SVM with OneVsRest (LinearSVC)

**Hyperparameters**

| **Parameter** | **What it Does** | **Why It's Used** | **When to Tune** |
| --- | --- | --- | --- |
| maxIter | Max number of iterations for convergence | Ensures optimization completes | Increase if model underfits or doesn't converge |
| regParam | L2 regularization strength (λ) | Prevents overfitting by penalizing large weights | Lower for more flexible models, higher to reduce overfitting |
| tol | Convergence tolerance | Stops training once the loss is not improving significantly | Lower for more precision, but slower |
| fitIntercept | Adds a bias term (intercept) to the model | Captures baseline class probability | Set to True unless data is centered |
| standardization | Scales features (zero mean, unit variance) | SVMs are sensitive to feature scales — this is critical | Keep True unless data is already scaled |

**Logistic Regression**

**Hyperparameters**

| **Parameter** | **What it Does** | **Why It's Used** | **When to Tune** |
| --- | --- | --- | --- |
| maxIter | Maximum iterations for convergence | Allows optimizer to reach best weights | Increase if model doesn't converge |
| regParam | Regularization strength (λ) | Prevents overfitting, simplifies the model | Lower = more flexible but overfit risk |
| elasticNetParam | Balance between L1 (sparse) and L2 (smooth) regularization | L1 drives feature selection; L2 stabilizes weights | Tune when dealing with many correlated or irrelevant features |

**Random Forest Classifier**

**Hyperparameters**

| **Parameter** | **What it Does** | **Why It's Used** | **When to Tune** |
| --- | --- | --- | --- |
| numTrees | Number of trees in the forest | More trees = better performance (to a point) | Tune for balance between accuracy and speed |
| maxDepth | Maximum depth of any tree | Controls complexity of trees | Too shallow = underfit, too deep = overfit |
| impurity | Splitting criterion: gini or entropy | Gini is faster, Entropy gives more accurate splits | Tune if you want more informative splits |
| minInstancesPerNode | Minimum samples required at a tree node to split | Prevents overfitting on noisy samples | Increase to regularize the model |