LinearModelStory

January 13, 2022

1 Libraries

Import your libraries

```
[47]: import numpy as np
      import pandas as pd
      import statistics as cal
      import matplotlib.pyplot as plt
      from sklearn.model_selection import KFold
      from sklearn.model_selection import train_test_split
      from sklearn.model_selection import GridSearchCV
      from sklearn.svm import SVC
      from sklearn.tree import DecisionTreeClassifier
      from sklearn.neighbors import KNeighborsClassifier
      from sklearn.linear_model import SGDClassifier
      from sklearn.metrics import accuracy_score, f1_score, precision_score,␣
       ↪recall_score, classification_report, plot_confusion_matrix, confusion_matrix
```

```
[48]: Player = 15
      Game = 2

      df = pd.read_csv('matrix_Player_' + str(Player) + '_game_' + str(Game) +␣
       ↪'_Processed_Action.csv')

      df.replace([np.inf, -np.inf], np.nan, inplace=True)
      df = df.fillna(0)

      print(df.Action[df.Action == "Sprinting"])
```

```
Series([], Name: Action, dtype: float64)
```

2 Importing Data

Import the CSV file with Actions, Sum and Div as a Dataframe called df. Fill the empty values of Action with 0. Replace NaN values with 0. Delete first 100 rows.

```python
[49]:  #Load the DataFrame in df

       Player = 15
       Game = 2

       df = pd.read_csv('matrix_Player_' + str(Player) + '_game_' + str(Game) +␣
        ↪'_Processed_Action.csv')

       #-----------------------------------------------------------------------

       # Replace NaN values for 0

       df.replace([np.inf, -np.inf], np.nan, inplace=True)
       df = df.fillna(0)

       #-----------------------------------------------------------------------

       #If df.Action has the value 'sprinting', it replaces it for the value 1

       df.Action[df.Action == "Sprinting"] = 1

       #-----------------------------------------------------------------------

       #Delete first 99 rows, so df starts at timeLine == 1.00

       df = df.iloc[99: , :]
```

```
<ipython-input-49-1ca778e572d0>:19: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df.Action[df.Action == "Sprinting"] = 1
```

3 Preparing Data

Split the Dataframe in chunks of n/100 seconds. Combine to 1 dataframe. With Sum,Div and
Action split into Train and Valid/Test.

```python
[50]:  #Convert data into chunks of a second
       n = 100 #chunk size (100 datapoints in one second)
       chunks = [df[i:i+n] for i in range(0,df.shape[0],n)]

       #-----------------------------------------------------------------------
       count = 0
       #Set chunks into dataframe
```

```python
#for chunk in chunks:
frames = []
for chunk in chunks:
    P = pd.DataFrame({'frAcc':[max(chunk['frAcc'].tolist())],
                      'frRoAcc':[chunk['frRoAcc'].tolist()], 'frDispl':
↪[chunk['frDispl'].tolist()],
                      'frRoAng':[chunk['frRoAng'].tolist()], 'frSpeed':
↪[max(chunk['frSpeed'].tolist())],
                      'timeLine':[max(chunk['timeLine'].tolist())],␣
↪'frameRotationalSpeedX':[chunk['frameRotationalSpeedX'].tolist()],
                      'frameRotationalSpeedY':[cal.
↪mean(chunk['frameRotationalSpeedY'].tolist())], 'frameRotationalSpeedZ':[cal.
↪mean(chunk['frameRotationalSpeedZ'].tolist())],
                      'wheelRotationalSpeedX':
↪[max(chunk['wheelRotationalSpeedX'].tolist())], 'wheelRotationalSpeedY':
↪[chunk['wheelRotationalSpeedY'].tolist()],
                      'wheelRotationalSpeedZ':[chunk['wheelRotationalSpeedZ'].
↪tolist()], 'frRoSpeed':[max(chunk['frRoSpeed'].tolist())],
                      'Sum_WheelX_FrameZ':[max(chunk['Sum_WheelX_FrameZ'].
↪tolist())], 'Div_FrameZ_WheelX':[cal.mean(chunk['Div_FrameZ_WheelX'].
↪tolist())],
                      'Filt_WheelX':[cal.mean(chunk['Filt_WheelX'].tolist())],␣
↪'Filt_FrameZ':[cal.mean(chunk['Filt_FrameZ'].tolist())],
                      'Action':[max(chunk['Action'].tolist())]})
    #count += 1
    #print(count)       #    as we are working with some values removed and also␣
↪max values we have less values
    frames.append(P)
df = pd.concat(frames,ignore_index=True)
```

```python
[51]: # split chunk data into train test validate (with colum [sum and Div] as input,␣
↪and action as output)
X_train, X_test, y_train, y_test = train_test_split(df[[
                                                  'Sum_WheelX_FrameZ',
                                                  'Div_FrameZ_WheelX',
                                                  'wheelRotationalSpeedX',
                                                  'Filt_FrameZ',
                                                  'Filt_WheelX',
                                                  'frameRotationalSpeedY'
                                                  ]], #these are the␣
↪features
                                                  df.Action, test_size = 0.2,␣
↪random_state=42)
```

```python
[76]: sgdc = SGDClassifier(loss='hinge', penalty='l2', max_iter=1, tol=0.05)
print(sgdc)
```

```
sgd = sgdc.fit(X_train, y_train)

score = sgdc.score(X_train, y_train)
print("Training score: ", score)
```

```
SGDClassifier(max_iter=1, tol=0.05)
Training score:  0.6430335609472614
```

```
/opt/jupyterhub/anaconda/lib/python3.8/site-
packages/sklearn/linear_model/_stochastic_gradient.py:574: ConvergenceWarning:
Maximum number of iteration reached before convergence. Consider increasing
max_iter to improve the fit.
  warnings.warn("Maximum number of iteration reached before "
```

[77]:
```
#sgdc = SGDClassifier(loss='-------------', max_iter=10000, tol=0.05)


# Possible values for loss hyperparameter

#hinge->0.3595815778003775
#modified_huber->0.3604532907162574
#log->0.4464622984163882
#squared_error->DOESN'T WORK
#huber->0.3591457213424379
#epsilon_insensitive->0.641144849629522
#squared_epsilon_insensitive->0.640995641435421
```

4 Validation

[78]:
```
from sklearn.metrics import recall_score
from sklearn.metrics import precision_score

test_predictions = sgd.predict(X_test)

# Create precision or recall score based on the metric you imported
score1 = precision_score(y_test, test_predictions)
score2 = recall_score(y_test, test_predictions)
print(score1, '  ', score2)
#Precision: Ensures you don't over predict positive values.
#Recall: Ensures you don't miss any positive values.

X = df[['Sum_WheelX_FrameZ',
        'Div_FrameZ_WheelX',
        'wheelRotationalSpeedX',
        'Filt_FrameZ',
```

```
        'Filt_WheelX',
        'frameRotationalSpeedY']], #these are the features
y = df.Action




#Confusion Matrix
plot_confusion_matrix(sgd, X_test, y_test)
plt.show()
```

0.0737410071942446   0.25949367088607594
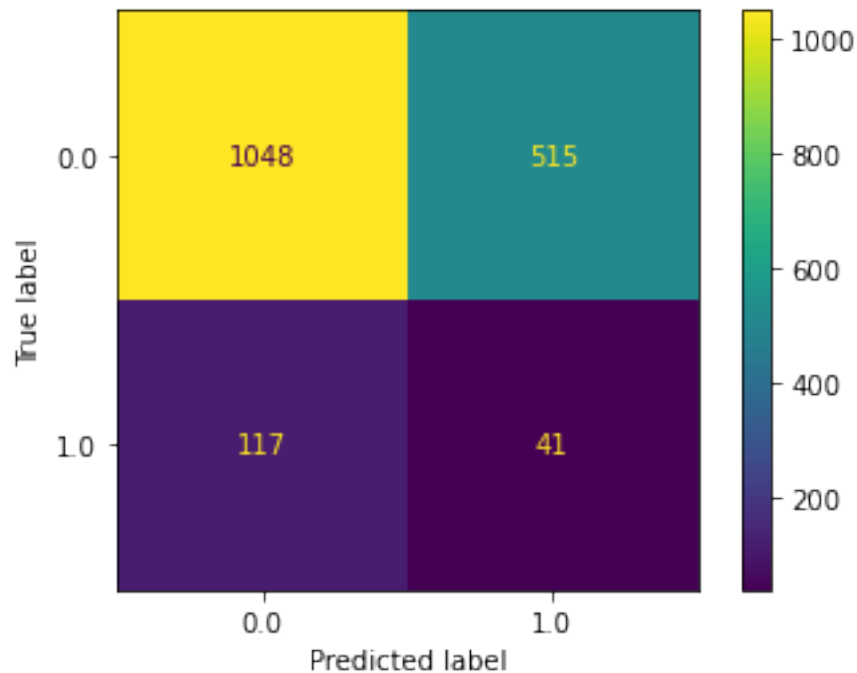
[79]:
```
classes = ['Not Sprinting', 'Sprinting']
y_pred = sgd.predict(X_test)
print(classification_report(y_test, y_pred, target_names=classes))
#Precision        Ratio of true positives to the sum of true and false␣
 ↪positives.

#Recall         Ratio of true positives to the sum of true positives and false␣
 ↪negatives.

#F1 Score         The F1 is the weighted harmonic mean of precision and recall.
#The closer the value of the F1 score is to 1.0, the better the expected␣
 ↪performance of the model is.
```

```
#Support        Support is the number of actual occurrences of the class in the␣
 ↪dataset.
#It doesn't vary between models, it just diagnoses the performance evaluation␣
 ↪process.
```

	precision	recall	f1-score	support
Not Sprinting	0.90	0.67	0.77	1563
Sprinting	0.07	0.26	0.11	158
accuracy			0.63	1721
macro avg	0.49	0.46	0.44	1721
weighted avg	0.82	0.63	0.71	1721

5 Tuning

```
[70]: #CROSS-VALIDATION
X = df[['Sum_WheelX_FrameZ',
        'Div_FrameZ_WheelX',
        'wheelRotationalSpeedX',
        'Filt_FrameZ',
        'Filt_WheelX',
        'frameRotationalSpeedY']] #these are the features
y = df.Action




from sklearn.model_selection import cross_val_score
cv_scores = cross_val_score(sgd, X.to_numpy(), y, cv=4 )
cv_scores#gives predictions of each split
```

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[70]: `array([0.43840074, 0.61273826, 0.29986053, 0.68619247])`

[71]:
```python
#from imblearn.over_sampling import RandomOverSampler
#ros = RandomOverSampler(random_state=0)
#X_resampled, y_resampled = ros.fit_resample(X, y)
```

[72]:
```python
grid_param = {'alpha':[0.00001, 0.0001, 0.001, 0.01, 0.1, 1],
              'loss':['hinge', 'log', 'huber', 'epsilon_insensitive',
'squared_epsilon_insensitive'], 'penalty':['l1','l2'], 'class_weight':
['balanced']}


searcher = GridSearchCV(sgd, grid_param, cv=10)
searcher.fit(X_train, y_train)




#hinge->0.35958157780037775
#modified_huber->0.3604532907162574
#log->0.4464622984163882
#squared_error->DOESN'T WORK
#huber->0.3591457213424379
#epsilon_insensitive->0.641144849629522
#squared_epsilon_insensitive

#gd_sr = GridSearchCV(estimator=sgd, param_grid=grid_param, scoring='accuracy',
cv=5, n_jobs=-1)

#gd_sr.fit(X_train, y_train)
```

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[72]:
```
GridSearchCV(cv=10,
             estimator=SGDClassifier(class_weight='balanced',
                                     loss='squared_epsilon_insensitive',
                                     max_iter=1, n_jobs=8, penalty='l1',
                                     tol=0.05),
             param_grid={'alpha': [1e-05, 0.0001, 0.001, 0.01, 0.1, 1],
                         'class_weight': ['balanced'],
                         'loss': ['hinge', 'log', 'huber',
                                  'epsilon_insensitive',
                                  'squared_epsilon_insensitive'],
                         'penalty': ['l1', 'l2']})
```

[73]:
```python
#Here  I print results because i can't see it in the block above
print("Best CV params", searcher.best_params_)
print("Best CV accuracy", searcher.best_score_)
print("Test accuracy of best grid search hypers:", searcher.score(X_test,
 ↪y_test))
```

```
Best CV params {'alpha': 0.0001, 'class_weight': 'balanced', 'loss': 'huber',
'penalty': 'l1'}
Best CV accuracy 0.5624436746886285
Test accuracy of best grid search hypers: 0.6368390470656595
```

[74]:
```python
sgdc = SGDClassifier(alpha = 0.0001, loss='squared_epsilon_insensitive',
 ↪penalty='l1', max_iter=1, tol=0.05, n_jobs=8, class_weight='balanced')
print(sgdc)#class_weight='balanced' => Balances the data from the model

sgd = sgdc.fit(X_train, y_train)
```
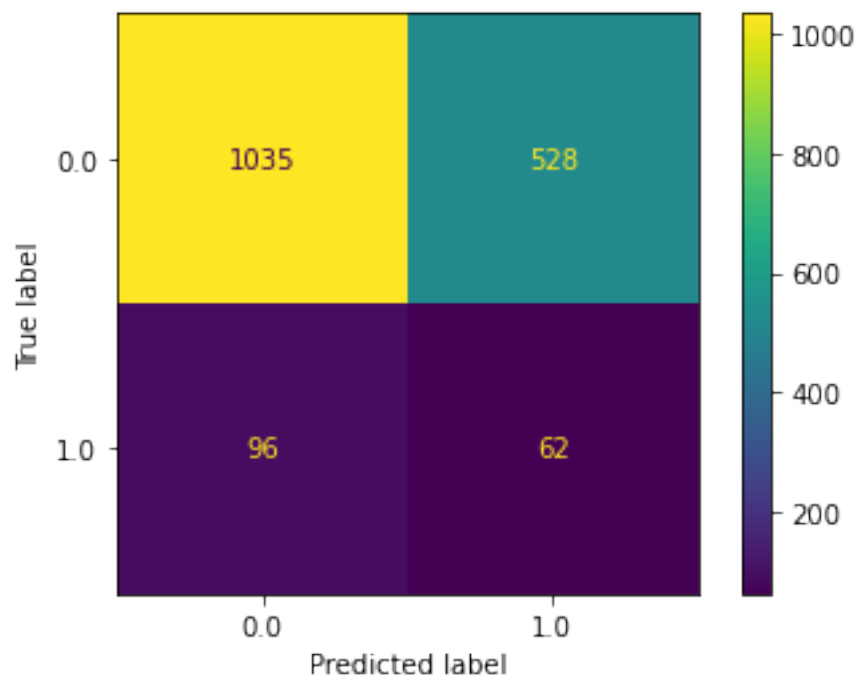
```python
score = sgdc.score(X_train, y_train)


plot_confusion_matrix(sgd, X_test, y_test)
plt.show()
```

/opt/jupyterhub/anaconda/lib/python3.8/site-
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SGDClassifier(class_weight='balanced', loss='squared_epsilon_insensitive',
              max_iter=1, n_jobs=8, penalty='l1', tol=0.05)

[ ]:

[ ]: