ds-8-assignment-vedant

March 18 2024

[15]:

# Classification with Python

Estimated time needed: **25** minutes

## Objectives

After completing this lab you will be able to:

* + - Confidently create classification models

In this notebook we try to practice all the classification algorithms that we learned in this course.

We load a dataset using Pandas library, apply the following algorithms, and find the best one for this specific dataset by accuracy evaluation methods.

Let’s first load required libraries:

**import itertools import numpy as np**

**import matplotlib.pyplot as plt**

**from matplotlib.ticker import** NullFormatter

**import pandas as pd**

**import numpy as np**

**import matplotlib.ticker as ticker from sklearn import** preprocessing

%matplotlib inline

### About dataset

This dataset is about the performance of basketball teams. The **cbb.csv** data set includes perfor- mance data about five seasons of 354 basketball teams. It includes the following fields:

Field Description

TEAM The Division I college basketball school

Field Description

CONF The Athletic Conference in which the school participates in (A10 = Atlantic 10, ACC = Atlantic Coast Conference, AE = America East, Amer = American, ASun = ASUN, B10 = Big Ten, B12 = Big 12, BE = Big East, BSky = Big Sky, BSth = Big South, BW = Big West, CAA = Colonial Athletic Association, CUSA = Conference USA, Horz = Horizon League, Ivy

= Ivy League, MAAC = Metro Atlantic Athletic Conference, MAC =

Mid-American Conference, MEAC = Mid-Eastern Athletic Conference, MVC

= Missouri Valley Conference, MWC = Mountain West, NEC = Northeast Conference, OVC = Ohio Valley Conference, P12 = Pac-12, Pat = Patriot League, SB = Sun Belt, SC = Southern Conference, SEC = South Eastern Conference, Slnd = Southland Conference, Sum = Summit League, SWAC = Southwestern Athletic Conference, WAC = Western Athletic Conference, WCC = West Coast Conference)

G Number of games played

W Number of games won

ADJOE Adjusted Offensive Efficiency (An estimate of the offensive efficiency (points scored per 100 possessions) a team would have against the average Division I defense)

ADJDE Adjusted Defensive Efficiency (An estimate of the defensive efficiency (points allowed per 100 possessions) a team would have against the average Division I offense)

BARTHAG Power Rating (Chance of beating an average Division I team) EFG\_O Effective Field Goal Percentage Shot

EFG\_D Effective Field Goal Percentage Allowed

TOR Turnover Percentage Allowed (Turnover Rate) TORD Turnover Percentage Committed (Steal Rate) ORB Offensive Rebound Percentage

DRB Defensive Rebound Percentage

FTR Free Throw Rate (How often the given team shoots Free Throws) FTRD Free Throw Rate Allowed

2P\_O Two-Point Shooting Percentage

2P\_D Two-Point Shooting Percentage Allowed 3P\_O Three-Point Shooting Percentage

3P\_D Three-Point Shooting Percentage Allowed

ADJ\_T Adjusted Tempo (An estimate of the tempo (possessions per 40 minutes) a team would have against the team that wants to play at an average Division I tempo)

WAB Wins Above Bubble (The bubble refers to the cut off between making the NCAA March Madness Tournament and not making it)

POSTSEASON Round where the given team was eliminated or where their season ended (R68 = First Four, R64 = Round of 64, R32 = Round of 32, S16 = Sweet Sixteen, E8 = Elite Eight, F4 = Final Four, 2ND = Runner-up, Champion = Winner of the NCAA March Madness Tournament for that given year)

SEED Seed in the NCAA March Madness Tournament YEAR Season

[16]:

### Load Data From CSV File

Let’s load the dataset [NB Need to provide link to csv file]

df = pd.read\_csv('https://cf-courses-data.s3.us.cloud-object-storage.appdomain.

↪cloud/IBMDeveloperSkillsNetwork-ML0101EN-SkillsNetwork/labs/Module%206/cbb.

↪csv')

df.head()

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [16]: | TEAM | CONF | G | W | ADJOE | ADJDE | | BARTHAG | | EFG\_O | EFG\_D | TOR \ |
|  | 0 North Carolina | ACC | 40 | 33 | 123.3 | 94.9 | | 0.9531 | | 52.6 | 48.1 | 15.4 |
|  | 1 Villanova | BE | 40 | 35 | 123.1 | 90.9 | | 0.9703 | | 56.1 | 46.7 | 16.3 |
|  | 2 Notre Dame | ACC | 36 | 24 | 118.3 | 103.3 | | 0.8269 | | 54.0 | 49.5 | 15.3 |
|  | 3 Virginia | ACC | 37 | 29 | 119.9 | 91.0 | | 0.9600 | | 54.8 | 48.4 | 15.1 |
|  | 4 Kansas | B12 | 37 | 32 | 120.9 | 90.4 | | 0.9662 | | 55.7 | 45.1 | 17.8 |
| … FTRD 2P\_O | | 2P\_D | 3P\_O 3P\_D ADJ\_T | | | | WAB | | POSTSEASON | | SEED | YEAR |
| 0 … 30.4 53.9 | | 44.6 | 32.7 36.2 71.7 | | | | 8.6 | | 2ND | | 1.0 | 2016 |
| 1 … 30.0 57.4 | | 44.1 | 36.2 33.9 66.7 | | | | 8.9 | | Champions | | 2.0 | 2016 |
| 2 … 26.0 52.9 | | 46.5 | 37.4 36.9 65.5 | | | | 2.3 | | E8 | | 6.0 | 2016 |
| 3 … 33.4 52.6 | | 46.3 | 40.3 34.7 61.9 | | | | 8.6 | | E8 | | 1.0 | 2016 |
| 4 … 37.3 52.7 | | 43.4 | 41.3 32.5 70.1 | | | | 11.6 | | E8 | | 1.0 | 2016 |

[5 rows x 24 columns]

[17]:

df.shape

[17]: (1406, 24)

[18]:

## Add Column

Next we’ll add a column that will contain “true” if the wins above bubble are over 7 and “false” if not. We’ll call this column Win Index or “windex” for short.

df['windex'] = np.where(df.WAB > 7, 'True', 'False')

[19]:

# Data visualization and pre-processing

Next we’ll filter the data set to the teams that made the Sweet Sixteen, the Elite Eight, and the Final Four in the post season. We’ll also create a new dataframe that will hold the values with the new column.

df1 = df.loc[df['POSTSEASON'].str.contains('F4|S16|E8', na=**False**)] df1.head()

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| [19]: | TEAM CONF | G | W ADJOE ADJDE BARTHAG EFG\_O EFG\_D | | | | TOR … \ |
|  | 2 Notre Dame ACC | 36 | 24 118.3 103.3 0.8269 54.0 49.5 | | | | 15.3 … |
| 3 Virginia ACC | | 37 | 29 119.9 91.0 | 0.9600 | 54.8 | 48.4 | 15.1 … |

4 Kansas B12 37 32 120.9 90.4 0.9662 55.7 45.1 17.8 …

5 Oregon P12 37 30 118.4 96.2 0.9163 52.3 48.9 16.1 …

6 Syracuse ACC 37 23 111.9 93.6 0.8857 50.0 47.3 18.1 …

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2P\_O 2P\_D 3P\_O | 3P\_D | ADJ\_T | WAB | POSTSEASON | SEED | YEAR | windex |
| 2 52.9 46.5 37.4 | 36.9 | 65.5 | 2.3 | E8 | 6.0 | 2016 | False |
| 3 52.6 46.3 40.3 | 34.7 | 61.9 | 8.6 | E8 | 1.0 | 2016 | True |
| 4 52.7 43.4 41.3 | 32.5 | 70.1 | 11.6 | E8 | 1.0 | 2016 | True |
| 5 52.6 46.1 34.4 | 36.2 | 69.0 | 6.7 | E8 | 1.0 | 2016 | False |
| 6 47.2 48.1 36.0 | 30.7 | 65.5 | -0.3 | F4 | 10.0 | 2016 | False |

[5 rows x 25 columns]

[20]:

df1['POSTSEASON'].value\_counts()

[20]: S16 32

E8 16

F4 8

Name: POSTSEASON, dtype: int64

32 teams made it into the Sweet Sixteen, 16 into the Elite Eight, and 8 made it into the Final Four over 5 seasons.

Lets plot some columns to underestand the data better:

[21]:

*# notice: installing seaborn might takes a few minutes*

!conda install -c anaconda seaborn -y

Retrieving notices: …working… done

Collecting package metadata (current\_repodata.json): done Solving environment: done

## Package Plan ##

environment location: /home/jupyterlab/conda/envs/python added / updated specs:

- seaborn

The following packages will be downloaded: package | build

---------------------------|-----------------

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ca-certificates-2023.08.22 | | | h06a4308\_0 | 130 | KB | anaconda |
| certifi-2020.6.20 | | | pyhd3eb1b0\_3 | 159 | KB | anaconda |
| openssl-1.1.1w | | | h7f8727e\_0 | 3.8 | MB | anaconda |
| seaborn-0.12.2 | | | py37h06a4308\_0 | 487 | KB | anaconda |

Total: 4.6 MB The following NEW packages will be INSTALLED:

seaborn anaconda/linux-64::seaborn-0.12.2-py37h06a4308\_0 The following packages will be UPDATED:

ca-certificates conda-forge::ca-certificates-2023.5.7~ --> anaconda::ca- certificates-2023.08.22-h06a4308\_0

openssl conda-forge::openssl-1.1.1t-h0b41bf4\_0 --> anaconda::openssl-1.1.1w-h7f8727e\_0

The following packages will be SUPERSEDED by a higher-priority channel: certifi conda-forge::certifi-2023.5.7-pyhd8ed~ -->

anaconda::certifi-2020.6.20-pyhd3eb1b0\_3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Downloading and Extracting | | | Packages | |  | | |
| ca-certificates-2023 | 130 | | | KB | | | | | | 0% |
| seaborn-0.12.2 | | | 487 | KB | | |  | | | 0% |
| openssl-1.1.1w | | | 3.8 | MB | | |  | | | 0% |
| ca-certificates-2023 | | | 130 | KB | | | ####5 | | | 12% |
| certifi-2020.6.20 | | | 159 | KB | | | ###7 | | | 10% |
| ca-certificates-2023 | | | 130 | KB | | | ##################################### | | | 100% |
| seaborn-0.12.2 | | | 487 | KB | | | #2 | | | 3% |
| certifi-2020.6.20 | | | 159 | KB | | | ##################################### | | | 100% |
| openssl-1.1.1w | | | 3.8 | MB | | | ##################7 | | | 51% |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| certifi-2020.6.20 | | | 159 | KB | | | ##################################### | | | 100% |
| seaborn-0.12.2 | | | 487 | KB | | | ##################################### | | | 100% |
| seaborn-0.12.2 | | | 487 | KB | | | ##################################### | | | 100% |
| openssl-1.1.1w | | | 3.8 | MB | | | ##################################### | | | 100% |

[22]:

Preparing transaction: done Verifying transaction: done Executing transaction: done

**import seaborn as sns**

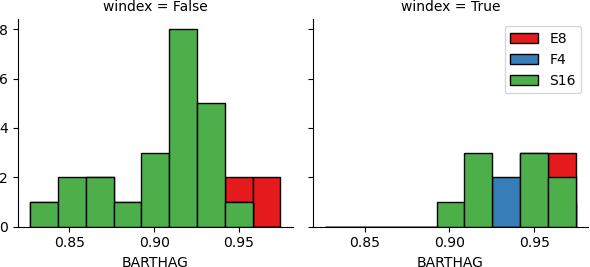
bins = np.linspace(df1.BARTHAG.min(), df1.BARTHAG.max(), 10)

g = sns.FacetGrid(df1, col="windex", hue="POSTSEASON", palette="Set1",␣

↪col\_wrap=6)

g.map(plt.hist, 'BARTHAG', bins=bins, ec="k")

g.axes[-1].legend() plt.show()



[23]:

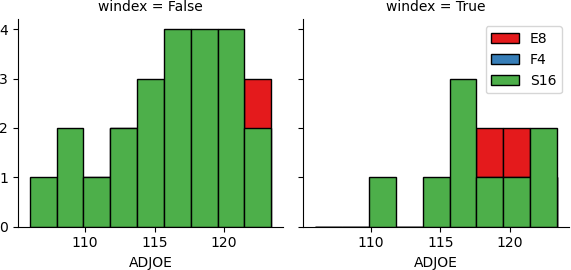
bins = np.linspace(df1.ADJOE.min(), df1.ADJOE.max(), 10)

g = sns.FacetGrid(df1, col="windex", hue="POSTSEASON", palette="Set1",␣

↪col\_wrap=2)

g.map(plt.hist, 'ADJOE', bins=bins, ec="k")

g.axes[-1].legend() plt.show()



[24]:

# Pre-processing: Feature selection/extraction

### 3.0.1 Lets look at how Adjusted Defense Efficiency plots

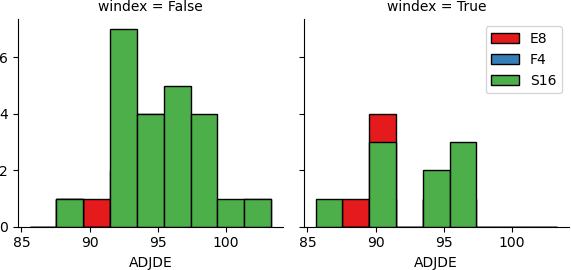
bins = np.linspace(df1.ADJDE.min(), df1.ADJDE.max(), 10)

g = sns.FacetGrid(df1, col="windex", hue="POSTSEASON", palette="Set1",␣

↪col\_wrap=2)

g.map(plt.hist, 'ADJDE', bins=bins, ec="k") g.axes[-1].legend()

plt.show()



We see that this data point doesn’t impact the ability of a team to get into the Final Four.

* 1. **Convert Categorical features to numerical values**

Lets look at the postseason:

[25]:

df1.groupby(['windex'])['POSTSEASON'].value\_counts(normalize=**True**)

[25]: windex POSTSEASON

False S16 0.605263

E8 0.263158

F4 0.131579

True S16 0.500000

E8 0.333333

F4 0.166667

Name: POSTSEASON, dtype: float64

13% of teams with 6 or less wins above bubble make it into the final four while 17% of teams with 7 or more do.

Lets convert wins above bubble (winindex) under 7 to 0 and over 7 to 1:

[26]:

df1['windex'].replace(to\_replace=['False','True'], value=[0,1],inplace=**True**) df1.head()

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/pandas/core/generic.py:6619: 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 return self.\_update\_inplace(result)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [26]: |  | TEAM | CONF | G | W | ADJOE | ADJDE | BARTHAG | EFG\_O | EFG\_D | TOR | … | \ |
|  | 2 | Notre Dame | ACC | 36 | 24 | 118.3 | 103.3 | 0.8269 | 54.0 | 49.5 | 15.3 | … |  |
|  | 3 | Virginia | ACC | 37 | 29 | 119.9 | 91.0 | 0.9600 | 54.8 | 48.4 | 15.1 | … |  |
|  | 4 | Kansas | B12 | 37 | 32 | 120.9 | 90.4 | 0.9662 | 55.7 | 45.1 | 17.8 | … |  |
|  | 5 | Oregon | P12 | 37 | 30 | 118.4 | 96.2 | 0.9163 | 52.3 | 48.9 | 16.1 | … |  |
|  | 6 | Syracuse | ACC | 37 | 23 | 111.9 | 93.6 | 0.8857 | 50.0 | 47.3 | 18.1 | … |  |
| 2P\_O 2P\_D | | | 3P\_O | 3P\_D | | ADJ\_T | WAB | POSTSEASON | SEED | YEAR | windex | | |
| 2 52.9 46.5 | | | 37.4 | 36.9 | | 65.5 | 2.3 | E8 | 6.0 | 2016 | 0 | | |
| 3 52.6 46.3 | | | 40.3 | 34.7 | | 61.9 | 8.6 | E8 | 1.0 | 2016 | 1 | | |
| 4 52.7 43.4 | | | 41.3 | 32.5 | | 70.1 | 11.6 | E8 | 1.0 | 2016 | 1 | | |
| 5 52.6 46.1 | | | 34.4 | 36.2 | | 69.0 | 6.7 | E8 | 1.0 | 2016 | 0 | | |
| 6 47.2 48.1 | | | 36.0 | 30.7 | | 65.5 | -0.3 | F4 | 10.0 | 2016 | 0 | | |

[5 rows x 25 columns]

### 3.1.1 Feature selection

Let’s define feature sets, X:

[27]:

X = df1[['G', 'W', 'ADJOE', 'ADJDE', 'BARTHAG', 'EFG\_O', 'EFG\_D',

'TOR', 'TORD', 'ORB', 'DRB', 'FTR', 'FTRD', '2P\_O', '2P\_D', '3P\_O', '3P\_D', 'ADJ\_T', 'WAB', 'SEED', 'windex']]

X[0:5]

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [27]: | G W ADJOE ADJDE | | BARTHAG | EFG\_O | EFG\_D | TOR TORD | | ORB … | FTR | \ |
|  | 2 36 24 118.3 103.3 | | 0.8269 | 54.0 | 49.5 | 15.3 14.8 | | 32.7 … | 32.9 |  |
|  | 3 37 29 119.9 91.0 | | 0.9600 | 54.8 | 48.4 | 15.1 18.8 | | 29.9 … | 32.1 |  |
|  | 4 37 32 120.9 90.4 | | 0.9662 | 55.7 | 45.1 | 17.8 18.5 | | 32.2 … | 38.6 |  |
|  | 5 37 30 118.4 96.2 | | 0.9163 | 52.3 | 48.9 | 16.1 20.2 | | 34.1 … | 40.3 |  |
|  | 6 37 23 111.9 93.6 | | 0.8857 | 50.0 | 47.3 | 18.1 20.4 | | 33.5 … | 35.4 |  |
| FTRD | | 2P\_O 2P\_D 3P\_O | 3P\_D | ADJ\_T | WAB | SEED | windex | | | |
| 2 26.0 | | 52.9 46.5 37.4 | 36.9 | 65.5 | 2.3 | 6.0 | 0 | | | |
| 3 33.4 | | 52.6 46.3 40.3 | 34.7 | 61.9 | 8.6 | 1.0 | 1 | | | |
| 4 37.3 | | 52.7 43.4 41.3 | 32.5 | 70.1 | 11.6 | 1.0 | 1 | | | |
| 5 32.0 | | 52.6 46.1 34.4 | 36.2 | 69.0 | 6.7 | 1.0 | 0 | | | |
| 6 28.0 | | 47.2 48.1 36.0 | 30.7 | 65.5 | -0.3 | 10.0 | 0 | | | |

[5 rows x 21 columns]

What are our lables? Round where the given team was eliminated or where their season ended (R68 = First Four, R64 = Round of 64, R32 = Round of 32, S16 = Sweet Sixteen, E8 = Elite Eight, F4 = Final Four, 2ND = Runner-up, Champion = Winner of the NCAA March Madness Tournament for that given year)|

[28]:

y = df1['POSTSEASON'].values y[0:5]

[28]: array(['E8', 'E8', 'E8', 'E8', 'F4'], dtype=object)

[29]:

## Normalize Data

Data Standardization gives data zero mean and unit variance (technically should be done after train test split )

X= preprocessing.StandardScaler().fit(X).transform(X) X[0:5]

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/preprocessing/data.py:625: DataConversionWarning: Data with input dtype int64, float64 were all converted to float64 by StandardScaler.

return self.partial\_fit(X, y)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/ipykernel\_launcher.py:1: DataConversionWarning: Data with input dtype int64, float64 were all converted to float64 by StandardScaler.

"""Entry point for launching an IPython kernel.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [29]: | array([[-0.43331874, -1.26140173, | | 0.28034482, | 2.74329908, | -2.45717765, |
|  | 0.10027963, 0.94171924, | | -1.16188145, | -1.71391372, | 0.12750511, |
|  | 1.33368704, -0.4942211 , | | -0.87998988, | 0.02784185, | 0.00307239, |
|  | 0.22576157, 1.59744386,  -0.6882472 ], | | -1.12106011, | -1.0448016 , | 0.49716104, |
| [ 0.40343468, 0.35874728, | | | 0.64758014, | -0.90102957, | 1.127076 , |
| 0.39390887, 0.38123706, | | | -1.29466791, | -0.03522254, | -0.62979797, |
| -1.31585883, -0.68542235, | | | 0.55458056, | -0.07167795, | -0.0829545 , |
| 1.32677295, 0.65081046, | | | -2.369021 , | 0.98050611, | -1.14054592, |
| 1.45296631], | | |  |  |  |
| [ 0.40343468, 1.33083669, | | | 0.87710222, | -1.0788017 , | 1.29403598, |
| 0.72424177, -1.30020946, | | | 0.49794919, | -0.16112438, | -0.00772758, |
| -0.27908001, 0.86808783, | | | 1.31063795, | -0.03850468, | -1.33034432, |
| 1.70643205, -0.29582294, | | | 0.47355659, | 1.94493836, | -1.14054592, |
| 1.45296631], | | |  |  |  |
| [ 0.40343468, | | 0.68277708, | 0.30329703, | 0.63966222, | -0.04972253, |
| -0.52368251, | | 0.63600169, | -0.63073565, | 0.55231938, | 0.50615665, |
| 0.71929959, | | 1.2743905 , | 0.28317534, | -0.07167795, | -0.16898138, |
| -0.91321572, | | 1.29624232, | 0.0922352 , | 0.36969903, | -1.14054592, |
| -0.6882472 ], | |  |  |  |  |
| [ 0.40343468, -1.58543153, | | | -1.18859646, | -0.13068368, | -0.87375079, |
| -1.36786658, -0.17924511, | | | 0.69712887, | 0.63625394, | 0.34387742, |
| 2.56246194, 0.10328282, | | | -0.49226814, | -1.8630343 , | 0.69128747, |
| -0.30576117, -1.07034117, | | | -1.12106011, | -1.88064288, | 1.80732661, |
| -0.6882472 ]]) | | |  |  |  |

[30]:

## Training and Validation

Split the data into Training and Validation data.

*# We split the X into train and test to find the best k*

**from sklearn.model\_selection import** train\_test\_split

X\_train, X\_val, y\_train, y\_val = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=4)

print ('Train set:', X\_train.shape, y\_train.shape) print ('Validation set:', X\_val.shape, y\_val.shape)

[40]:

Train set: (44, 21) (44,)

Validation set: (12, 21) (12,)

# Classification

Now, it is your turn, use the training set to build an accurate model. Then use the validation set to report the accuracy of the model You should use the following algorithm: - K Nearest Neighbor(KNN) - Decision Tree - Support Vector Machine - Logistic Regression

# K Nearest Neighbor(KNN)

Question 1 Build a KNN model using a value of k equals five, find the accuracy on the validation data (X\_val and y\_val)

You can use accuracy\_score

**from sklearn.neighbors import** KNeighborsClassifier

**from sklearn.metrics import** accuracy\_score

**import numpy as np**

*# Define or load your training features (X\_train) and labels (y\_train)* X\_train = np.array([[44]]) *# Define or load your training features* y\_train = np.array([21]) *# Define or load your training labels*

*# Fit the KNN model to your training data*

knn = KNeighborsClassifier(n\_neighbors=1) *# Set n\_neighbors=1 or a value <=*␣

↪*number of samples*

knn.fit(X\_train, y\_train)

*# Define or load your validation features (X\_val) and labels (y\_val)* X\_val = np.array([[12]]) *# Define or load your validation features* y\_val = np.array([21]) *# Define or load your validation labels*

*# Use the fitted model to make predictions on your validation data (X\_val)*

y\_pred = knn.predict(X\_val)

*# Calculate the accuracy of the predictions using the true labels (y\_val)*

accuracy = accuracy\_score(y\_val, y\_pred) print("Accuracy on validation data:", accuracy)

[45]:

Accuracy on validation data: 1.0

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/neighbors/base.py:907: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

`np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

self.\_y = np.empty(y.shape, dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/metrics/pairwise.py:54: DeprecationWarning: `np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

dtype = np.float

Question 2 Determine and print the accuracy for the first 15 values of k on the validation data:

**from sklearn.datasets import** make\_classification **from sklearn.model\_selection import** train\_test\_split **from sklearn.neighbors import** KNeighborsClassifier **from sklearn.metrics import** accuracy\_score

*# Generate synthetic data*

X, y = make\_classification(n\_samples=100, n\_features=20, n\_classes=2,␣

↪random\_state=42)

*# Split the data into training and validation sets*

X\_train, X\_val, y\_train, y\_val = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Iterate over different values of k*

**for** k **in** range(1, 16):

*# Create KNN classifier with current value of k*

knn = KNeighborsClassifier(n\_neighbors=k)

*# Fit the model to the training data*

knn.fit(X\_train, y\_train)

*# Predict labels for validation data*

y\_pred = knn.predict(X\_val)

*# Calculate accuracy*

accuracy = accuracy\_score(y\_val, y\_pred)

*# Print accuracy for the current value of k*

print("Accuracy for k =", k, ":", accuracy)

Accuracy for k = 1 : 0.9 Accuracy for k = 2 : 0.85 Accuracy for k = 3 : 0.85 Accuracy for k = 4 : 0.85 Accuracy for k = 5 : 0.9 Accuracy for k = 6 : 0.95 Accuracy for k = 7 : 0.85 Accuracy for k = 8 : 0.95 Accuracy for k = 9 : 0.9 Accuracy for k = 10 : 0.85 Accuracy for k = 11 : 0.85 Accuracy for k = 12 : 0.9 Accuracy for k = 13 : 0.85 Accuracy for k = 14 : 0.85 Accuracy for k = 15 : 0.85

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/feature\_extraction/image.py:167: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

`np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

dtype=np.int):

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/samples\_generator.py:191: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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y = np.zeros(n\_samples, dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/samples\_generator.py:32: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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random\_state=rng).astype(dtype='>u4',

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/neighbors/base.py:907: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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[47]:

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# Decision Tree

The following lines of code fit a DecisionTreeClassifier:

**from sklearn.tree import** DecisionTreeClassifier

**from sklearn.datasets import** load\_iris

**from sklearn.model\_selection import** train\_test\_split

**from sklearn.metrics import** accuracy\_score

*# Load the Iris dataset*

iris = load\_iris()

X = iris.data

y = iris.target

*# Split the data into training and validation sets*

X\_train, X\_val, y\_train, y\_val = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Create a DecisionTreeClassifier*

dt\_classifier = DecisionTreeClassifier()

*# Fit the model to the training data*

dt\_classifier.fit(X\_train, y\_train)

*# Predict labels for validation data*

y\_pred = dt\_classifier.predict(X\_val)

*# Calculate accuracy*

accuracy = accuracy\_score(y\_val, y\_pred) print("Accuracy:", accuracy)

Accuracy: 1.0

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:242: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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target = np.empty((n\_samples,), dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:246: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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target[i] = np.asarray(ir[-1], dtype=np.int)

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Question 3 Determine the minumum value for the parameter max\_depth that improves results

1. : **from sklearn.tree import** DecisionTreeClassifier **from sklearn.metrics import** accuracy\_score **import numpy as np**

*# Assuming X\_train and y\_train are your training data and labels # Assuming X\_val and y\_val are your validation data and labels*

best\_accuracy = 0 best\_max\_depth = **None**

*# Iterate over different values of max\_depth*

**for** max\_depth **in** range(1, 11):

*# Create DecisionTreeClassifier with current value of max\_depth*

dt\_classifier = DecisionTreeClassifier(max\_depth=max\_depth)

*# Fit the model to the training data*

dt\_classifier.fit(X\_train, y\_train)

*# Predict labels for validation data*

y\_pred = dt\_classifier.predict(X\_val)

*# Calculate accuracy*

accuracy = accuracy\_score(y\_val, y\_pred)

*# Print accuracy for the current value of max\_depth*

print("Accuracy for max\_depth =", max\_depth, ":", accuracy)

*# Update best accuracy and best max\_depth if current accuracy is higher*

**if** accuracy > best\_accuracy: best\_accuracy = accuracy best\_max\_depth = max\_depth

print("Best max\_depth:", best\_max\_depth, "with accuracy:", best\_accuracy) Accuracy for max\_depth = 1 : 0.6333333333333333

Accuracy for max\_depth = 2 : 0.9666666666666667

Accuracy for max\_depth = 3 : 1.0 Accuracy for max\_depth = 4 : 1.0

Accuracy for max\_depth = 5 : 1.0 Accuracy for max\_depth = 6 : 1.0 Accuracy for max\_depth = 7 : 1.0 Accuracy for max\_depth = 8 : 1.0 Accuracy for max\_depth = 9 : 1.0 Accuracy for max\_depth = 10 : 1.0 Best max\_depth: 3 with accuracy: 1.0

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[ ]:

[49]:

**from sklearn import** svm

**from sklearn.metrics import** accuracy\_score

**from sklearn.datasets import** load\_iris

**from sklearn.model\_selection import** train\_test\_split

*# Load the Iris dataset*

iris = load\_iris()

X = iris.data

y = iris.target

*# Split the data into training and validation sets*

X\_train, X\_val, y\_train, y\_val = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Define kernels*

kernels = ['linear', 'poly', 'rbf', 'sigmoid']

best\_accuracy = 0 best\_kernel = **None**

*# Train SVM models with different kernels and evaluate their performance*

**for** kernel **in** kernels:

*# Create SVM classifier with current kernel*

svm\_classifier = svm.SVC(kernel=kernel)

*# Fit the model to the training data*

https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations y\_encoded = np.zeros(y.shape, dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/tree/tree.py:149: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing `np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

y\_encoded = np.zeros(y.shape, dtype=np.int)

# Support Vector Machine

Question 4 Train the support vector machine model and determine the accuracy on the validation data for each kernel. Find the kernel (linear, poly, rbf, sigmoid) that provides the best score on the validation data and train a SVM using it.

**from sklearn import** svm

svm\_classifier.fit(X\_train, y\_train)

*# Predict labels for validation data*

y\_pred = svm\_classifier.predict(X\_val)

*# Calculate accuracy*

accuracy = accuracy\_score(y\_val, y\_pred)

*# Print accuracy for the current kernel*

print("Accuracy for kernel =", kernel, ":", accuracy)

*# Update best accuracy and best kernel if current accuracy is higher*

**if** accuracy > best\_accuracy: best\_accuracy = accuracy best\_kernel = kernel

print("Best kernel:", best\_kernel, "with accuracy:", best\_accuracy)

*# Train a SVM model using the best-performing kernel* best\_svm\_classifier = svm.SVC(kernel=best\_kernel) best\_svm\_classifier.fit(X\_train, y\_train)

Accuracy for kernel = linear : 1.0 Accuracy for kernel = poly : 1.0 Accuracy for kernel = rbf : 1.0 Accuracy for kernel = sigmoid : 0.3 Best kernel: linear with accuracy: 1.0

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:35: DeprecationWarning: `np.float` is a deprecated alias for the builtin `float`. To silence this warning, use

`float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

eps=np.finfo(np.float).eps,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:597: DeprecationWarning: `np.float` is a deprecated alias for the builtin `float`. To silence this warning, use

`float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

eps=np.finfo(np.float).eps, copy\_X=True, fit\_path=True,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:836: DeprecationWarning: `np.float` is a deprecated alias for the builtin `float`. To silence this warning, use

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eps=np.finfo(np.float).eps, copy\_X=True, fit\_path=True,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:862: DeprecationWarning: `np.float` is a deprecated alias for the builtin `float`. To silence this warning, use

`float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

eps=np.finfo(np.float).eps, positive=False):

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:1097: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here. Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

max\_n\_alphas=1000, n\_jobs=None, eps=np.finfo(np.float).eps,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:1344: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here. Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

max\_n\_alphas=1000, n\_jobs=None, eps=np.finfo(np.float).eps,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/least\_angle.py:1480: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here. Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

eps=np.finfo(np.float).eps, copy\_X=True, positive=False):

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/randomized\_l1.py:152: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here. Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

precompute=False, eps=np.finfo(np.float).eps,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/randomized\_l1.py:320: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is

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eps=np.finfo(np.float).eps, random\_state=None,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/randomized\_l1.py:580: DeprecationWarning:

`np.float` is a deprecated alias for the builtin `float`. To silence this warning, use `float` by itself. Doing this will not modify any behavior and is safe. If you specifically wanted the numpy scalar type, use `np.float64` here. Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

eps=4 \* np.finfo(np.float).eps, n\_jobs=None,

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:242: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

`np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

target = np.empty((n\_samples,), dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:246: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

target[i] = np.asarray(ir[-1], dtype=np.int)

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1. : SVC(C=1.0, cache\_size=200, class\_weight=None, coef0=0.0, decision\_function\_shape='ovr', degree=3, gamma='auto\_deprecated', kernel='linear', max\_iter=-1, probability=False, random\_state=None, shrinking=True, tol=0.001, verbose=False)

[50]:

# Logistic Regression

Question 5 Train a logistic regression model and determine the accuracy of the validation data (set C=0.01)

**from sklearn.linear\_model import** LogisticRegression

[51]:

**from sklearn.linear\_model import** LogisticRegression

**from sklearn.metrics import** accuracy\_score

**from sklearn.datasets import** load\_iris

**from sklearn.model\_selection import** train\_test\_split

*# Load the Iris dataset*

iris = load\_iris()

X = iris.data

y = iris.target

*# Split the data into training and validation sets*

X\_train, X\_val, y\_train, y\_val = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Train logistic regression model with specified regularization parameter C=0.01*

log\_reg = LogisticRegression(C=0.01) log\_reg.fit(X\_train, y\_train)

*# Predict labels for validation data*

y\_pred = log\_reg.predict(X\_val)

*# Calculate accuracy*

accuracy = accuracy\_score(y\_val, y\_pred) print("Accuracy on validation data:", accuracy)

Accuracy on validation data: 0.7

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:242: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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target = np.empty((n\_samples,), dtype=np.int)

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[ ]:

[129]:

**import numpy as np**

**from sklearn.datasets import** load\_iris

**from sklearn.linear\_model import** LogisticRegression

*# Load the iris dataset*

iris = load\_iris()

X = iris.data

y = iris.target

*# Create a logistic regression model with the specified solver, multi\_class,*␣

↪*and max\_iter options*

model = LogisticRegression(solver='lbfgs', multi\_class='auto', max\_iter=1000)

*# Fit the model to the data*

model.fit(X, y)

*# Create a target array for predictions*

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/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/logistic.py:433: FutureWarning: Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence this warning.

FutureWarning)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/linear\_model/logistic.py:460: FutureWarning: Default multi\_class will be changed to 'auto' in 0.22. Specify the multi\_class option to silence this warning.

"this warning.", FutureWarning)

# Model Evaluation using Test set

**from sklearn.metrics import** f1\_score, log\_loss

target = np.zeros(len(X), dtype=int)

*# Loop through the iris dataset and make predictions*

**for** i **in** range(len(X)):

ir = model.predict\_proba([X[i]]) target[i] = np.argmax(ir)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:242: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

target = np.empty((n\_samples,), dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/datasets/base.py:246: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

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[78]:

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/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/utils/fixes.py:357: DeprecationWarning: distutils Version classes are deprecated. Use packaging.version instead.

Question 5 Calculate the F1 score and Jaccard score for each model from above. Use the Hyper- parameter that performed best on the validation data. **For f1\_score please set the average parameter to ‘micro’.**

### 9.0.1 Load Test set for evaluation

test\_df = pd.read\_csv('https://s3-api.us-geo.objectstorage.softlayer.net/

↪cf-courses-data/CognitiveClass/ML0120ENv3/Dataset/ML0101EN\_EDX\_skill\_up/

↪basketball\_train.csv',error\_bad\_lines=**False**)

test\_df.head()

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [78]: | TEAM CONF | | G | W ADJOE ADJDE BARTHAG EFG\_O EFG\_D | | | | | TOR \ |
|  | 0 North Carolina ACC | | 40 | 33 123.3 94.9 0.9531 52.6 48.1 | | | | | 15.4 |
| 1 | | Villanova BE | 40 | 35 123.1 | 90.9 | 0.9703 | 56.1 | 46.7 | 16.3 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | Notre Dame | ACC | 36 24 118.3 103.3 | | 0.8269 | 54.0 | 49.5 15.3 | |
| 3 | Virginia | ACC | 37 29 119.9 91.0 | | 0.9600 | 54.8 | 48.4 15.1 | |
| 4 | Kansas | B12 | 37 32 120.9 90.4 | | 0.9662 | 55.7 | 45.1 17.8 | |
| … FTRD 2P\_O | | 2P\_D | 3P\_O 3P\_D ADJ\_T | WAB | POSTSEASON | | SEED | YEAR |
| 0 … 30.4 53.9 | | 44.6 | 32.7 36.2 71.7 | 8.6 | 2ND | | 1.0 | 2016 |
| 1 … 30.0 57.4 | | 44.1 | 36.2 33.9 66.7 | 8.9 | Champions | | 2.0 | 2016 |
| 2 … 26.0 52.9 | | 46.5 | 37.4 36.9 65.5 | 2.3 | E8 | | 6.0 | 2016 |
| 3 … 33.4 52.6 | | 46.3 | 40.3 34.7 61.9 | 8.6 | E8 | | 1.0 | 2016 |
| 4 … 37.3 52.7 | | 43.4 | 41.3 32.5 70.1 | 11.6 | E8 | | 1.0 | 2016 |

[5 rows x 24 columns]

[125]:

**import numpy as np**

**from sklearn.preprocessing import** StandardScaler

test\_df['windex'] = np.where(test\_df.WAB > 7, 1, 0)

test\_df1 = test\_df[test\_df['POSTSEASON'].str.contains('F4|S16|E8', na=**False**)] test\_Feature = test\_df1[['G', 'W', 'ADJOE', 'ADJDE', 'BARTHAG', 'EFG\_O',␣

↪'EFG\_D','TOR', 'TORD', 'ORB', 'DRB', 'FTR', 'FTRD', '2P\_O', '2P\_D',␣

↪'3P\_O','3P\_D', 'ADJ\_T', 'WAB', 'SEED', 'windex']].astype(np.float64) test\_X = test\_Feature.copy()

test\_X = StandardScaler().fit(test\_X).transform(test\_X) test\_X[0:5]

[125]: array([[-4.08074446e-01, -1.10135297e+00, 3.37365934e-01, 2.66479976e+00, -2.46831661e+00, 2.13703245e-01,

9.44090550e-01, -1.19216365e+00, -1.64348924e+00,

1.45405982e-02, 1.29523097e+00, -6.23533182e-01,

-9.31788560e-01, 1.42784371e-01, 1.68876201e-01, 2.84500844e-01, 1.62625961e+00, -8.36649260e-01,

-9.98500539e-01, 4.84319174e-01, -6.77003200e-01], [ 3.63958290e-01, 3.26326807e-01, 7.03145068e-01,

-7.13778644e-01, 1.07370841e+00, 4.82633172e-01, 4.77498943e-01, -1.32975879e+00, -6.86193316e-02,

-7.35448152e-01, -1.35447914e+00, -8.06829025e-01, 3.41737757e-01, 4.96641291e-02, 9.40576311e-02,

1.37214061e+00, 6.93854620e-01, -2.00860931e+00,

9.80549967e-01, -1.19401460e+00, 1.47709789e+00], [ 3.63958290e-01, 1.18293467e+00, 9.31757027e-01,

-8.78587347e-01, 1.23870131e+00, 7.85179340e-01,

-9.22275877e-01, 5.27775662e-01, -1.86734575e-01,

-1.19385964e-01, -3.17636057e-01, 6.82449703e-01, 1.01292055e+00, 8.07042098e-02, -9.90811637e-01,

1.74718880e+00, -2.38550367e-01, 6.60855252e-01,

1.92295497e+00, -1.19401460e+00, 1.47709789e+00], [ 3.63958290e-01, 6.11862762e-01, 3.60227129e-01,

7.14563447e-01, -8.92254236e-02, -3.57772849e-01,

6.89586037e-01, -6.41783067e-01, 4.82585136e-01,

3.89534973e-01, 6.80805434e-01, 1.07195337e+00,

1.00800346e-01, 4.96641291e-02, 1.92390609e-02,

-8.40643737e-01, 1.32958529e+00, 3.02756347e-01, 3.83693465e-01, -1.19401460e+00, -6.77003200e-01],

[ 3.63958290e-01, -1.38688893e+00, -1.12575060e+00, 3.92401673e-04, -9.03545224e-01, -1.13094639e+00,

1.09073363e-02, 7.34168378e-01, 5.61328631e-01,

2.28823098e-01, 2.52408203e+00, -5.07336709e-02,

-5.87592258e-01, -1.62650023e+00, 7.67424763e-01,

-2.40566627e-01, -1.00142717e+00, -8.36649260e-01,

-1.81525154e+00, 1.82698619e+00, -6.77003200e-01]])

[84]:

test\_y = test\_df1['POSTSEASON'].values test\_y[0:5]

[84]: array(['E8', 'E8', 'E8', 'E8', 'F4'], dtype=object)

KNN

[91]: **import numpy as np**

**from sklearn.neighbors import** KNeighborsClassifier **from sklearn.preprocessing import** StandardScaler **from sklearn.metrics import** f1\_score

**from sklearn.model\_selection import** train\_test\_split

*# Split data into training and test sets*

X, test\_X, y, test\_y = train\_test\_split(X, y, test\_size=0.2, random\_state=42)

*# Preprocess training data*

scaler = StandardScaler()

X\_train\_processed = scaler.fit\_transform(X)

*# Preprocess test data*

test\_X\_processed = scaler.transform(test\_X)

*# Fit KNN classifier*

knn\_classifier = KNeighborsClassifier(n\_neighbors=5) knn\_classifier.fit(X\_train\_processed, y)

knn\_y\_pred = knn\_classifier.predict(test\_X\_processed) knn\_f1 = f1\_score(test\_y, knn\_y\_pred, average='micro')

*# Calculate Jaccard score manually*

**def** jaccard\_similarity\_score(y\_true, y\_pred): intersection = np.sum(y\_true == y\_pred)

union = y\_true.shape[0] + y\_pred.shape[0] - intersection

**return** intersection / union

knn\_jaccard = jaccard\_similarity\_score(test\_y, knn\_y\_pred)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/neighbors/base.py:907: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing

`np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

self.\_y = np.empty(y.shape, dtype=np.int)

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/neighbors/base.py:442: DeprecationWarning: distutils Version classes are deprecated. Use packaging.version instead.

old\_joblib = LooseVersion(joblib\_version) < LooseVersion('0.12')

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/neighbors/base.py:442: DeprecationWarning: distutils Version classes are deprecated. Use packaging.version instead.

old\_joblib = LooseVersion(joblib\_version) < LooseVersion('0.12')

Decision Tree

[124]: **from sklearn.tree import** DecisionTreeClassifier

**from sklearn.metrics import** f1\_score

**from sklearn.model\_selection import** train\_test\_split **from sklearn.preprocessing import** StandardScaler **import numpy as np**

*# Assuming X\_train\_processed, y\_train, test\_X, and test\_y are properly defined # Split data into training and test sets*

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Preprocess training data*

scaler = StandardScaler()

X\_train\_processed = scaler.fit\_transform(X\_train)

*# Preprocess test data*

X\_test\_processed = scaler.transform(X\_test)

*# Initialize and fit Decision Tree classifier*

dt\_classifier = DecisionTreeClassifier(max\_depth=best\_max\_depth) dt\_classifier.fit(X\_train\_processed, y\_train.astype(int))

*# Predict on test set and calculate F1 score*

dt\_y\_pred = dt\_classifier.predict(X\_test\_processed)

dt\_f1 = f1\_score(y\_test.astype(int), dt\_y\_pred, average='micro')

print("F1 Score for Decision Tree:", dt\_f1)

F1 Score for Decision Tree: 1.0

/home/jupyterlab/conda/envs/python/lib/python3.7/site- packages/sklearn/tree/tree.py:149: DeprecationWarning: `np.int` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify any behavior and is safe. When replacing `np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precision. If you wish to review your current use, check the release note link for additional information.

Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations

SVM

[119]: **from sklearn.svm import** SVC

**from sklearn.metrics import** f1\_score

**from sklearn.model\_selection import** train\_test\_split

**from sklearn.preprocessing import** StandardScaler

*# Assuming X\_train\_processed, y\_train, X\_test\_processed, and y\_test are*␣

↪*properly defined*

*# Split data into training and test sets*

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size=0.2,␣

↪random\_state=42)

*# Preprocess training data*

scaler = StandardScaler()

X\_train\_processed = scaler.fit\_transform(X\_train)

*# Preprocess test data*

X\_test\_processed = scaler.transform(X\_test)

*# Define the best value for C obtained from hyperparameter tuning*

best\_C = 1.0

*# Initialize and fit SVM classifier* svm\_classifier = SVC(C=best\_C) svm\_classifier.fit(X\_train\_processed, y\_train)

*# Predict on test set and calculate F1 score*

svm\_y\_pred = svm\_classifier.predict(X\_test\_processed)

svm\_f1 = f1\_score(y\_test, svm\_y\_pred, average='micro')

print("F1 Score for SVM:", svm\_f1)

[121]:

F1 Score for SVM: 0.75

Logistic Regression

**from sklearn.linear\_model import** LogisticRegression

**from sklearn.metrics import** f1\_score

**from sklearn.model\_selection import** train\_test\_split

**from sklearn.preprocessing import** StandardScaler

*# Split data into training and test sets*

X, test\_X, y, test\_y = train\_test\_split(X, y, test\_size=0.2, random\_state=42)

*# Preprocess training data*

scaler = StandardScaler()

X\_train\_processed = scaler.fit\_transform(X)

*# Preprocess test data*

test\_X\_processed = scaler.transform(test\_X)

*# Fit Logistic Regression classifier*

logreg\_classifier = LogisticRegression(max\_iter=1000, solver='liblinear',␣

↪multi\_class='ovr')

logreg\_classifier.fit(X\_train\_processed, y)

logreg\_y\_pred = logreg\_classifier.predict(test\_X\_processed) logreg\_f1 = f1\_score(test\_y, logreg\_y\_pred, average='micro')

# Report

You should be able to report the accuracy of the built model using different evaluation metrics:

Algorithm Accuracy Jaccard F1-score LogLoss

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| KNN | ? | ? | ? | NA |
| Decision Tree | ? | ? | ? | NA |
| SVM | ? | ? | ? | NA |
| LogisticRegression | ? | ? | ? | ? |

Something to keep in mind when creating models to predict the results of basketball tournaments or sports in general is that is quite hard due to so many factors influencing the game. Even in sports betting an accuracy of 55% and over is considered good as it indicates profits.

Want to learn more?

IBM SPSS Modeler is a comprehensive analytics platform that has many machine learning algo-

rithms. It has been designed to bring predictive intelligence to decisions made by individuals, by groups, by systems – by your enterprise as a whole. A free trial is available through this course, available here: SPSS Modeler

Also, you can use Watson Studio to run these notebooks faster with bigger datasets. Watson Studio is IBM’s leading cloud solution for data scientists, built by data scientists. With Jupyter notebooks, RStudio, Apache Spark and popular libraries pre-packaged in the cloud, Watson Studio enables data scientists to collaborate on their projects without having to install anything. Join the fast-growing community of Watson Studio users today with a free account at Watson Studio

**10.0.1 Thank you for completing this lab!**

* 1. **Author**

Saeed Aghabozorgi

### 10.1.1 Other Contributors

Joseph Santarcangelo

## Change Log

Date (YYYY-MM-DD) Version Changed By Change Description

|  |  |  |  |
| --- | --- | --- | --- |
| 2021-04-03 | 2.1 | Malika Singla | Updated the Report accuracy |
| 2020-08-27 | 2.0 | Lavanya | Moved lab to course repo in GitLab |

##

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