**Project Report: Support Vector Machines (SVM)**

**Task Objective**

The objective of this project is to implement Support Vector Machines (SVM) for both linear and non-linear classification using the Breast Cancer dataset. The key goals include:

* Training SVM models using linear and RBF (Radial Basis Function) kernels.
* Visualizing decision boundaries in 2D.
* Tuning hyperparameters (C, gamma).
* Evaluating performance using classification metrics.

**Tools & Libraries Used**

* **Language**: Python
* **Libraries**:
  + Scikit-learn – for model training and evaluation
  + Matplotlib – for visualization
  + NumPy – for numerical operations

**Dataset: Breast Cancer Wisconsin Dataset**

* **Source**: sklearn.datasets.load\_breast\_cancer
* **Target Classes**:
  + 0: Malignant
  + 1: Benign
* **Features Used**: First 2 features (for 2D visualization)

**Methodology**

1. **Data Preprocessing**
   * Selected first two features for visualization.
   * Split data into 70% training and 30% testing sets.
   * Standardized features using StandardScaler.
2. **Model Training**
   * **Linear Kernel SVM**: SVC(kernel='linear')
   * **RBF Kernel SVM**: SVC(kernel='rbf', gamma='scale')
3. **Model Evaluation**
   * Performance measured using: Accuracy, Precision, Recall, F1-Score.
   * Cross-validation performed with GridSearchCV to tune hyperparameters.
4. **Visualization**
   * Decision boundaries plotted for both models.

**Results**

**Classification Reports**

**Linear SVM:**

| **Metric** | **Class 0** | **Class 1** |
| --- | --- | --- |
| Precision | 91.1% | 89.6% |
| Recall | 81.0% | 95.4% |
| F1-Score | 85.7% | 92.4% |
| **Accuracy** | **90.1%** |  |

**RBF SVM:**

| **Metric** | **Class 0** | **Class 1** |
| --- | --- | --- |
| Precision | 91.2% | 90.4% |
| Recall | 82.5% | 95.4% |
| F1-Score | 86.7% | 92.8% |
| **Accuracy** | **90.6%** |  |

Screenshots





