PHASE 5 – HYPERPARAMETER TUNING REPORT

This report presents the results of phase 5 in Heart Disease Prediction Project. In this phase phase hyperparameter tuning was applied to four supervised learning (Logistics Regression, Random Forest, SVM, KNN) using RandomizedSearch CV. The goal was to improve their performance by selecting the best hyperparameters.

	Model	Test Accuracy	Best Parameters
0	Logistic Regression	0.840336	{'solver': 'lbfgs', 'penalty': 'l2', 'C': 0.59...
1	Random Forest	0.928571	{'n_estimators': 50, 'min_samples_split': 2, '...
2	SVM	0.886555	{'kernel': 'rbf', 'gamma': 'scale', 'C': 26.82...
3	KNN	0.920168	{'weights': 'distance', 'n_neighbors': 10}

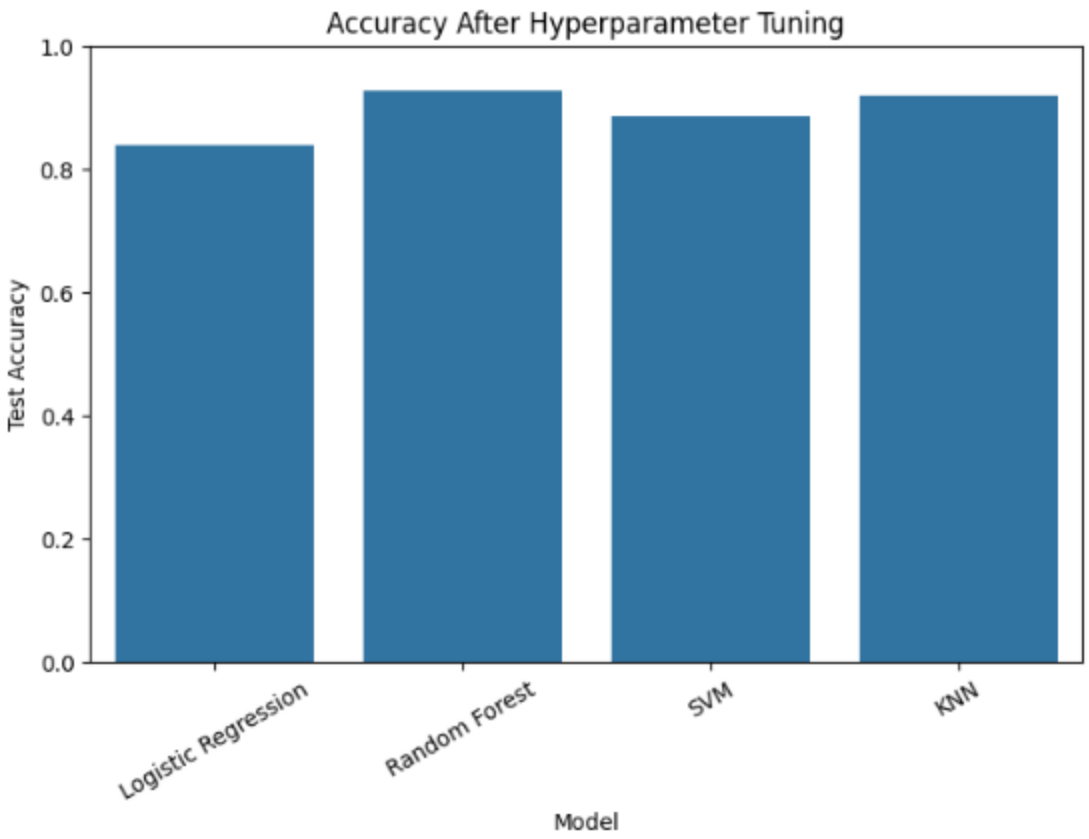
```
🔧 Tuning Logistic Regression...
C:\Users\laiba\anaconda3\envs\newenv\Lib\site-packages\sklearn\model_selection\_search.
than n_iter=20. Running 10 iterations. For exhaustive searches, use GridSearchCV.
  warnings.warn(
 Done in 0.4s
Best Params: {'solver': 'lbfgs', 'penalty': 'l2', 'C': np.float64(0.5994842503189409)}
 Test Accuracy: 0.8403

🔧 Tuning Random Forest...
 Done in 14.7s
Best Params: {'n_estimators': 50, 'min_samples_split': 2, 'max_depth': None}
 Test Accuracy: 0.9286

🔧 Tuning SVM...
 Done in 16.1s
Best Params: {'kernel': 'rbf', 'gamma': 'scale', 'C': np.float64(26.826957952797247)}
 Test Accuracy: 0.8866

🔧 Tuning KNN...
C:\Users\laiba\anaconda3\envs\newenv\Lib\site-packages\sklearn\model_selection\_search.
than n_iter=20. Running 16 iterations. For exhaustive searches, use GridSearchCV.
  warnings.warn(
 Done in 0.5s
Best Params: {'weights': 'distance', 'n_neighbors': 10}
 Test Accuracy: 0.9202
```

Comparison of Model Accuracies



The results show that **Random Forest achieved the highest accuracy after hyperparameter tuning**, outperforming all other models. **KNN and SVM also** performed well, while **Logistic Regression** showed comparatively lower accuracy. This indicates that for this dataset, **ensemble-based and non-linear models generalize better than linear models**. Hyperparameter tuning helped improve model performance, provided insights into model behavior, and ensured a fair and reliable comparison between different algorithms.