The main objective of the support vector machine algorithm is to maximize the margin. The wider margin indicates better classification performance

kernel: kernel is a mathematical function, which is used in SVM to map the original input data points into high-dimensional feature spaces, so, that the hyperplane can be easily found out even if the data points are not linearly separable in the original input space. Some of the common kernel functions are linear, polynomial, radial basis function (RBF), and sigmoid.

Hard margin: The maximum-margin hyperplane or the hard margin hyperplane is a hyperplane that properly separates the data points of different categories without any misclassifications.

Hinge loss: A typical loss function in SVMs is hinge loss. It punishes incorrect classifications or margin violations. The objective function in SVM is frequently formed by combining it with regularisation term.

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Conclusion: A conclusion of an experiment implementing support vector machine (svm) could highlight its effectiveness in classification tasks, particularly when dealing with high-dimensional data. It might emphasize the importance of properly tuning parameters such as the kernel type and regularization parameter to achieve optimal performance. Additionally, the conclusion could discuss the interpretability of SVM models and their robustness to overfitting compared to other machine learning algorithms.