Weather Prediction Project

Sections required in your report:

- Main objective of the project that specifies whether your model will be focused on a specific type of Deep Learning or Reinforcement Learning algorithm and the benefits that your analysis brings to the business or stakeholders of the dataset
- Data description: Describe the dataset you are working with, including the source of the data and how it was obtained with the dataset
- Summary of exploratory data analysis and process steps for data cleaning or feature engineering
- Summary of training at least three variations of the Deep Learning model you selected. For example, you can use different scaling techniques or different hyperparameters
- A paragraph explaining which of your Deep Learning models you recommend as a final model that best fits your needs in terms of accuracy and explainability
- Business Key Findings and Insights: which works your reader through the main findings of your modeling exercise
- Next steps: describe what you would do if you had more time to improve the model, suggesting a strategy for more or better quality of data features to achieve a better model.

Objective

The model will be using Deep Learning and Machine Learning models

The project aims to bring a forecast which can be helpful in regards on the flight traffic can be handled smoothly.

Data Description

The dataset is weather records taken in Madrid (1997-2015) on a Barajas Airport. It contains all 365 in case year 22 columns. The data is provided by The Aemet Company.

The dataset includes temperature, dew points, humidity, sea level pressure, visibility, wind speeds, precipitation (much snow, sparse and snow) and events.

We will be using this dataset to predict what weather event (Rain or Snow).

Feature 1	Feature 2	Feature 3
Max Temperature	Mean Temperature	Min Temperature
Max Dew Point	Mean Dew Point	Min Dew Point
Max Humidity	Mean Humidity	Min Humidity
Max Sea Level Pressure(In)	Mean Sea Level Pressure(In)	Min Sea Level Pressure(In)
Max Visibility(Miles)	Mean Visibility(Miles)	Min Visibility(Miles)
Max Wind Speed(Mph)	Mean Wind Speed(Mph)	Max Gust Speed(Mph)
Precipitation(In)		
Cloud Cover		
Events		
WindDirDegrees		

Summary of data exploration, data cleaning and feature engineering

- Rest of the attributes are numerical (float64)
- Events are categorical (has data type object)
- Rain Events are almost twice of Snow Events
- Rain Events are spread across the year while Snow Events occurs across independent variables
- We drop attributes having no or very sparse data
- Drop Events column as it is the target variable
- Dropped highly correlated variables based on corr()
- Convert date from string to datetime

Import Libraries

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt

%matplotlib inline
%matplotlib inline
%matplotlib inline

from pandas_profiling.profile import ProfileReport

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, MinMaxScaler, LabelEncoder
from sklearn.utils.class_weight import compute_class_weight

from tensorflow.keras.models import Sequential, load_model
from tensorflow.keras.layers import Dense, Dropout, Input, Conv1D, MaxPool1D, GlobalMaxPool1D, BatchNormalization
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau, ModelCheckpoint
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.optimizers import Adam, SGD, RMSprop
from tensorflow.keras.metrics import CategoricalCrossentropy, Recall, Precision, AUC, TruePositives, FalsePositives, TrueNegatives, FalseNegatives
from tensorflow.keras.regularizers import l1, l2, l1_l2
from tensorflow.keras.models import keras_tuner, HyperModel, RandomSearch, BayesianOptimization, Hyperband

from sklearn.metrics import confusion_matrix, classification_report, roc_curve, roc_auc_score, f1_score, precision_score, recall_score

%matplotlib inline
%matplotlib inline
%matplotlib inline
%matplotlib inline
%matplotlib inline
%matplotlib inline

from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Exploratory Data Analysis

```
In [1]: df = pd.read_csv('/content/drive/MyDrive/CSV/Madrid.csv')
```

```
In [2]: df.shape
```

```
(365,23)
```

```
In [3]: df.info()
```

```
<class 'DataFrame'>
RangeIndex: 365 entries, 0 to 364
Data columns (total 23 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   Date                     365 non-Null    int64
 1   Max Temperature          365 non-Null    int64
 2   Mean Temperature         365 non-Null    int64
 3   Min Temperature          365 non-Null    int64
 4   Max Dew Point            365 non-Null    int64
 5   Mean Dew Point           365 non-Null    int64
 6   Min Dew Point            365 non-Null    int64
 7   Max Humidity             365 non-Null    int64
 8   Mean Humidity            365 non-Null    int64
 9   Min Humidity             365 non-Null    int64
 10  Max Sea Level Pressure(In) 365 non-Null  float64
 11  Mean Sea Level Pressure(In) 365 non-Null float64
 12  Min Sea Level Pressure(In) 365 non-Null  float64
 13  Max Visibility(Miles)    365 non-Null    int64
 14  Mean Visibility(Miles)   365 non-Null    int64
 15  Min Visibility(Miles)    365 non-Null    int64
 16  Max Wind Speed(Mph)      365 non-Null    int64
 17  Mean Wind Speed(Mph)     365 non-Null    int64
 18  Max Gust Speed(Mph)      365 non-Null    int64
 19  Precipitation(In)        365 non-Null    int64
 20  Cloud Cover              365 non-Null    int64
 21  Events                   365 non-Null    object
 22  WindDirDegrees           365 non-Null    int64
dtypes: float64(3), int64(19), object(1)
memory usage: 65.6+ KB
```

```
In [4]: df.head()
```

	Date	Max Temperature	Mean Temperature	Min Temperature	Max Dew Point	Mean Dew Point	Min Dew Point	Max Humidity	Mean Humidity	Min Humidity	Max Sea Level Pressure(In)	Mean Sea Level Pressure(In)	Min Sea Level Pressure(In)	Max Visibility(Miles)	Mean Visibility(Miles)	Min Visibility(Miles)	Max Wind Speed(Mph)	Mean Wind Speed(Mph)	Max Gust Speed(Mph)	Precipitation(In)	Cloud Cover	Events	WindDirDegrees
0	1	6	3	1	4	1	-2	93	76	59	30.62	30.39	30.16	10	7	3	19	9	29	0.00	6	Rain	166
1	2	7	4	1	4	1	-2	93	76	59	30.71	30.47	30.23	10	7	3	19	9	29	0.00	6	Rain	167
2	3	7	4	1	4	1	-2	93	76	59	30.80	30.55	30.30	10	7	3	19	9	29	0.00	6	Rain	168
3	4	7	4	1	4	1	-2	93	76	59	30.89	30.63	30.37	10	7	3	19	9	29	0.00	6	Rain	169
4	5	7	4	1	4	1	-2	93	76	59	30.98	30.71	30.44	10	7	3	19	9	29	0.00	6	Rain	170

365 rows × 23 columns

```
In [5]: df.describe()
```

	Date	Max Temperature	Mean Temperature	Min Temperature	Max Dew Point	Mean Dew Point	Min Dew Point	Max Humidity	Mean Humidity	Min Humidity	Max Sea Level Pressure(In)	Mean Sea Level Pressure(In)	Min Sea Level Pressure(In)	Max Visibility(Miles)	Mean Visibility(Miles)	Min Visibility(Miles)	Max Wind Speed(Mph)	Mean Wind Speed(Mph)	Max Gust Speed(Mph)	Precipitation(In)	Cloud Cover	WindDirDegrees
count	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000
mean	183.000000	17.000000	12.000000	7.000000	10.000000	7.000000	3.000000	82.000000	69.000000	55.000000	30.000000	29.800000	29.600000	10.000000	8.000000	6.000000	24.000000	13.000000	40.000000	0.100000	4.000000	174.000000
std	105.507109	7.000000	6.000000	6.000000	6.000000	6.000000	6.000000	7.000000	7.000000	8.000000	0.200000	0.200000	0.200000	0.000000	1.000000	3.000000	5.000000	3.000000	7.000000	0.300000	2.000000	5.000000
min	1.000000	3.000000	-1.000000	-5.000000	1.000000	-2.000000	-8.000000	43.000000	31.000000	16.000000	29.370000	29.140000	28.900000	10.000000	6.000000	1.000000	9.000000	4.000000	19.000000	0.000000	0.000000	162.000000
25%	92.000000	12.000000	8.000000	3.000000	5.000000	3.000000	-1.000000	78.000000	65.000000	51.000000	30.000000	29.800000	29.600000	10.000000	7.000000	3.000000	19.000000	9.000000	34.000000	0.000000	3.000000	170.000000
50%	183.000000	17.000000	12.000000	7.000000	10.000000	7.000000	3.000000	82.000000	69.000000	55.000000	30.000000	29.800000	29.600000	10.000000	8.000000	6.000000	24.000000	13.000000	40.000000	0.000000	4.000000	174.000000
75%	274.000000	22.000000	16.000000	11.000000	15.000000	11.000000	8.000000	87.000000	74.000000	61.000000	30.200000	30.000000	29.800000	10.000000	9.000000	8.000000	28.000000	17.000000	46.000000	0.000000	6.000000	178.000000
max	365.000000	31.000000	24.000000	19.000000	22.000000	19.000000	14.000000	100.000000	100.000000	100.000000	30.730000	30.500000	30.270000	10.000000	10.000000	10.000000	41.000000	24.000000	75.000000	1.000000	6.000000	187.000000

```
In [6]: df.columns
```

```
Index(['Date', 'Max Temperature', 'Mean Temperature', 'Min Temperature',
       'Max Dew Point', 'Mean Dew Point', 'Min Dew Point', 'Max Humidity',
       'Mean Humidity', 'Min Humidity', 'Max Sea Level Pressure(In)',
       'Mean Sea Level Pressure(In)', 'Min Sea Level Pressure(In)',
       'Max Visibility(Miles)', 'Mean Visibility(Miles)',
       'Min Visibility(Miles)', 'Max Wind Speed(Mph)', 'Mean Wind Speed(Mph)',
       'Max Gust Speed(Mph)', 'Precipitation(In)', 'Cloud Cover',
       'Events', 'WindDirDegrees'],
      dtype=object)
```

```
In [7]: df.shape
```

```
(365, 23)
```

```
In [8]: df.isnull()
```

	Date	Max Temperature	Mean Temperature	Min Temperature	Max Dew Point	Mean Dew Point	Min Dew Point	Max Humidity	Mean Humidity	Min Humidity	Max Sea Level Pressure(In)	Mean Sea Level Pressure(In)	Min Sea Level Pressure(In)	Max Visibility(Miles)	Mean Visibility(Miles)	Min Visibility(Miles)	Max Wind Speed(Mph)	Mean Wind Speed(Mph)	Max Gust Speed(Mph)	Precipitation(In)	Cloud Cover	Events	WindDirDegrees
0	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False	False

365 rows × 23 columns

```
In [9]: df.isnull().sum()
```

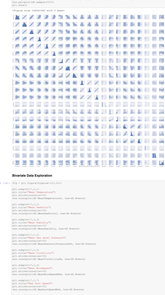
```
Date                         0
Max Temperature              0
Mean Temperature             0
Min Temperature              0
Max Dew Point                0
Mean Dew Point               0
Min Dew Point                0
Max Humidity                 0
Mean Humidity                0
Min Humidity                 0
Max Sea Level Pressure(In)   0
Mean Sea Level Pressure(In)  0
Min Sea Level Pressure(In)   0
Max Visibility(Miles)        0
Mean Visibility(Miles)       0
Min Visibility(Miles)        0
Max Wind Speed(Mph)          0
Mean Wind Speed(Mph)         0
Max Gust Speed(Mph)          0
Precipitation(In)            0
Cloud Cover                  0
Events                       0
WindDirDegrees               0
dtype: int64
```

Data Visualization

```
In [10]: df.hist(figsize=(20,20))
```

Univariate Data Exploration

```
In [11]: px.histogram(df, x='Max Temperature', color='Events', nbins=50, opacity=0.8,
         color_discrete_sequence=px.colors.qualitative.Dark24)
         [OUT:HIDDEN]
```




```
In [12]: px.histogram(df, x='Mean Temperature', color='Events', nbins=50, opacity=0.8,
         color_discrete_sequence=px.colors.qualitative.Dark24)
         [OUT:HIDDEN]
```

```
In [13]: px.histogram(df, x='Min Temperature', color='Events', nbins=50, opacity=0.8,
         color_discrete_sequence=px.colors.qualitative.Dark24)
         [OUT:HIDDEN]
```

```
In [14]: px.bar(df,
                x='Events',
                y='Max Temperature',
                color='Events',
                color_discrete_sequence=px.colors.qualitative.Dark24)
         [OUT:HIDDEN]
```

Pairplots

```
In [15]: px.scatter_matrix(df,
         [OUT:HIDDEN]
         [OUT:HIDDEN]
         [OUT:HIDDEN]
```

```
In [1004]: X_train_prepared = scaler.transform(X_train)
```

```
In [1005]: X_train_prepared
Out[1005]: array([[ 1.38772142, -0.88703241, -1.49496204, ..., -0.48496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., -0.27496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., 0.72503124,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., -0.48496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., -0.48496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., 12.27503124,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., -0.48496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., -0.48496876,
        -0.12126126, -0.12126126],
       [ 1.38772142, -0.88703241, -1.49496204, ..., 0.72503124
```

```
In [47]: pd.DataFrame(model_fit.cv_results_)
```

```
Out[47]:
   mean_fit_time  std_fit_time  mean_score_time  ...
0       0.000000      0.000000         0.000000  ...
1       0.000000      0.000000         0.000000  ...
2       0.000000      0.000000         0.000000  ...
3       0.000000      0.000000         0.000000  ...
4       0.000000      0.000000         0.000000  ...
5       0.000000      0.000000         0.000000  ...
6       0.000000      0.000000         0.000000  ...
7       0.000000      0.000000         0.000000  ...
8       0.000000      0.000000         0.000000  ...
9       0.000000      0.000000         0.000000  ...
10      0.000000      0.000000         0.000000  ...
11      0.000000      0.000000         0.000000  ...
12      0.000000      0.000000         0.000000  ...
13      0.000000      0.000000         0.000000  ...
14      0.000000      0.000000         0.000000  ...
15      0.000000      0.000000         0.000000  ...
16      0.000000      0.000000         0.000000  ...
17      0.000000      0.000000         0.000000  ...
18      0.000000      0.000000         0.000000  ...
19      0.000000      0.000000         0.000000  ...
20      0.000000      0.000000         0.000000  ...
21      0.000000      0.000000         0.000000  ...
22      0.000000      0.000000         0.000000  ...
23      0.000000      0.000000         0.000000  ...
24      0.000000      0.000000         0.000000  ...
25      0.000000      0.000000         0.000000  ...
26      0.000000      0.000000         0.000000  ...
27      0.000000      0.000000         0.000000  ...
28      0.000000      0.000000         0.000000  ...
29      0.000000      0.000000         0.000000  ...
30      0.000000      0.000000         0.000000  ...
31      0.000000      0.000000         0.000000  ...
32      0.000000      0.000000         0.000000  ...
33      0.000000      0.000000         0.000000  ...
34      0.000000      0.000000         0.000000  ...
35      0.000000      0.000000         0.000000  ...
36      0.000000      0.000000         0.000000  ...
37      0.000000      0.000000         0.000000  ...
38      0.000000      0.000000         0.000000  ...
39      0.000000      0.000000         0.000000  ...
40      0.000000      0.000000         0.000000  ...
41      0.000000      0.000000         0.000000  ...
42      0.000000      0.000000         0.000000  ...
43      0.000000      0.000000         0.000000  ...
44      0.000000      0.000000         0.000000  ...
45      0.000000      0.000000         0.000000  ...
46      0.000000      0.000000         0.000000  ...
47      0.000000      0.000000         0.000000  ...
48      0.000000      0.000000         0.000000  ...
49      0.000000      0.000000         0.000000  ...
50      0.000000      0.000000         0.000000  ...
51      0.000000      0.000000         0.000000  ...
52      0.000000      0.000000         0.000000  ...
53      0.000000      0.000000         0.000000  ...
54      0.000000      0.000000         0.000000  ...
55      0.000000      0.000000         0.000000  ...
56      0.000000      0.000000         0.000000  ...
57      0.000000      0.000000         0.000000  ...
58      0.000000      0.000000         0.000000  ...
59      0.000000      0.000000         0.000000  ...
60      0.000000      0.000000         0.000000  ...
61      0.000000      0.000000         0.000000  ...
62      0.000000      0.000000         0.000000  ...
63      0.000000      0.000000         0.000000  ...
64      0.000000      0.000000         0.000000  ...
65      0.000000      0.000000         0.000000  ...
66      0.000000      0.000000         0.000000  ...
67      0.000000      0.000000         0.000000  ...
68      0.000000      0.000000         0.000000  ...
69      0.000000      0.000000         0.000000  ...
70      0.000000      0.000000         0.000000  ...
71      0.000000      0.000000         0.000000  ...
72      0.000000      0.000000         0.000000  ...
73      0.000000      0.000000         0.000000  ...
74      0.000000      0.000000         0.000000  ...
75      0.000000      0.000000         0.000000  ...
76      0.000000      0.000000         0.000000  ...
77      0.000000      0.000000         0.000000  ...
78      0.000000      0.000000         0.000000  ...
79      0.000000      0.000000         0.000000  ...
80      0.000000      0.000000         0.000000  ...
81      0.000000      0.000000         0.000000  ...
82      0.000000      0.000000         0.000000  ...
83      0.000000      0.000000         0.000000  ...
84      0.000000      0.000000         0.000000  ...
85      0.000000      0.000000         0.000000  ...
86      0.000000      0.000000         0.000000  ...
87      0.000000      0.000000         0.000000  ...
88      0.000000      0.000000         0.000000  ...
89      0.000000      0.000000         0.000000  ...
90      0.000000      0.000000         0.000000  ...
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93      0.000000      0.000000         0.000000  ...
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96      0.000000      0.000000         0.000000  ...
97      0.000000      0.000000         0.000000  ...
98      0.000000      0.000000         0.000000  ...
99      0.000000      0.000000         0.000000  ...
100     0.000000      0.000000         0.000000  ...
101     0.000000      0.000000         0.000000  ...
102     0.000000      0.000000         0.000000  ...
103     0.000000      0.000000         0.000000  ...
104     0.000000      0.000000         0.000000  ...
105     0.000000      0.000000         0.000000  ...
106     0.000000      0.000000         0.000000  ...
107     0.000000      0.000000         0.000000  ...
108     0.000000      0.000000         0.000000  ...
109     0.000000      0.000000         0.000000  ...
110     0.000000      0.000000         0.000000  ...
111     0.000000      0.000000         0.000000  ...
112     0.000000      0.000000         0.000000  ...
113     0.000000      0.000000         0.000000  ...
114     0.000000      0.000000         0.000000  ...
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117     0.000000      0.000000         0.000000  ...
118     0.000000      0.000000         0.000000  ...
119     0.000000      0.000000         0.000000  ...
120     0.000000      0.000000         0.000000  ...
121     0.000000      0.000000         0.000000  ...
122     0.000000      0.000000         0.000000  ...
123     0.000000      0.000000         0.000000  ...
124     0.000000      0.000000         0.000000  ...
125     0.000000      0.000000         0.000000  ...
126     0.000000      0.000000         0.000000  ...
127     0.000000      0.000000         0.000000  ...
128     0.000000      0.000000         0.000000  ...
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131     0.000000      0.000000         0.000000  ...
132     0.000000      0.000000         0.000000  ...
133     0.000000      0.000000         0.000000  ...
134     0.000000      0.000000         0.000000  ...
135     0.000000      0.000000         0.000000  ...
136     0.000000      0.000000         0.000000  ...
137     0.000000      0.000000         0.000000  ...
138     0.000000      0.000000         0.000000  ...
139     0.000000      0.000000         0.000000  ...
140     0.000000      0.000000         0.000000  ...
141     0.000000      0.000000         0.000000  ...
142     0.000000      0.000000         0.000000  ...
143     0.000000      0.000000         0.000000  ...
144     0.000000      0.000000         0.000000  ...
145     0.000000      0.000000         0.000000  ...
146     0.000000      0.000000         0.000000  ...
147     0.000000      0.000000         0.000000  ...
148     0.000000      0.000000         0.000000  ...
149     0.000000      0.000000         0.000000  ...
150     0.000000      0.000000         0.000000  ...
151     0.000000      0.000000         0.000000  ...
152     0.000000      0.000000         0.000000  ...
153     0.000000      0.000000         0.000000  ...
154     0.000000      0.000000         0.000000  ...
155     0.000000      0.000000         0.000000  ...
156     0.000000      0.000000         0.000000  ...
157     0.000000      0.000000         0.000000  ...
158     0.000000      0.000000         0.000000  ...
159     0.000000      0.000000         0.000000  ...
160     0.000000      0.000000         0.000000  ...
161     0.000000      0.000000         0.000000  ...
162     0.000000      0.000000         0.000000  ...
163     0.000000      0.000000         0.000000  ...
164     0.000000      0.000000         0.000000  ...
165     0.000000      0.000000         0.000000  ...
166     0.000000      0.000000         0.000000  ...
167     0.000000      0.000000         0.000000  ...
168     0.000000      0.000000         0.000000  ...
169     0.000000      0.000000         0.000000  ...
170     0.000000      0.000000         0.000000  ...
171     0.000000      0.000000         0.000000  ...
172     0.000000      0.000000         0.000000  ...
173     0.000000      0.000000         0.000000  ...
174     0.000000      0.000000         0.000000  ...
175     0.000000      0.000000         0.000000  ...
176     0.000000      0.000000         0.000000  ...
177     0.000000      0.000000         0.000000  ...
178     0.000000      0.000000         0.000000  ...
179     0.000000      0.000000         0.000000  ...
180     0.000000      0.000000         0.000000  ...
181     0.000000      0.000000         0.000000  ...
182     0.000000      0.000000         0.000000  ...
183     0.000000      0.000000         0.000000  ...
184     0.000000      0.000000         0.000000  ...
185     0.000000      0.000000         0.000000  ...
186     0.000000      0.000000         0.000000  ...
187     0.000000      0.000000         0.000000  ...
188     0.000000      0.000000         0.000000  ...
189     0.000000      0.000000         0.000000  ...
190     0.000000      0.000000         0.000000  ...
191     0.000000      0.000000         0.000000  ...
192     0.000000      0.000000         0.000000  ...
193     0.000000      0.000000         0.000000  ...
194     0.000000      0.000000         0.000000  ...
195     0.000000      0.000000         0.000000  ...
196     0.000000      0.000000         0.000000  ...
197     0.000000      0.000000         0.000000  ...
198     0.000000      0.000000         0.000000  ...
199     0.000000      0.000000         0.000000  ...
200     0.000000      0.000000         0.000000  ...
```
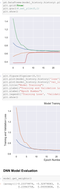

```
In [48]: pd.DataFrame(model_fit.cv_results_).plot(kind='line')
pd.set_option('max_colwidth',-1)
pd.set_option('max_rows',-1)
pd.set_option('max_columns',-1)
```




```
In [49]: plot_grid_search_validation_curve(model_fit,'learning_rate',cv=5)
```

DNN Model Evaluation

```
In [50]: model_cat_metrics(),
```

```
Out[50]:(array([0.00000000, 0.00000000, 0.00000000, 0.00000000,
        0.00000000, 0.00000000, 0.00000000, 0.00000000,
        0.00000000, 0.00000000, 0.00000000, 0.00000000,
        
```