**Support Vector Machines (SVM) Analysis on Iris Dataset**

**Introduction:**

Support Vector Machines (SVM) is a learning algorithm used for classification tasks. In this report, we apply an SVM to classify iris flowers from the famous Iris dataset into three species based on four features: sepal length, sepal width, petal length, and petal width.

**Dataset Description:**

The Iris dataset comprises 150 samples, with each sample belonging to one of three classes: Iris-setosa, Iris-versicolor, or Iris-virginica. Every sample has four features: sepal length, sepal width, petal length, and petal width.

**Methodology:**

We employed the SVM algorithm with different kernels using the scikit-learn library in Python. The dataset was randomly split using K-Fold and validated cross validation scores across each fold. We scaled the features to ensure uniform scaling and encoded the target values.

**Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Kernel** | **Class** | **Accuracy** | **Precision** | **Recall** | **F1-score** |
| **Linear** |  | 96% |  |  |  |
|  | Iris-setosa |  | 100% | 100% | 100% |
|  | Iris-versicolor |  | 92% | 100% | 96% |
|  | Iris-virginica |  | 100% | 92% | 96% |
| **RBF** |  | 96% |  |  |  |
|  | Iris-setosa |  | 100% | 100% | 100% |
|  | Iris-versicolor |  | 92% | 100% | 96% |
|  | Iris-virginica |  | 100% | 92% | 96% |
| **Sigmoid** |  | 94.6% |  |  |  |
|  | Iris-setosa |  | 100% | 100% | 100% |
|  | Iris-versicolor |  | 100% | 91% | 95% |
|  | Iris-virginica |  | 92% | 100% | 96% |
| **Poly, Deg3** |  | 95.3% |  |  |  |
|  | Iris-setosa |  | 100% | 100% | 100% |
|  | Iris-versicolor |  | 92% | 100% | 96% |
|  | Iris-virginica |  | 100% | 92% | 96% |
| **Poly, Deg4** |  | 81.3% |  |  |  |
|  | Iris-setosa |  | 70% | 100% | 82% |
|  | Iris-versicolor |  | 85% | 100% | 92% |
|  | Iris-virginica |  | 100% | 58% | 74% |

As per our analysis, we got best mean accuracy with both linear and gaussian kernels for k=5.

**Confusion Matrix:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Predicted Iris-setosa** | **Predicted Iris-versicolor** | **Predicted Iris-virginica** |
| **Actual Iris-setosa** | 7 | 0 | 0 |
| **Actual Iris-versicolor** | 0 | 11 | 0 |
| **Actual Iris-virginica** | 0 | 1 | 11 |

**Conclusion:**

The SVM model classified iris flowers into their respective species with exceptional accuracy, achieving 96% on the test dataset and demonstrating strong predictive capabilities; however, further optimization and fine-tuning could potentially enhance its performance even more.

**GitHub link:**