PROJECT: RAINFALL PREDICTION ON WEATHER DATASET

IMPORTING NEEDED LIBRARIES

```
# Importing Libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
```

UPLOADING THE DATASET

```
# Uploading The Dataset
df = pd.read_csv("/content/weatherAUS.csv")
df.head()
```

```
         Date Location  MinTemp  MaxTemp  Rainfall  Evaporation
Sunshine  \
0  2008-12-01   Albury     13.4     22.9       0.6          NaN
NaN
1  2008-12-02   Albury      7.4     25.1       0.0          NaN
NaN
2  2008-12-03   Albury     12.9     25.7       0.0          NaN
NaN
3  2008-12-04   Albury      9.2     28.0       0.0          NaN
NaN
4  2008-12-05   Albury     17.5     32.3       1.0          NaN
NaN

  WindGustDir  WindGustSpeed WindDir9am  ... Humidity3pm  Pressure9am
\
0           W           44.0          W  ...        22.0       1007.7

1         WNW           44.0        NNW  ...        25.0       1010.6

2         WSW           46.0          W  ...        30.0       1007.6

3          NE           24.0         SE  ...        16.0       1017.6

4           W           41.0        ENE  ...        33.0       1010.8


   Pressure3pm  Cloud9am  Cloud3pm  Temp9am  Temp3pm  RainToday
RISK_MM  \
0       1007.1       8.0       NaN     16.9     21.8         No
0.0
1       1007.8       NaN       NaN     17.2     24.3         No
0.0
```

```
2       1008.7       NaN       2.0     21.0     23.2          No
0.0
3       1012.8       NaN       NaN     18.1     26.5          No
1.0
4       1006.0       7.0       8.0     17.8     29.7          No
0.2

   RainTomorrow
0            No
1            No
2            No
3            No
4            No

[5 rows x 24 columns]
```

DATA PREPROCESSING

```
# Finding the Statistical Measures of the Dataset
df.describe()
```

```
             MinTemp        MaxTemp       Rainfall   Evaporation  \
count  141556.000000  141871.000000  140787.000000  81350.000000
mean       12.186400      23.226784       2.349974      5.469824
std         6.403283       7.117618       8.465173      4.188537
min        -8.500000      -4.800000       0.000000      0.000000
25%         7.600000      17.900000       0.000000      2.600000
50%        12.000000      22.600000       0.000000      4.800000
75%        16.800000      28.200000       0.800000      7.400000
max        33.900000      48.100000     371.000000    145.000000

           Sunshine  WindGustSpeed   WindSpeed9am   WindSpeed3pm  \
count  74377.000000  132923.000000  140845.000000  139563.000000
mean       7.624853      39.984292      14.001988      18.637576
std        3.781525      13.588801       8.893337       8.803345
min        0.000000       6.000000       0.000000       0.000000
25%        4.900000      31.000000       7.000000      13.000000
50%        8.500000      39.000000      13.000000      19.000000
75%       10.600000      48.000000      19.000000      24.000000
max       14.500000     135.000000     130.000000      87.000000

         Humidity9am    Humidity3pm    Pressure9am    Pressure3pm  \
count  140419.000000  138583.000000  128179.000000  128212.000000
mean       68.843810      51.482606    1017.653758    1015.258204
std        19.051293      20.797772       7.105476       7.036677
min         0.000000       0.000000     980.500000     977.100000
25%        57.000000      37.000000    1012.900000    1010.400000
50%        70.000000      52.000000    1017.600000    1015.200000
75%        83.000000      66.000000    1022.400000    1020.000000
max       100.000000     100.000000    1041.000000    1039.600000
```

```
           Cloud9am      Cloud3pm         Temp9am         Temp3pm
RISK_MM
count  88536.000000  85099.000000  141289.000000  139467.000000
142193.000000
mean       4.437189      4.503167      16.987509      21.687235
2.360682
std        2.887016      2.720633       6.492838       6.937594
8.477969
min        0.000000      0.000000      -7.200000      -5.400000
0.000000
25%        1.000000      2.000000      12.300000      16.600000
0.000000
50%        5.000000      5.000000      16.700000      21.100000
0.000000
75%        7.000000      7.000000      21.600000      26.400000
0.800000
max        9.000000      9.000000      40.200000      46.700000
371.000000
```

```
# Checking the Dimention of the Dataset
df.shape
```

```
(142193, 24)
```

```
# Checking the Data type of the Dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 142193 entries, 0 to 142192
Data columns (total 24 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   Date           142193 non-null  object
 1   Location       142193 non-null  object
 2   MinTemp        141556 non-null  float64
 3   MaxTemp        141871 non-null  float64
 4   Rainfall       140787 non-null  float64
 5   Evaporation    81350 non-null   float64
 6   Sunshine       74377 non-null   float64
 7   WindGustDir    132863 non-null  object
 8   WindGustSpeed  132923 non-null  float64
 9   WindDir9am     132180 non-null  object
 10  WindDir3pm     138415 non-null  object
 11  WindSpeed9am   140845 non-null  float64
 12  WindSpeed3pm   139563 non-null  float64
 13  Humidity9am    140419 non-null  float64
 14  Humidity3pm    138583 non-null  float64
 15  Pressure9am    128179 non-null  float64
 16  Pressure3pm    128212 non-null  float64
```

```
 17  Cloud9am       88536 non-null   float64
 18  Cloud3pm       85099 non-null   float64
 19  Temp9am        141289 non-null  float64
 20  Temp3pm        139467 non-null  float64
 21  RainToday      140787 non-null  object
 22  RISK_MM        142193 non-null  float64
 23  RainTomorrow   142193 non-null  object
dtypes: float64(17), object(7)
memory usage: 26.0+ MB
```

```
# Dropping the Less Important Features from the Dataset
df = df.drop(["Evaporation", "Sunshine", "Cloud9am", "Cloud3pm",
"Location", "Date"], axis=1)
df.head()
```

```
   MinTemp  MaxTemp  Rainfall WindGustDir  WindGustSpeed WindDir9am  \
0     13.4     22.9       0.6           W           44.0          W
1      7.4     25.1       0.0         WNW           44.0        NNW
2     12.9     25.7       0.0         WSW           46.0          W
3      9.2     28.0       0.0          NE           24.0         SE
4     17.5     32.3       1.0           W           41.0        ENE

  WindDir3pm  WindSpeed9am  WindSpeed3pm  Humidity9am  Humidity3pm  \
0        WNW          20.0          24.0         71.0         22.0
1        WSW           4.0          22.0         44.0         25.0
2        WSW          19.0          26.0         38.0         30.0
3          E          11.0           9.0         45.0         16.0
4         NW           7.0          20.0         82.0         33.0

   Pressure9am  Pressure3pm  Temp9am  Temp3pm RainToday  RISK_MM
RainTomorrow
0       1007.7       1007.1     16.9     21.8        No      0.0
No
1       1010.6       1007.8     17.2     24.3        No      0.0
No
2       1007.6       1008.7     21.0     23.2        No      0.0
No
3       1017.6       1012.8     18.1     26.5        No      1.0
No
4       1010.8       1006.0     17.8     29.7        No      0.2
No
```

```
# Removing rows from the Dataset that contains missing values (NaN).
df = df.dropna(axis = 0)
df.shape
```

```
(112925, 18)
```

```
# Printing All the Columns from the Dataset
df.columns
```

```
Index(['MinTemp', 'MaxTemp', 'Rainfall', 'WindGustDir',
'WindGustSpeed',
       'WindDir9am', 'WindDir3pm', 'WindSpeed9am', 'WindSpeed3pm',
       'Humidity9am', 'Humidity3pm', 'Pressure9am', 'Pressure3pm',
'Temp9am',
       'Temp3pm', 'RainToday', 'RISK_MM', 'RainTomorrow'],
      dtype='object')
```

LABEL ENCODING

```
# Using Label Encoding to change the Categorical Values to Numerical
Values
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df["WindGustDir"] = le.fit_transform(df["WindGustDir"])
df["WindDir9am"] = le.fit_transform(df["WindDir9am"])
df["WindDir3pm"] = le.fit_transform(df["WindDir3pm"])
df["RainToday"] = le.fit_transform(df["RainToday"])
df["RainTomorrow"] = le.fit_transform(df["RainTomorrow"])

# Dropping the column "RainTomorrow" from the Dataset and storing that
to new variable called "Y"
X = df.drop(['RainTomorrow'], axis = 1)
Y = df['RainTomorrow']

X.head()
```

	MinTemp	MaxTemp	Rainfall	WindGustDir	WindGustSpeed	WindDir9am
0	13.4	22.9	0.6	13	44.0	13
1	7.4	25.1	0.0	14	44.0	6
2	12.9	25.7	0.0	15	46.0	13
3	9.2	28.0	0.0	4	24.0	9
4	17.5	32.3	1.0	13	41.0	1

	WindDir3pm	WindSpeed9am	WindSpeed3pm	Humidity9am	Humidity3pm
0	14	20.0	24.0	71.0	22.0
1	15	4.0	22.0	44.0	25.0
2	15	19.0	26.0	38.0	30.0
3	0	11.0	9.0	45.0	16.0
4	7	7.0	20.0	82.0	33.0

	Pressure9am	Pressure3pm	Temp9am	Temp3pm	RainToday	RISK_MM
0	1007.7	1007.1	16.9	21.8	0	0.0
1	1010.6	1007.8	17.2	24.3	0	0.0

```
2       1007.6       1008.7     21.0     23.2          0      0.0
3       1017.6       1012.8     18.1     26.5          0      1.0
4       1010.8       1006.0     17.8     29.7          0      0.2
```

DATA STANDARDIZATION

```
#This Method Computes the Mean and Standard Deviation of each feature
in 'X' and then
# Performs Standardization by Centering and Scaling the features.
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit_transform(X)
```

```
array([[ 0.11756741, -0.10822071, -0.20666127, ..., -0.04787026,
        -0.53828059, -0.27310246],
       [-0.84180219,  0.20684494, -0.27640495, ...,  0.31776848,
        -0.53828059, -0.27310246],
       [ 0.03761995,  0.29277194, -0.27640495, ...,  0.15688743,
        -0.53828059, -0.27310246],
       ...,
       [-1.44940294,  0.23548728, -0.27640495, ...,  0.34701958,
        -0.53828059, -0.27310246],
       [-1.16159206,  0.46462594, -0.27640495, ...,  0.58102838,
        -0.53828059, -0.27310246],
       [-0.77784422,  0.4789471 , -0.27640495, ...,  0.56640283,
        -0.53828059, -0.27310246]])
```

```
standardized_data = X
X = standardized_data
Y = df['RainTomorrow']

print(X)
print(Y)
```

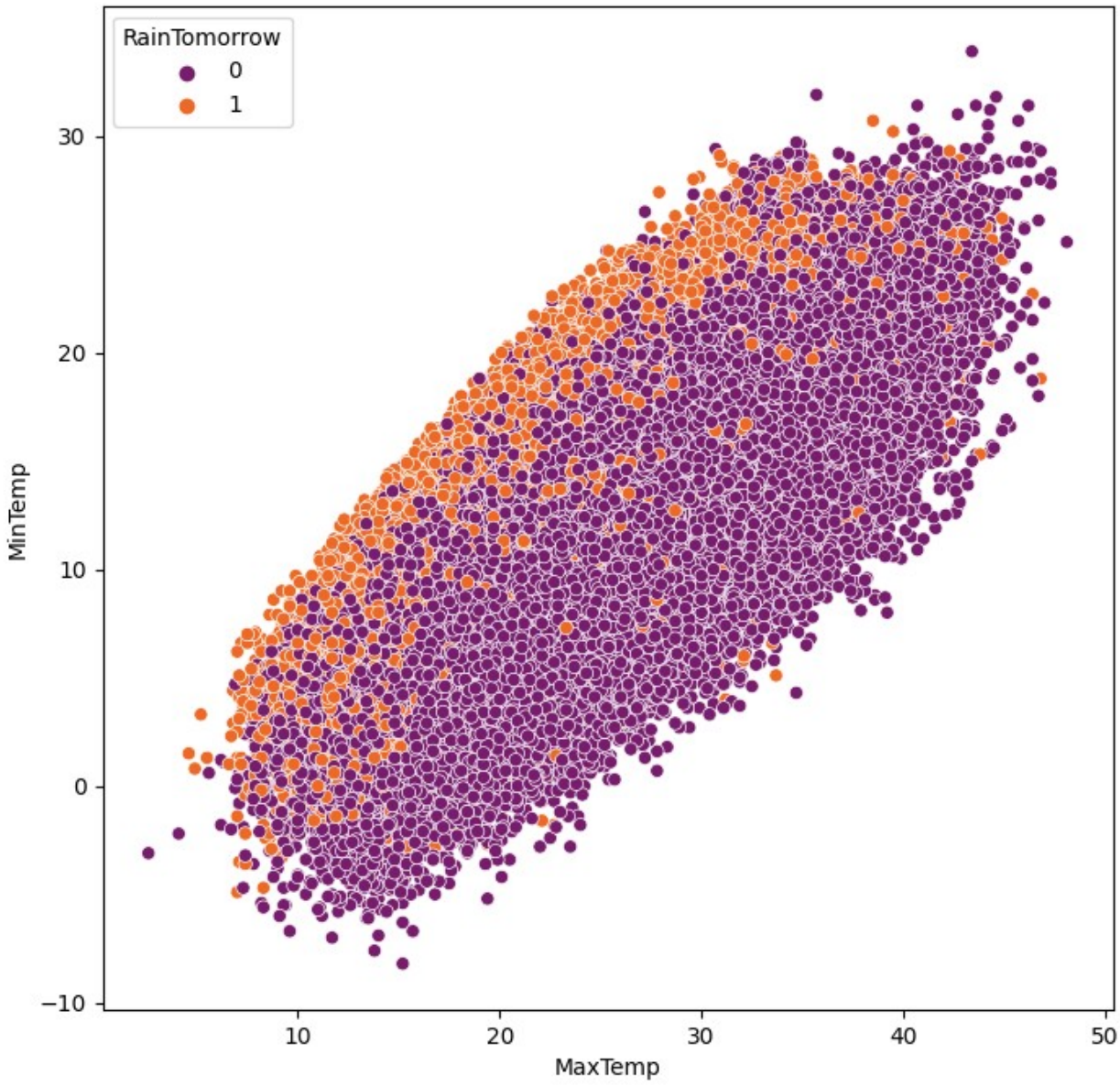
```
        MinTemp  MaxTemp  Rainfall  WindGustDir  WindGustSpeed
WindDir9am  \
0          13.4     22.9       0.6           13           44.0
13
1           7.4     25.1       0.0           14           44.0
6
2          12.9     25.7       0.0           15           46.0
13
3           9.2     28.0       0.0            4           24.0
9
4          17.5     32.3       1.0           13           41.0
1
...         ...      ...       ...          ...            ...
...
142188      3.5     21.8       0.0            0           31.0
2
```

```
142189      2.8     23.4       0.0            0           31.0
9
142190      3.6     25.3       0.0            6           22.0
9
142191      5.4     26.9       0.0            3           37.0
9
142192      7.8     27.0       0.0            9           28.0
10

        WindDir3pm  WindSpeed9am  WindSpeed3pm  Humidity9am
Humidity3pm  \
0               14          20.0          24.0         71.0
22.0
1               15           4.0          22.0         44.0
25.0
2               15          19.0          26.0         38.0
30.0
3                0          11.0           9.0         45.0
16.0
4                7           7.0          20.0         82.0
33.0
...            ...           ...           ...          ...          .
..
142188           0          15.0          13.0         59.0
27.0
142189           1          13.0          11.0         51.0
24.0
142190           3          13.0           9.0         56.0
21.0
142191          14           9.0           9.0         53.0
24.0
142192           3          13.0           7.0         51.0
24.0

        Pressure9am  Pressure3pm  Temp9am  Temp3pm  RainToday  RISK_MM

0            1007.7       1007.1     16.9     21.8          0      0.0

1            1010.6       1007.8     17.2     24.3          0      0.0

2            1007.6       1008.7     21.0     23.2          0      0.0

3            1017.6       1012.8     18.1     26.5          0      1.0

4            1010.8       1006.0     17.8     29.7          0      0.2

...             ...          ...      ...      ...        ...      ...

142188       1024.7       1021.2      9.4     20.9          0      0.0
```

```
142189       1024.6       1020.3     10.1     22.4           0       0.0

142190       1023.5       1019.1     10.9     24.5           0       0.0

142191       1021.0       1016.8     12.5     26.1           0       0.0

142192       1019.4       1016.5     15.1     26.0           0       0.0


[112925 rows x 17 columns]
0         0
1         0
2         0
3         0
4         0
         ..
142188    0
142189    0
142190    0
142191    0
142192    0
Name: RainTomorrow, Length: 112925, dtype: int64
```

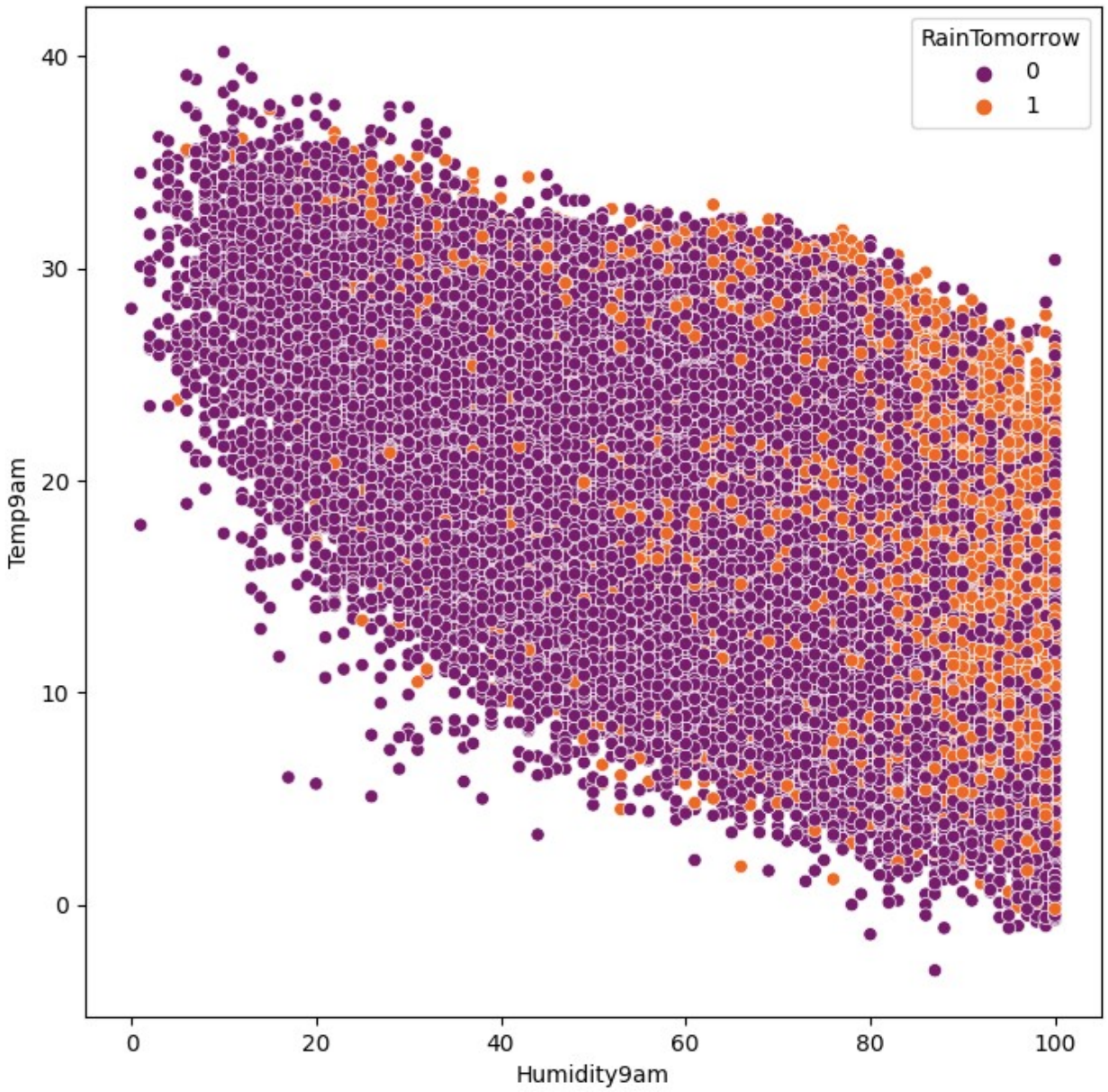
DATA VISUALIZATION

```
# Displaying the prediction, whether it will rain tomorrow or not
through Scatter Plot, considering "MaxTemp" and "MinTemp".
plt.figure(figsize = (8,8))
sns.scatterplot(x = 'MaxTemp', y = 'MinTemp', hue = 'RainTomorrow',
palette = 'inferno', data = df)

<Axes: xlabel='MaxTemp', ylabel='MinTemp'>
```



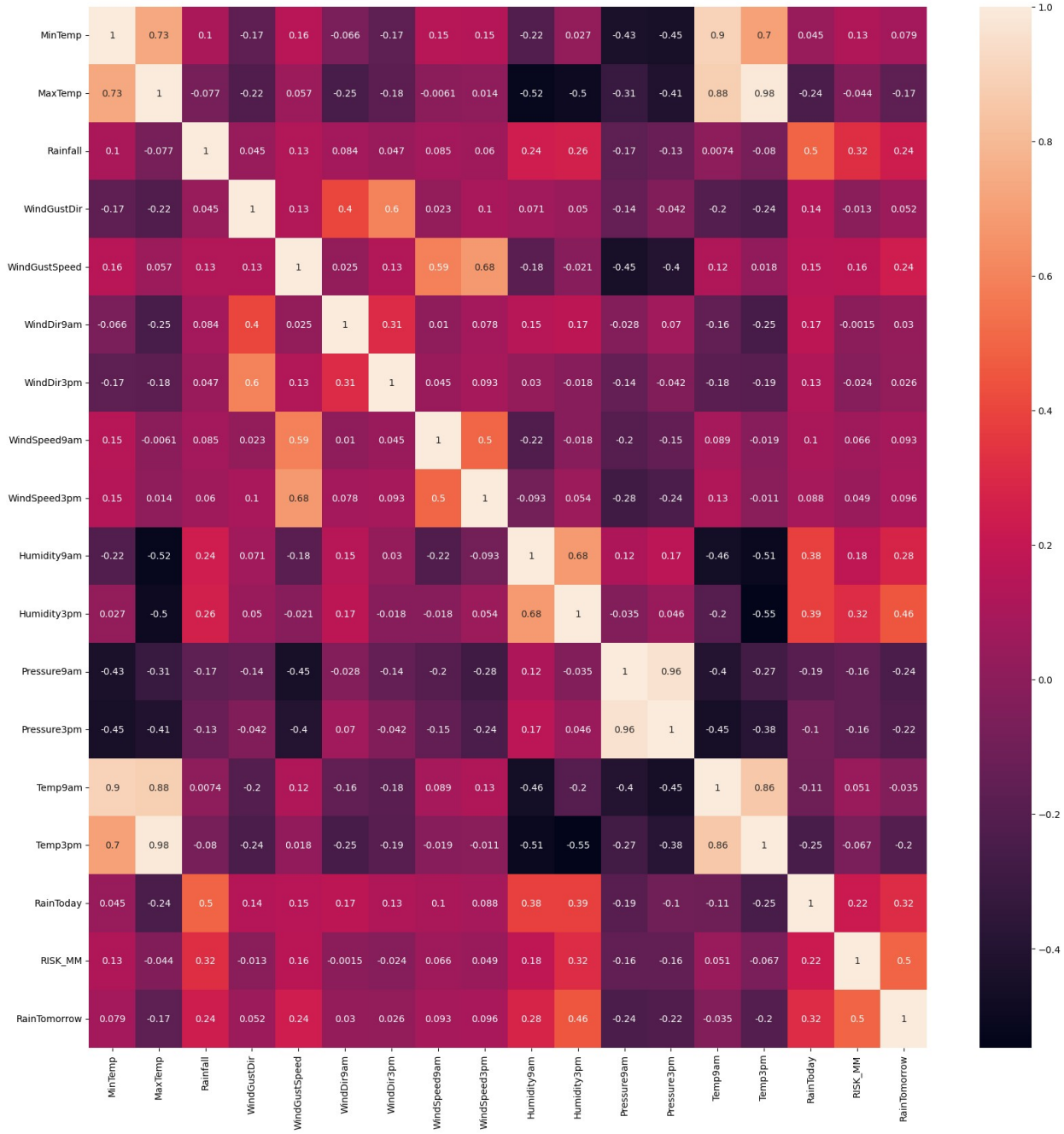

```
# Displaying the prediction, whether it will rain tomorrow or not
through Scatter Plot, considering "Humidity9am" and "Temp9am".
plt.figure(figsize = (8,8))
sns.scatterplot(x = 'Humidity9am', y = 'Temp9am', hue =
'RainTomorrow', palette = 'inferno', data = df)
```

```
<Axes: xlabel='Humidity9am', ylabel='Temp9am'>
```



HEATMAP

```
# Displaying the Correlations among dataset through Heatmap, to
compute the pairwise correlation between its columns.
corrmat = df.corr()
plt.figure(figsize=(20,20))
g=sns.heatmap(corrmat, annot=True)
```



TRAIN-TEST-SPLIT

```
# Splitting the Dataset into Training and Testing Dataset
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
test_size=0.2, random_state=0)

from sklearn.metrics import classification_report, confusion_matrix,
accuracy_score
```

DECISION TREE

```
# Taining the Model
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
model_1 = DecisionTreeClassifier()
model_1.fit(X_train, Y_train)

DecisionTreeClassifier()

# Finding the Accuracy score of Training Data
X_train_prediction = model_1.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)

# Finding the Accuracy Score of Testing Data

X_test_prediction = model_1.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)

# Printing the Confusion Matrix, Classification Report, and Accuray
Score
print('Matrix', confusion_matrix(Y_test, X_test_prediction))
print('f1', classification_report(Y_test, X_test_prediction))
print('Accuracy', accuracy_score(Y_test, X_test_prediction))

Matrix [[17650     0]
 [    0  4935]]
f1               precision    recall  f1-score   support

           0       1.00      1.00      1.00     17650
           1       1.00      1.00      1.00      4935

    accuracy                           1.00     22585
   macro avg       1.00      1.00      1.00     22585
weighted avg       1.00      1.00      1.00     22585

Accuracy 1.0

# Printing the Accuracy of Training Data and Test Data.
print('Accuracy on Training Data : ', training_data_accuracy)
print('Accuracy on Test Data : ', test_data_accuracy)

Accuracy on Training Data :  1.0
Accuracy on Test Data :  1.0
```

ARTIFICIAL NEURAL NETWORK

```
# Training the Model
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
```

```
model_2 = MLPClassifier()
model_2.fit(X_train, Y_train)
```

```
MLPClassifier()
```

```
# Finding the Accuracy score of Training Data
X_train_prediction = model_1.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)

# Finding the Accuracy Score of Testing Data

X_test_prediction = model_1.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)

# Printing the Confusion Matrix, Classification Report, and Accuray
Score
print('Matrix', confusion_matrix(Y_test, X_test_prediction))
print('f1', classification_report(Y_test, X_test_prediction))
print('Accuracy', accuracy_score(Y_test, X_test_prediction))
```

```
Matrix [[17650     0]
 [    0  4935]]
f1               precision    recall  f1-score   support

           0       1.00      1.00      1.00     17650
           1       1.00      1.00      1.00      4935

    accuracy                           1.00     22585
   macro avg       1.00      1.00      1.00     22585
weighted avg       1.00      1.00      1.00     22585
```

```
Accuracy 1.0
```

```
# Printing the Accuracy of Training Data and Test Data.
print('Accuracy on Training Data : ', training_data_accuracy)
print('Accuracy on Test Data : ' , accuracy_score(Y_test,
X_test_prediction))
```

```
Accuracy on Training Data :  1.0
Accuracy on Test Data :  1.0
```

RANDOM FOREST CLASSIFIER

```
# Training the Model
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
model_3 = DecisionTreeClassifier()
model_3.fit(X_train, Y_train)
```

```
DecisionTreeClassifier()
```

```
# Finding the Accuracy score of Training Data
X_train_prediction = model_1.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)

# Finding the Accuracy Score of Testing Data

X_test_prediction = model_1.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)

# Printing the Confusion Matrix, Classification Report, and Accuray
Score
print('Matrix', confusion_matrix(Y_test, X_test_prediction))
print('f1', classification_report(Y_test, X_test_prediction))
print('Accuracy', accuracy_score(Y_test, X_test_prediction))
```

```
Matrix [[17650     0]
 [    0  4935]]
f1               precision    recall  f1-score   support

           0       1.00      1.00      1.00     17650
           1       1.00      1.00      1.00      4935

    accuracy                           1.00     22585
   macro avg       1.00      1.00      1.00     22585
weighted avg       1.00      1.00      1.00     22585

Accuracy 1.0
```

```
# Printing the Accuracy of Training Data and Test Data.
print('Accuracy on Training Data : ', training_data_accuracy)
print('Accuracy on Test Data : ' , accuracy_score(Y_test,
X_test_prediction))
```

```
Accuracy on Training Data :  1.0
Accuracy on Test Data :  1.0
```

XGBOOST CLASSIFIER

```
# Training the Model
import xgboost as xgb
from sklearn.metrics import accuracy_score
xgb = xgb.XGBClassifier()
xgb.fit(X_train, Y_train)

XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None,
feature_types=None,
              gamma=None, gpu_id=None, grow_policy=None,
importance_type=None,
```

```
              interaction_constraints=None, learning_rate=None,
max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan,
monotone_constraints=None,
              n_estimators=100, n_jobs=None, num_parallel_tree=None,
              predictor=None, random_state=None, ...)

# Finding the Accuracy score of Training Data
X_train_prediction = model_1.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)

# Finding the Accuracy Score of Testing Data

X_test_prediction = model_1.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)

# Printing the Confusion Matrix, Classification Report, and Accuray
Score
print('Matrix', confusion_matrix(Y_test, X_test_prediction))
print('f1', classification_report(Y_test, X_test_prediction))
print('Accuracy', accuracy_score(Y_test, X_test_prediction))

Matrix [[17650     0]
 [    0  4935]]
f1               precision    recall  f1-score   support

           0       1.00      1.00      1.00     17650
           1       1.00      1.00      1.00      4935

    accuracy                           1.00     22585
   macro avg       1.00      1.00      1.00     22585
weighted avg       1.00      1.00      1.00     22585

Accuracy 1.0

# Printing the Accuracy of Training Data and Test Data.
print('Accuracy on Training Data : ', training_data_accuracy)
print('Accuracy on Test Data : ' , accuracy_score(Y_test,
X_test_prediction))

Accuracy on Training Data :  1.0
Accuracy on Test Data :  1.0
```

BUILDING A PREDICTIVE MODEL

```
input_data =
(12.9,25.7,0.0,15,46.0,13,15,19.0,26.0,38.0,30.0,1007.6,1008.7,21.0,23
.2,0,0.0)
```

```
# Changing the input data to numpy array
input_data_as_numpy_array = np.asarray(input_data)

# Reshape the array as we are predicting for one instance
input_data_reshaped = input_data_as_numpy_array.reshape(1, -1)


# Standardize the input data
std_data = scaler.transform(input_data_reshaped)
print(std_data)

prediction = xgb.predict(std_data)
print(prediction)

if (prediction[0]==0):
    print("It will not rain Tomorrow")
else:
    print("It will rain Tomorrow")
```

```
[[ 0.03761995  0.29277194 -0.27640495  1.55770511  0.39134523
1.26635166
   1.56864841  0.45789965  0.75750703 -1.55482757 -0.99521374 -
1.39718102
  -0.91249673  0.55672435  0.15688743 -0.53828059 -0.27310246]]
[0]
It will not rain Tomorrow
```