driving_behavior_XGBoost_binary_v3

September 1, 2022

[ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

[ ]:
```
df_training = pd.read_csv("../data_mod/train_motion_data.csv")
df_test = pd.read_csv("../data_mod/test_motion_data.csv")

df_training
```

[ ]:

	AccX	AccY	GyroZ	Class	VelX	VelY
0	0.000000	0.000000	0.101938	NORMAL	0.000000	0.000000
1	-1.624864	-1.082492	0.135536	NORMAL	-0.812432	-0.541246
2	-0.594660	-0.122410	0.087888	NORMAL	-0.297330	-0.061205
3	0.738478	-0.228456	0.054902	NORMAL	0.369239	-0.114228
4	0.101741	0.777568	0.054902	NORMAL	0.050871	0.388784
…	…	…	…	…	…	…
3639	0.915688	-2.017489	-1.236468	SLOW	0.457844	-1.008745
3640	-1.934203	0.914925	-0.477162	SLOW	-0.967102	0.457462
3641	-0.222845	0.747304	0.054291	SLOW	-0.111422	0.373652
3642	-0.349423	0.067261	-0.004963	SLOW	-0.174712	0.033630
3643	-0.402428	0.406218	0.001145	SLOW	-0.201214	0.203109

[3644 rows x 6 columns]

[ ]:
```
df_training.isna().sum()
```

[ ]:
```
AccX     0
AccY     0
GyroZ    0
Class    0
VelX     0
VelY     0
dtype: int64
```

0.1 Change categories to numbers

[ ]:
```
df_training = df_training.replace(
    {"Class": {"NORMAL": 0, "AGGRESSIVE": 1, "SLOW": 2}})
df_test = df_test.replace(
    {"Class": {"NORMAL": 0, "AGGRESSIVE": 1, "SLOW": 2}})
df_training
```

[ ]:

	AccX	AccY	GyroZ	Class	VelX	VelY
0	0.000000	0.000000	0.101938	0	0.000000	0.000000
1	-1.624864	-1.082492	0.135536	0	-0.812432	-0.541246
2	-0.594660	-0.122410	0.087888	0	-0.297330	-0.061205
3	0.738478	-0.228456	0.054902	0	0.369239	-0.114228
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…	…	…	…	…	…	…
3639	0.915688	-2.017489	-1.236468	2	0.457844	-1.008745
3640	-1.934203	0.914925	-0.477162	2	-0.967102	0.457462
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3642	-0.349423	0.067261	-0.004963	2	-0.174712	0.033630
3643	-0.402428	0.406218	0.001145	2	-0.201214	0.203109

[3644 rows x 6 columns]

0.1.1 Only select normal and aggressive values

[ ]:
```
df_training = df_training.loc[df_training['Class'] != 1]
df_test = df_test.loc[df_test['Class'] != 1]

df_training
```

[ ]:

	AccX	AccY	GyroZ	Class	VelX	VelY
0	0.000000	0.000000	0.101938	0	0.000000	0.000000
1	-1.624864	-1.082492	0.135536	0	-0.812432	-0.541246
2	-0.594660	-0.122410	0.087888	0	-0.297330	-0.061205
3	0.738478	-0.228456	0.054902	0	0.369239	-0.114228
4	0.101741	0.777568	0.054902	0	0.050871	0.388784
…	…	…	…	…	…	…
3639	0.915688	-2.017489	-1.236468	2	0.457844	-1.008745
3640	-1.934203	0.914925	-0.477162	2	-0.967102	0.457462
3641	-0.222845	0.747304	0.054291	2	-0.111422	0.373652
3642	-0.349423	0.067261	-0.004963	2	-0.174712	0.033630
3643	-0.402428	0.406218	0.001145	2	-0.201214	0.203109

[2531 rows x 6 columns]

0.2 Normalize the data

[ ]:
```
X_training = df_training.drop(columns=["Class"])
X_training = (X_training - X_training.mean()) / X_training.std() * 100

X_training["Class"] = df_training["Class"]
X_training
```

[ ]:

	AccX	AccY	GyroZ	VelX	VelY	Class
0	-1.855230	3.971188	88.116927	-1.855230	3.971188	0
1	-190.162298	-135.853745	119.158011	-190.162298	-135.853745	0
2	-70.770948	-11.840434	75.136116	-70.770948	-11.840434	0
3	83.727731	-25.538301	44.659418	83.727731	-25.538301	0
4	9.935643	104.409213	44.659418	9.935643	104.409213	0
…	…	…	…	…	…	…
3639	104.264697	-256.626925	-1148.446773	104.264697	-256.626925	2
3640	-226.011955	122.151549	-446.918404	-226.011955	122.151549	2
3641	-27.680909	100.500014	44.095035	-27.680909	100.500014	2
3642	-42.350223	12.659225	-10.650142	-42.350223	12.659225	2
3643	-48.492982	56.442174	-5.006309	-48.492982	56.442174	2

[2531 rows x 6 columns]

[ ]:
```
X_testing = df_test.drop(columns="Class")
X_testing = (X_testing - X_testing.mean()) / X_testing.std() * 100

X_testing["Class"] = df_test["Class"]
X_testing
```

[ ]:

	AccX	AccY	GyroZ	VelX	VelY	Class
814	79.340838	21.963793	38.859198	79.340838	21.963793	0
815	132.192943	569.257650	-11.298662	132.192943	569.257650	0
816	-33.998774	10.843662	-4.956864	-33.998774	10.843662	0
817	38.437952	57.366915	1.961463	38.437952	57.366915	0
818	-21.053767	3.156469	-25.711843	-21.053767	3.156469	0
…	…	…	…	…	…	…
3079	-95.464081	-76.862781	479.325902	-95.464081	-76.862781	2
3080	180.478081	51.148641	-645.478582	180.478081	51.148641	2
3081	151.492731	-217.785674	-450.612340	151.492731	-217.785674	2
3082	105.929590	84.125864	374.398012	105.929590	84.125864	2
3083	174.027088	32.946129	63.073341	174.027088	32.946129	2

[2270 rows x 6 columns]

0.3 Train model

[ ]:
```
X_train = X_training.drop(columns="Class")
y_train = X_training.Class

X_test = X_testing.drop(columns="Class")
y_test = X_testing.Class
```

[ ]:
```
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.model_selection import RandomizedSearchCV
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
```

[ ]:
```
xgb = GradientBoostingClassifier()

param_grid = {'n_estimators': np.arange(20, 80, 2), 'learning_rate': np.
↪linspace(0.2, 1, 20), 'max_depth': np.arange(1, 10), 'max_features':␣
↪['sqrt', None], 'max_leaf_nodes': np.arange(2, 30)}

xgb_gscv = RandomizedSearchCV(xgb, param_grid, n_iter=100, cv=5, verbose=10,␣
↪n_jobs=10, random_state=0)
xgb_gscv.fit(X_train, y_train)
```

[ ]:
```
best_params = xgb_gscv.best_params_
best_params
```

[ ]:
```
{'n_estimators': 64,
 'max_leaf_nodes': 13,
 'max_features': 'sqrt',
 'max_depth': 8,
 'learning_rate': 0.49473684210526314}
```

[ ]:
```
xgb_gscv.best_score_
```

[ ]:
```
0.5195585907960489
```

0.3.1 Check for overfitting

[ ]:
```
xgb_gscv.score(X_train, y_train)
```

[ ]:
```
0.8822599762939549
```

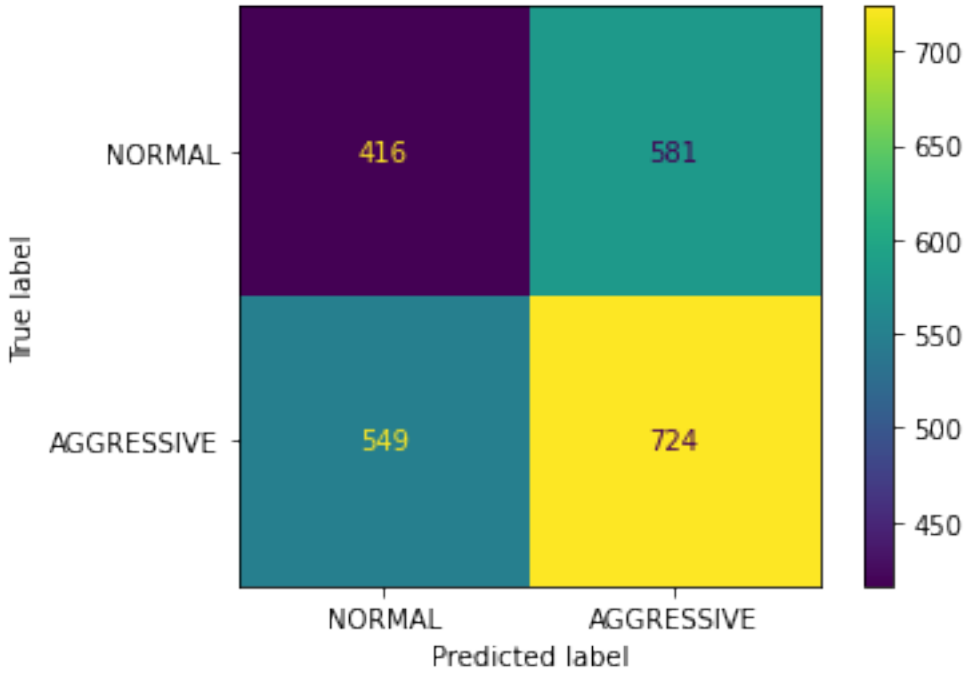
[ ]:
```
xgb_gscv.score(X_test, y_test)
```

[ ]:
```
0.5022026431718062
```

[ ]:
```
classes = ["NORMAL", "AGGRESSIVE"]
```

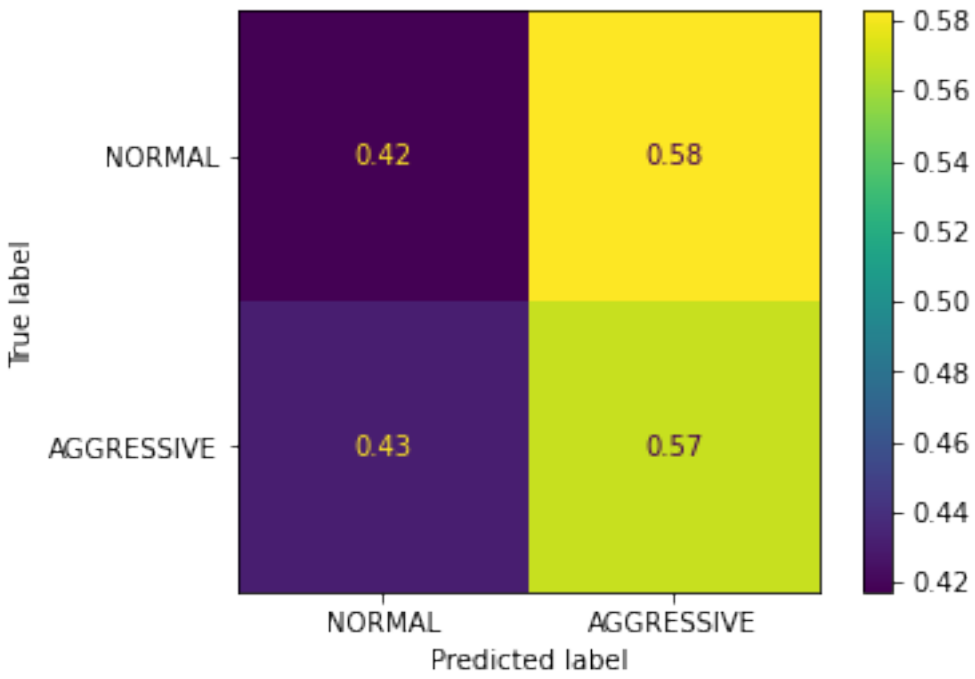
[ ]:
```
y_pred = xgb_gscv.predict(X_test)

CM = confusion_matrix(y_test, y_pred)
display = ConfusionMatrixDisplay(confusion_matrix=CM,
                         display_labels=classes)
display.plot()
```

[ ]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff074ce9310>
```



[ ]:
```
CM_norm = confusion_matrix(y_test, y_pred, normalize="true")
display = ConfusionMatrixDisplay(confusion_matrix=CM_norm,
                         display_labels=classes)
display.plot()
```

[ ]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff0749a5e20>
```



[ ]:
```
def evaluate(model, test_features, test_labels):
    accuracy = model.score(test_features, test_labels)
    print('Model Performance')
    print('Accuracy = {:0.3f}%.'.format(accuracy))

    return accuracy

base_model = GradientBoostingClassifier(n_estimators=100, learning_rate=1.0,␣
 ↪max_depth=1, random_state=0)
base_model.fit(X_train, y_train)
base_accuracy = evaluate(base_model, X_test, y_test)

best_random = xgb_gscv.best_estimator_
random_accuracy = evaluate(best_random, X_test, y_test)

print(f'Improvement of {100 * (random_accuracy - base_accuracy) / base_accuracy:
 ↪.3f}%.')
```

```
Model Performance
Accuracy = 0.533%.
Model Performance
Accuracy = 0.502%.
Improvement of -5.707%.
```

[ ]: