Model Optimization and Tuning Phase Template

Date	18 July 2024
Team ID	xxxxxx
Project Title	Detection of Autistic Spectrum Disorder: Classification
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining neural network models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

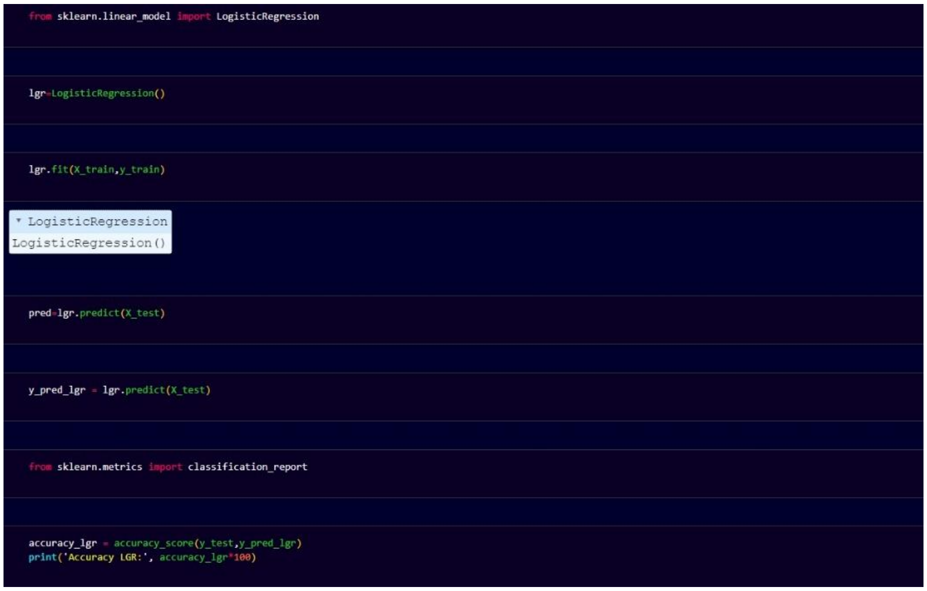
Hyperparameter Tuning Documentation (8 Marks):

Model	**Tuned Hyperparameters**

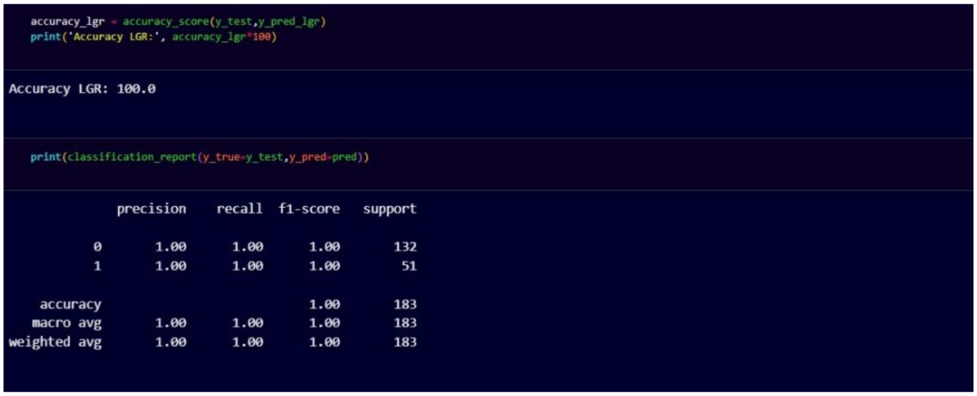
<table>
<tr>
<td>Logistic Regression</td>
<td>

C: Regularization strength<br> **Solver**: Optimization algorithm

C: Controls the regularization strength. Smaller values specify stronger regularization.<br> **Solver**: Algorithm to use for optimization.



```
from sklearn.linear_model import LogisticRegression

lgr=LogisticRegression()

lgr.fit(X_train,y_train)

▾ LogisticRegression
LogisticRegression()

pred=lgr.predict(X_test)

y_pred_lgr = lgr.predict(X_test)

from sklearn.metrics import classification_report

accuracy_lgr = accuracy_score(y_test,y_pred_lgr)
print('Accuracy LGR:', accuracy_lgr*100)
```



```
accuracy_lgr = accuracy_score(y_test,y_pred_lgr)
print('Accuracy LGR:', accuracy_lgr*100)

Accuracy LGR: 100.0

print(classification_report(y_true=y_test,y_pred=pred))

              precision    recall  f1-score   support

           0       1.00      1.00      1.00       132
           1       1.00      1.00      1.00        51

    accuracy                           1.00       183
   macro avg       1.00      1.00      1.00       183
weighted avg       1.00      1.00      1.00       183
```

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<tr>
<td>SVM</td>
<td>

C: Regularization parameter<br> **Kernel**: Type of kernel used<br> **Gamma**: Kernel coefficient

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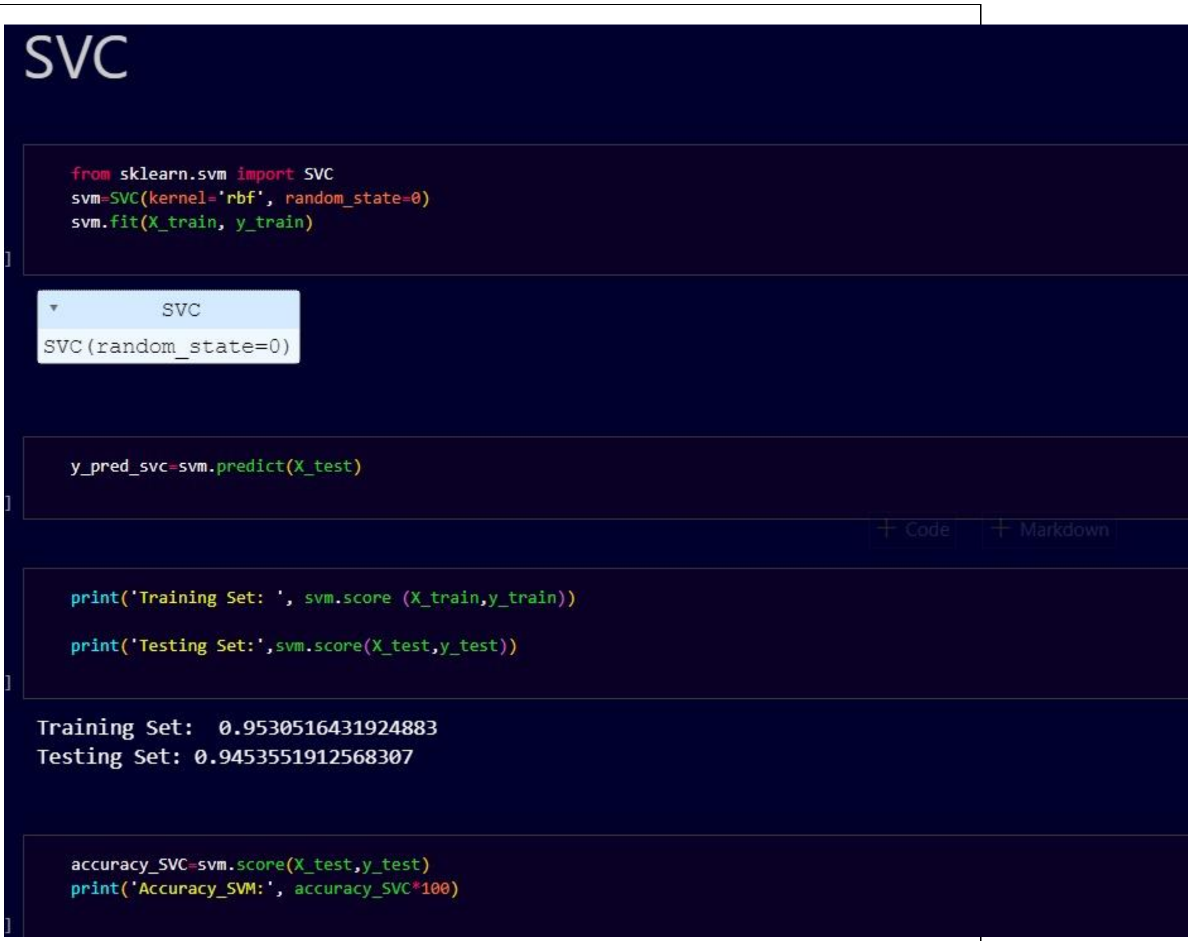
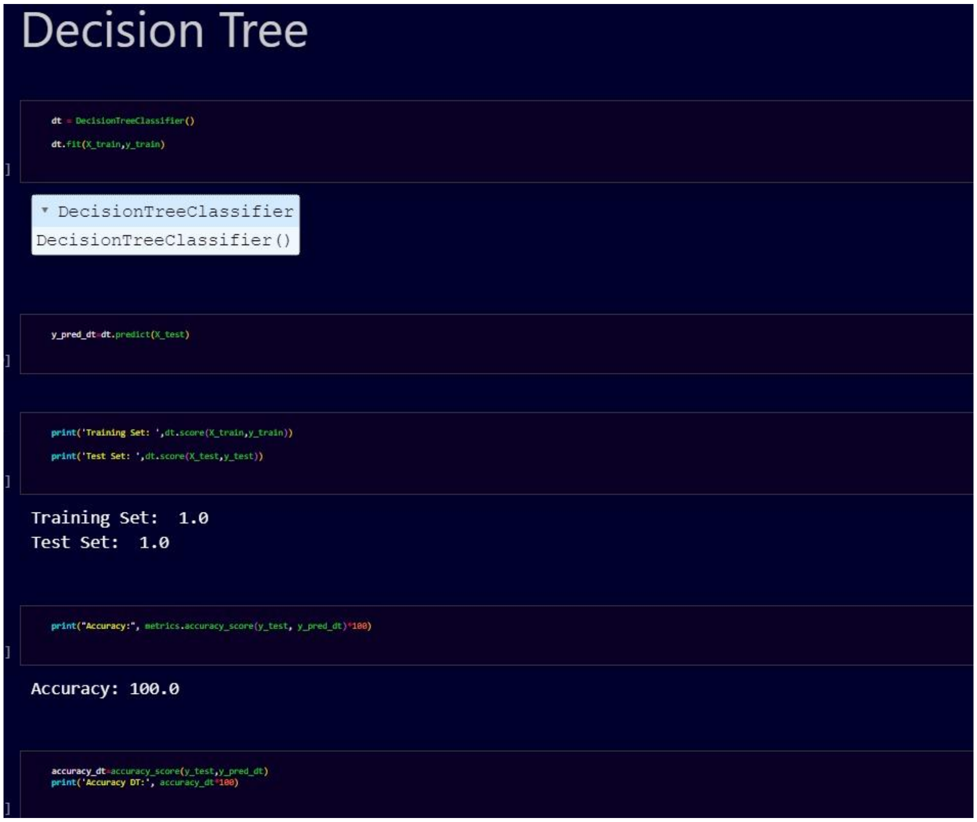

<h1>SVC</h1>
<pre>
from sklearn.svm import SVC
svm=SVC(kernel='rbf', random_state=0)
svm.fit(X_train, y_train)
</pre>
<pre>
SVC
SVC(random_state=0)
</pre>
<pre>
y_pred_svc=svm.predict(X_test)
</pre>

<pre>
print('Training Set: ', svm.score (X_train,y_train))

print('Testing Set:',svm.score(X_test,y_test))
</pre>
<pre>
Training Set: 0.9530516431924883
Testing Set: 0.9453551912568307
</pre>
<pre>
accuracy_SVC=svm.score(X_test,y_test)
print('Accuracy_SVM:', accuracy_SVC*100)
</pre>
</td>
</tr>
<tr>
<td><b>Decision Tree</b></td>
<td><b>Max Depth</b>: Maximum depth of the tree
 <b>Min Samples Split</b>:
Minimum number of samples required to split an internal node</td>
</tr>
</table>

	
	Decision Tree
	`dt = DecisionTreeClassifier()`
	`dt.fit(X_train,y_train)`
	▾ DecisionTreeClassifier
	`DecisionTreeClassifier()`
	`y_pred_dt=dt.predict(X_test)`
	`print('Training Set: ',dt.score(X_train,y_train))`
	`print('Test Set: ',dt.score(X_test,y_test))`
	`Training Set:  1.0`
	`Test Set:  1.0`
	`print("Accuracy:", metrics.accuracy_score(y_test, y_pred_dt)*100)`
	`Accuracy: 100.0`
	`accuracy_dt=accuracy_score(y_test,y_pred_dt)`
	`print('Accuracy DT:', accuracy_dt*100)`

Random Forest	**n_estimators**: Number of trees
 Max Features: Number of features to consider for splitting a node

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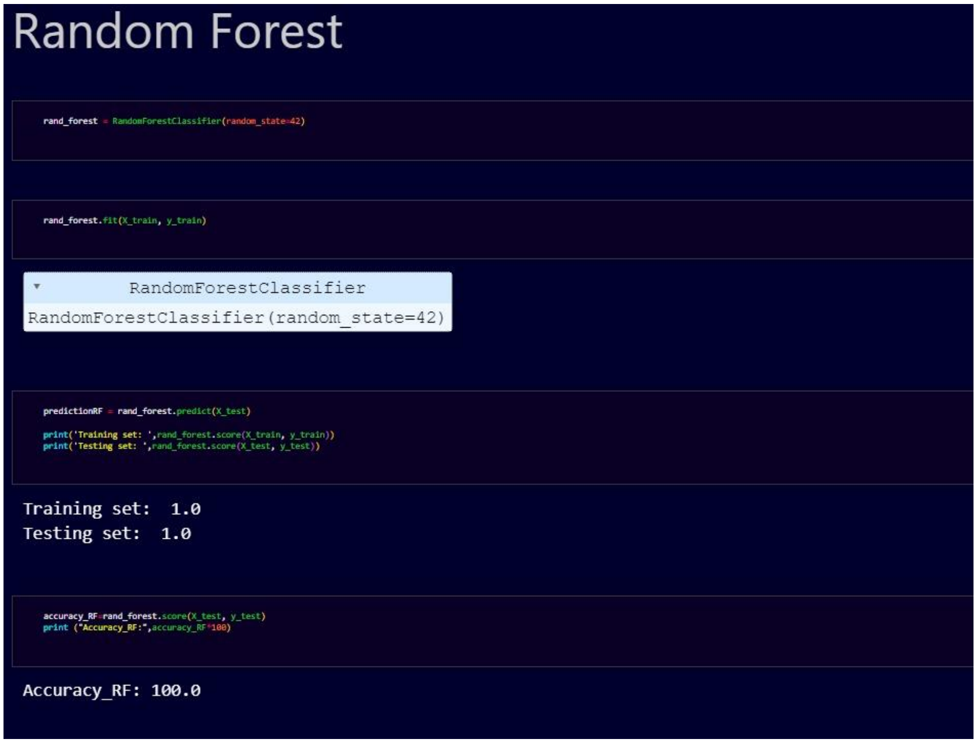

Random Forest

```
rand_forest = RandomForestClassifier(random_state=42)
```

```
rand_forest.fit(X_train, y_train)
```

```
▾ RandomForestClassifier
RandomForestClassifier(random_state=42)
```

```
predictionRF = rand_forest.predict(X_test)

print('Training set: ',rand_forest.score(X_train, y_train))
print('Testing set: ',rand_forest.score(X_test, y_test))
```

```
Training set:  1.0
Testing set:  1.0
```

```
accuracy_RF=rand_forest.score(X_test, y_test)
print ("Accuracy_RF:",accuracy_RF*100)
```

```
Accuracy_RF: 100.0
```

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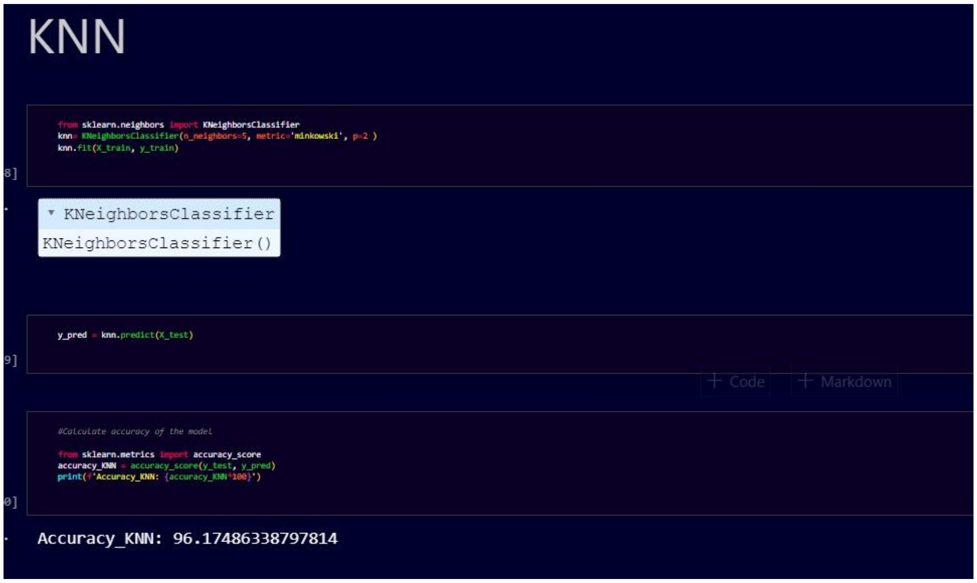
<tr>
<td>KNN</td>
<td>

n_neighbors: Number of neighbors<br> **Metric**: Distance metric



KNN

```
from sklearn.neighbors import KNeighborsClassifier
knn= KNeighborsClassifier(n_neighbors=5, metric='minkowski', p=2 )
knn.fit(X_train, y_train)
```

```
▾ KNeighborsClassifier
KNeighborsClassifier()
```

```
y_pred = knn.predict(X_test)
```

```
#Calculate accuracy of the model

from sklearn.metrics import accuracy_score
accuracy_KNN = accuracy_score(y_test, y_pred)
print(f'Accuracy_KNN: {accuracy_KNN*100}')
```

```
Accuracy_KNN: 96.17486338797814
```

</td>
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</table>

Final Model Selection Justification (2 Marks):

Final Model	**Reasoning**
Logistic Regression	**C**: Controls the regularization strength. Smaller values specify stronger regularization. **Solver**: Algorithm to use for optimization.
SVM	**C**: Controls the trade-off between achieving a low training error and a low testing error. **Kernel**: Defines the type of kernel function. **Gamma**: Determines the influence of a single training example.
Decision Tree	**Max Depth**: Limits the depth of the tree to prevent overfitting. **Min Samples Split**: Ensures that nodes are split only if a minimum number of samples is met.
Random Forest	**n_estimators**: The number of trees in the forest. **Max Features**: The number of features to consider when looking for the best split
KNN	**n_neighbors**: The number of neighbors to use for classification. **Metric**: The distance metric used for finding neighbors.