Rain Prediction Using ANN (Tensorflow 2 - Keras)

In [34]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df = pd.read_csv("D:\data science\Data scientist\Projects\P5 Rain pred using ANN\weatherAUS.csv")
```

Data Cleaning

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

Out[3]:

	Date	Location	MinTemp	MaxTemp	Rainfall	Evaporation	Sunshine	WindGustDir	WindGustSpeed	WindDir9am	...	Humidity9am	Humidity3pm	Pre
0	2008-12-01	Albury	13.4	22.9	0.6	NaN	NaN	W	44.0	W	...	71.0	22.0	
1	2008-12-02	Albury	7.4	25.1	0.0	NaN	NaN	WNW	44.0	NNW	...	44.0	25.0	
2	2008-12-03	Albury	12.9	25.7	0.0	NaN	NaN	WSW	46.0	W	...	38.0	30.0	
3	2008-12-04	Albury	9.2	28.0	0.0	NaN	NaN	NE	24.0	SE	...	45.0	16.0	
4	2008-12-05	Albury	17.5	32.3	1.0	NaN	NaN	W	41.0	ENE	...	82.0	33.0	

5 rows × 23 columns

In [4]:
```
len(df)
```

Out[4]:
```
145460
```

In [5]:
```
df.head().isnull().sum()
```

Out[5]:
```
Date             0
Location         0
MinTemp          0
MaxTemp          0
Rainfall         0
Evaporation      5
Sunshine         5
WindGustDir      0
WindGustSpeed    0
WindDir9am       0
WindDir3pm       0
WindSpeed9am     0
WindSpeed3pm     0
Humidity9am      0
Humidity3pm      0
Pressure9am      0
Pressure3pm      0
Cloud9am         3
Cloud3pm         3
Temp9am          0
Temp3pm          0
RainToday        0
RainTomorrow     0
dtype: int64
```

In [6]:
```
df = df.dropna()
```

In [7]:
```
df.head().isnull().sum()
```

Out[7]:
```
Date             0
Location         0
MinTemp          0
MaxTemp          0
Rainfall         0
Evaporation      0
Sunshine         0
WindGustDir      0
WindGustSpeed    0
WindDir9am       0
WindDir3pm       0
WindSpeed9am     0
WindSpeed3pm     0
Humidity9am      0
Humidity3pm      0
Pressure9am      0
Pressure3pm      0
Cloud9am         0
Cloud3pm         0
Temp9am          0
Temp3pm          0
RainToday        0
RainTomorrow     0
dtype: int64
```

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

Out[8]:

	Date	Location	MinTemp	MaxTemp	Rainfall	Evaporation	Sunshine	WindGustDir	WindGustSpeed	WindDir9am	...	Humidity9am	Humidity3pm
6049	2009-01-01	Cobar	17.9	35.2	0.0	12.0	12.3	SSW	48.0	ENE	...	20.0	13.0
6050	2009-01-02	Cobar	18.4	28.9	0.0	14.8	13.0	S	37.0	SSE	...	30.0	8.0
6052	2009-01-04	Cobar	19.4	37.6	0.0	10.8	10.6	NNE	46.0	NNE	...	42.0	22.0
6053	2009-01-05	Cobar	21.9	38.4	0.0	11.4	12.2	WNW	31.0	WNW	...	37.0	22.0
6054	2009-01-06	Cobar	24.2	41.0	0.0	11.2	8.4	WNW	35.0	NW	...	19.0	15.0

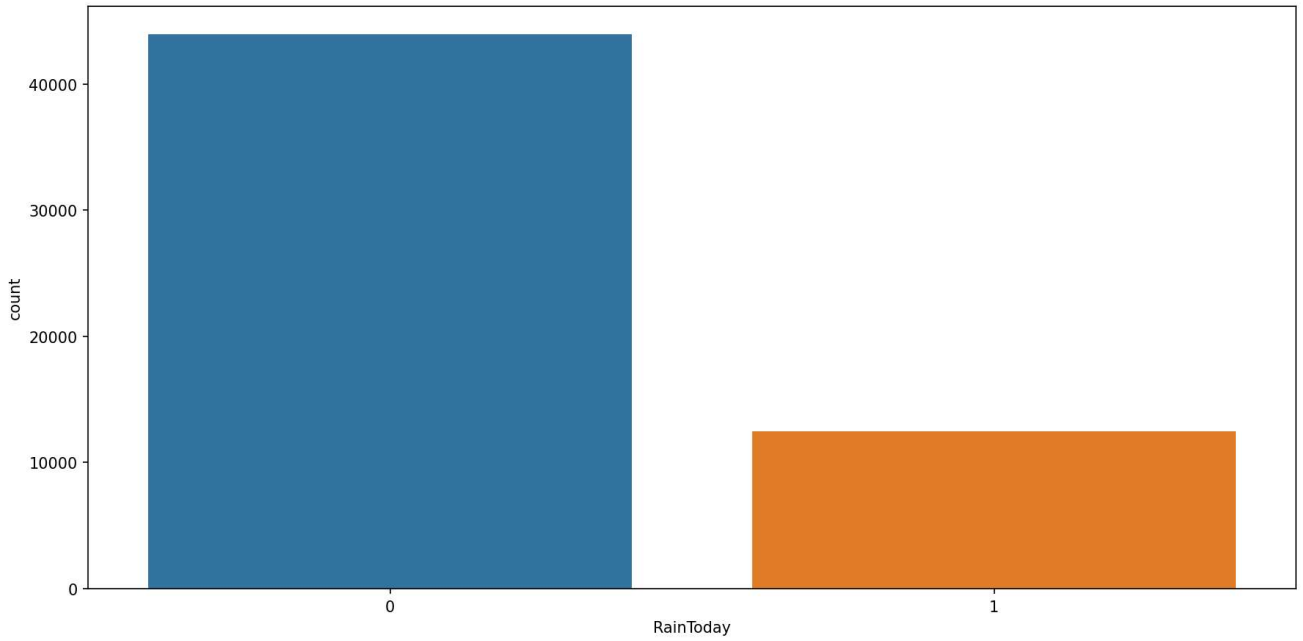
5 rows × 23 columns

In [9]:
```
df.info()
```

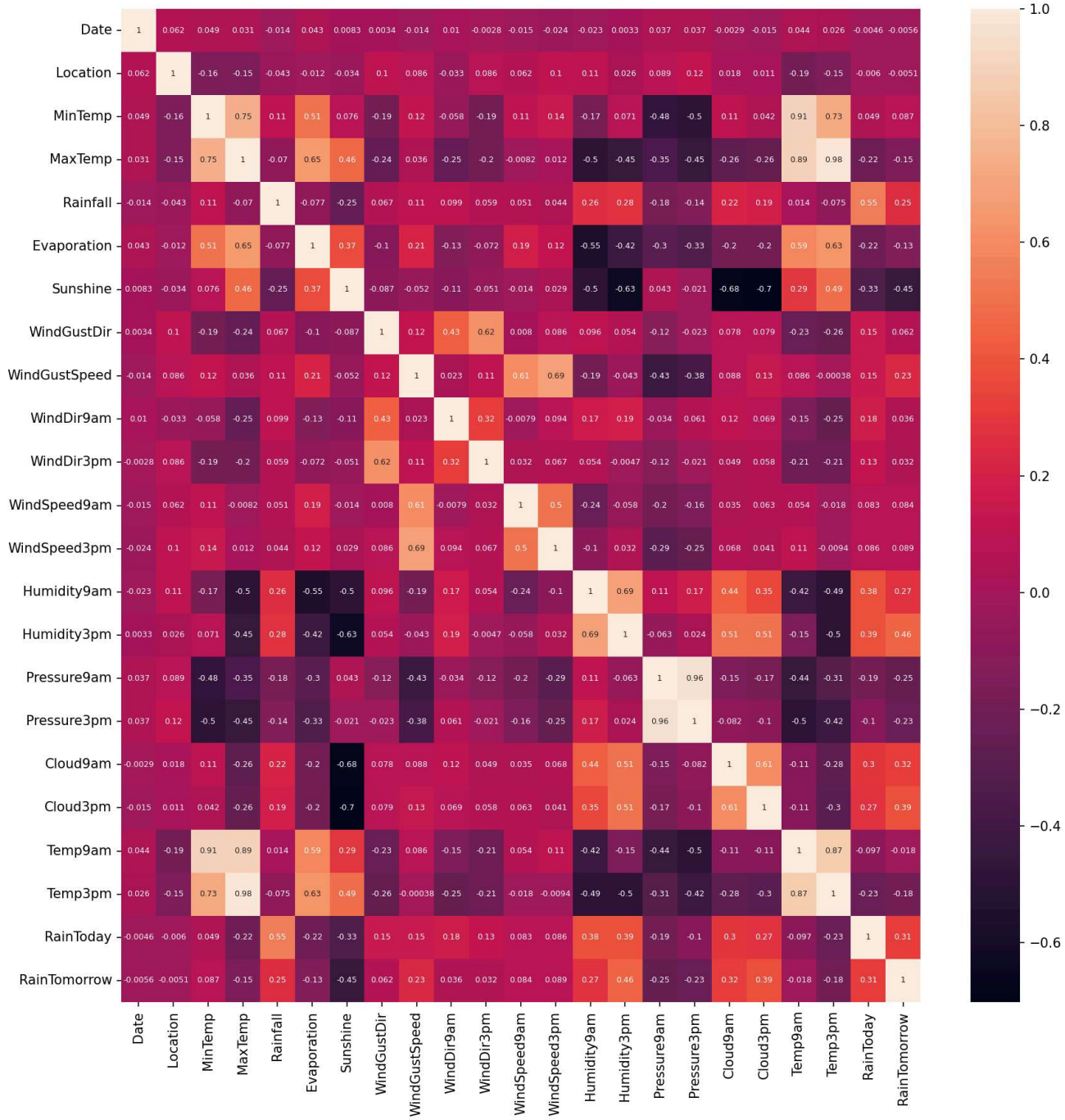
```
<class 'pandas.core.frame.DataFrame'>
Index: 56420 entries, 6049 to 142302
Data columns (total 23 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Date           56420 non-null  object
 1   Location       56420 non-null  object
 2   MinTemp        56420 non-null  float64
 3   MaxTemp        56420 non-null  float64
 4   Rainfall       56420 non-null  float64
 5   Evaporation    56420 non-null  float64
 6   Sunshine       56420 non-null  float64
 7   WindGustDir    56420 non-null  object
 8   WindGustSpeed  56420 non-null  float64
 9   WindDir9am     56420 non-null  object
 10  WindDir3pm     56420 non-null  object
 11  WindSpeed9am   56420 non-null  float64
 12  WindSpeed3pm   56420 non-null  float64
 13  Humidity9am    56420 non-null  float64
 14  Humidity3pm    56420 non-null  float64
 15  Pressure9am    56420 non-null  float64
 16  Pressure3pm    56420 non-null  float64
 17  Cloud9am       56420 non-null  float64
 18  Cloud3pm       56420 non-null  float64
 19  Temp9am        56420 non-null  float64
 20  Temp3pm        56420 non-null  float64
 21  RainToday      56420 non-null  object
 22  RainTomorrow   56420 non-null  object
dtypes: float64(16), object(7)
memory usage: 10.3+ MB
```

Data Visualization

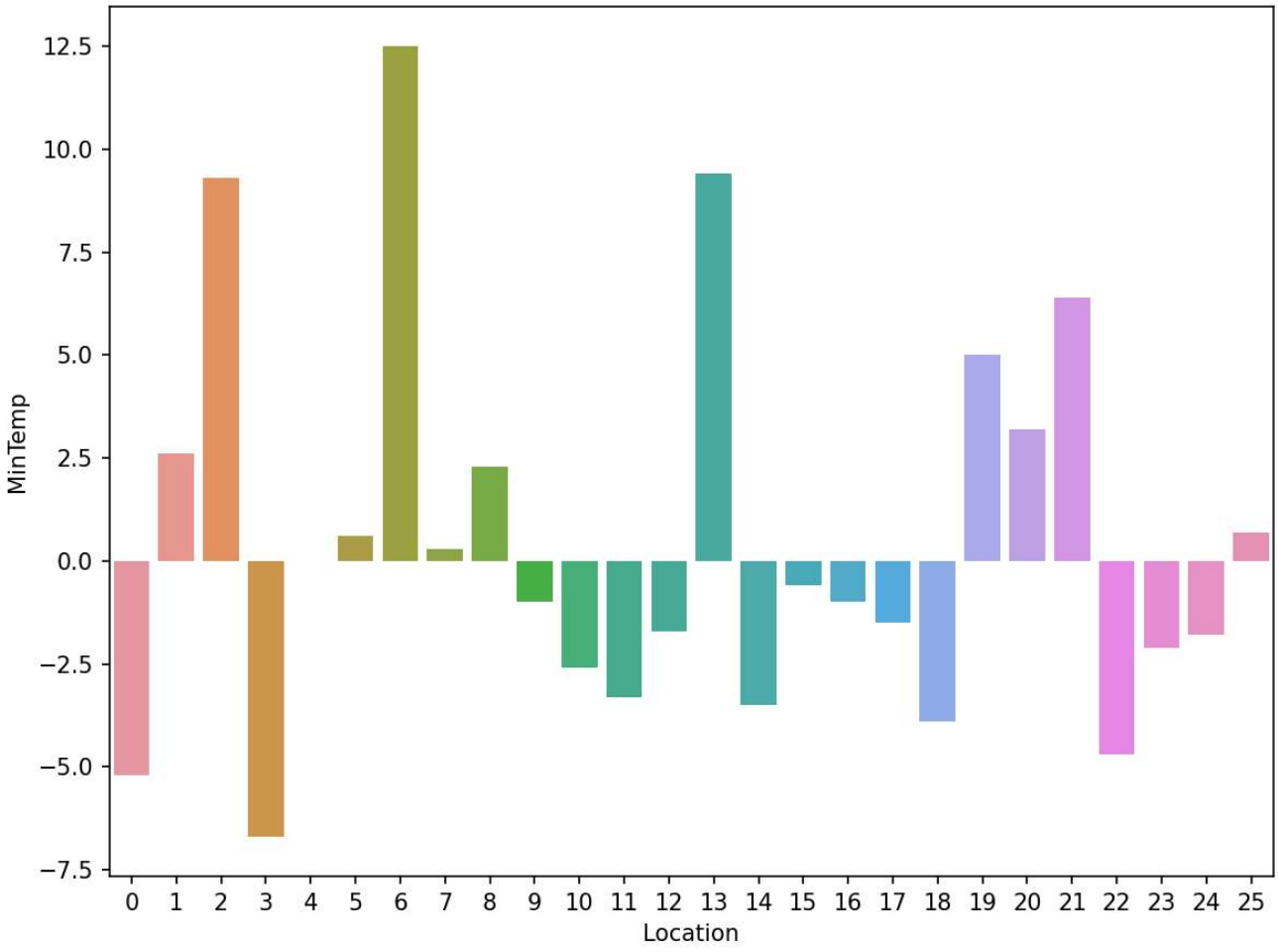
In [52]:
```
plt.figure(figsize=(12,6),dpi = 150)
sns.countplot(data = df,x='RainToday')
plt.tight_layout()
```



In [81]:
```
plt.figure(figsize=(12,12),dpi = 150)
sns.heatmap(df.corr(),annot = True,fmt='.2g',annot_kws={"size": 6})
plt.tight_layout()
```



In [80]:
```
lowest = df.groupby(by='Location')['MinTemp'].min().reset_index()
plt.figure(figsize=(8, 6),dpi = 150)
sns.barplot(data=lowest, x='Location', y='MinTemp')
plt.tight_layout()
```



Data Preparation

In [10]:
```
object_columns = df.select_dtypes(include=['object']).columns.tolist()
object_columns
```

Out[10]:
```
['Date',
 'Location',
 'WindGustDir',
 'WindDir9am',
 'WindDir3pm',
 'RainToday',
 'RainTomorrow']
```

In [11]:
```
from sklearn.preprocessing import LabelEncoder
label_encoder = LabelEncoder()
for i in object_columns:
    df[i] = label_encoder.fit_transform(df[i])

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 56420 entries, 6049 to 142302
Data columns (total 23 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Date           56420 non-null  int32
 1   Location       56420 non-null  int32
 2   MinTemp        56420 non-null  float64
 3   MaxTemp        56420 non-null  float64
 4   Rainfall       56420 non-null  float64
 5   Evaporation    56420 non-null  float64
 6   Sunshine       56420 non-null  float64
 7   WindGustDir    56420 non-null  int32
 8   WindGustSpeed  56420 non-null  float64
 9   WindDir9am     56420 non-null  int32
 10  WindDir3pm     56420 non-null  int32
 11  WindSpeed9am   56420 non-null  float64
 12  WindSpeed3pm   56420 non-null  float64
 13  Humidity9am    56420 non-null  float64
 14  Humidity3pm    56420 non-null  float64
 15  Pressure9am    56420 non-null  float64
 16  Pressure3pm    56420 non-null  float64
 17  Cloud9am       56420 non-null  float64
 18  Cloud3pm       56420 non-null  float64
 19  Temp9am        56420 non-null  float64
 20  Temp3pm        56420 non-null  float64
 21  RainToday      56420 non-null  int32
 22  RainTomorrow   56420 non-null  int32
dtypes: float64(16), int32(7)
memory usage: 8.8 MB
```

In [12]:
```
X = df.drop(['RainTomorrow'],axis = 1)
y = df['RainTomorrow']
```

In [13]:
```
X.head(7)
```

Out[13]:

	Date	Location	MinTemp	MaxTemp	Rainfall	Evaporation	Sunshine	WindGustDir	WindGustSpeed	WindDir9am	...	WindSpeed3pm	Humidity9am
6049	407	4	17.9	35.2	0.0	12.0	12.3	11	48.0	1	...	20.0	20.0
6050	408	4	18.4	28.9	0.0	14.8	13.0	8	37.0	10	...	19.0	30.0
6052	410	4	19.4	37.6	0.0	10.8	10.6	5	46.0	5	...	15.0	42.0
6053	411	4	21.9	38.4	0.0	11.4	12.2	14	31.0	14	...	6.0	37.0
6054	412	4	24.2	41.0	0.0	11.2	8.4	14	35.0	7	...	13.0	19.0
6055	413	4	27.1	36.1	0.0	13.0	0.0	3	43.0	3	...	20.0	26.0
6056	414	4	23.3	34.0	0.0	9.8	12.6	11	41.0	8	...	19.0	33.0

7 rows × 22 columns

In [14]:
```
print(y.unique())
```

```
[0 1]
```

In [15]:
```
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 = 42)

X.shape
```

Out[15]:
```
(56420, 22)
```

In [16]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaled_X_train = scaler.fit_transform(X_train)
scaled_X_test = scaler.transform(X_test)
```

In [17]:
```
print(len(y_train))
print(len(scaled_X_train))
print(len(scaled_X_test))
print(len(y_test))
```

```
45136
45136
11284
11284
```

Model Building

In [29]:
```
from keras.layers import Dense, BatchNormalization, Dropout
from keras.models import Sequential
from keras import callbacks
from keras.optimizers import Adam

early_stopping = callbacks.EarlyStopping(
    min_delta=0.001,
    patience=10,
    restore_best_weights=True,
)


model = Sequential()

model.add(Dense(units = 32, kernel_initializer = 'uniform', activation = 'relu', input_dim = 22))
model.add(Dense(units = 32, kernel_initializer = 'uniform', activation = 'relu'))
model.add(Dense(units = 16, kernel_initializer = 'uniform', activation = 'relu'))
model.add(Dropout(0.25))
model.add(Dense(units = 16, kernel_initializer = 'uniform', activation = 'relu'))
model.add(Dropout(0.25))
model.add(Dense(units = 8, kernel_initializer = 'uniform', activation = 'relu'))
model.add(Dropout(0.5))
model.add(Dense(units = 8, kernel_initializer = 'uniform', activation = 'relu'))
model.add(Dropout(0.5))
model.add(Dense(units = 1, kernel_initializer = 'uniform', activation = 'sigmoid'))

opt = Adam(learning_rate=0.001)
model.compile(optimizer = opt, loss = 'binary_crossentropy', metrics = ['accuracy'])

history = model.fit(scaled_X_train,y_train, batch_size = 32, epochs = 150, callbacks=[early_stopping], validation_split=0.2
```

```
Epoch 1/150
1129/1129 [==============================] - 3s 2ms/step - loss: 0.4483 - accuracy: 0.7804 - val_loss: 0.3761 - val_accura
cy: 0.7771
Epoch 2/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.4067 - accuracy: 0.7804 - val_loss: 0.3676 - val_accura
cy: 0.7771
Epoch 3/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.4018 - accuracy: 0.7804 - val_loss: 0.3692 - val_accura
cy: 0.7771
Epoch 4/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3994 - accuracy: 0.7804 - val_loss: 0.3657 - val_accura
cy: 0.7771
Epoch 5/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.4021 - accuracy: 0.7804 - val_loss: 0.3658 - val_accura
cy: 0.7771
Epoch 6/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3974 - accuracy: 0.7804 - val_loss: 0.3682 - val_accura
cy: 0.7771
Epoch 7/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3963 - accuracy: 0.7804 - val_loss: 0.3627 - val_accura
cy: 0.7771
Epoch 8/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3951 - accuracy: 0.7926 - val_loss: 0.3640 - val_accura
cy: 0.8501
Epoch 9/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3951 - accuracy: 0.8186 - val_loss: 0.3738 - val_accura
cy: 0.7771
Epoch 10/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3933 - accuracy: 0.8156 - val_loss: 0.3612 - val_accura
cy: 0.8530
Epoch 11/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3951 - accuracy: 0.8293 - val_loss: 0.3636 - val_accura
cy: 0.8490
Epoch 12/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3930 - accuracy: 0.8327 - val_loss: 0.3678 - val_accura
cy: 0.8475
Epoch 13/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3909 - accuracy: 0.8339 - val_loss: 0.3641 - val_accura
cy: 0.8531
Epoch 14/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3934 - accuracy: 0.8406 - val_loss: 0.3628 - val_accura
cy: 0.8508
Epoch 15/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3902 - accuracy: 0.8402 - val_loss: 0.3659 - val_accura
cy: 0.8463
Epoch 16/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3909 - accuracy: 0.8387 - val_loss: 0.3608 - val_accura
cy: 0.8532
Epoch 17/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3896 - accuracy: 0.8400 - val_loss: 0.3598 - val_accura
cy: 0.8530
Epoch 18/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3882 - accuracy: 0.8397 - val_loss: 0.3606 - val_accura
cy: 0.8511
Epoch 19/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3916 - accuracy: 0.8401 - val_loss: 0.3576 - val_accura
cy: 0.8535
Epoch 20/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3858 - accuracy: 0.8420 - val_loss: 0.3602 - val_accura
cy: 0.8542
Epoch 21/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3888 - accuracy: 0.8413 - val_loss: 0.3634 - val_accura
cy: 0.8533
Epoch 22/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3884 - accuracy: 0.8391 - val_loss: 0.3609 - val_accura
cy: 0.8517
Epoch 23/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3871 - accuracy: 0.8412 - val_loss: 0.3661 - val_accura
cy: 0.8485
Epoch 24/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3849 - accuracy: 0.8424 - val_loss: 0.3710 - val_accura
cy: 0.8506
Epoch 25/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3851 - accuracy: 0.8396 - val_loss: 0.3605 - val_accura
cy: 0.8501
Epoch 26/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3836 - accuracy: 0.8412 - val_loss: 0.3618 - val_accura
cy: 0.8488
Epoch 27/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3840 - accuracy: 0.8385 - val_loss: 0.3644 - val_accura
cy: 0.8405
Epoch 28/150
```

```
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3843 - accuracy: 0.8381 - val_loss: 0.3629 - val_accura
cy: 0.8497
Epoch 29/150
1129/1129 [==============================] - 2s 2ms/step - loss: 0.3857 - accuracy: 0.8424 - val_loss: 0.3625 - val_accura
cy: 0.8502
```

In [30]:
```
history_df = pd.DataFrame(history.history)
plt.figure(figsize =(10,4),dpi = 200)
plt.plot(history_df.loc[:, ['loss']], "Red", label='Training loss')
plt.plot(history_df.loc[:, ['val_loss']],"Green", label='Validation loss')
plt.title('Training and Validation loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend(loc="best")

plt.show()

print(len(y_train))
print(len(scaled_X_train))
print(len(scaled_X_test))
print(len(y_test))
```


```
45136
45136
11284
11284
```

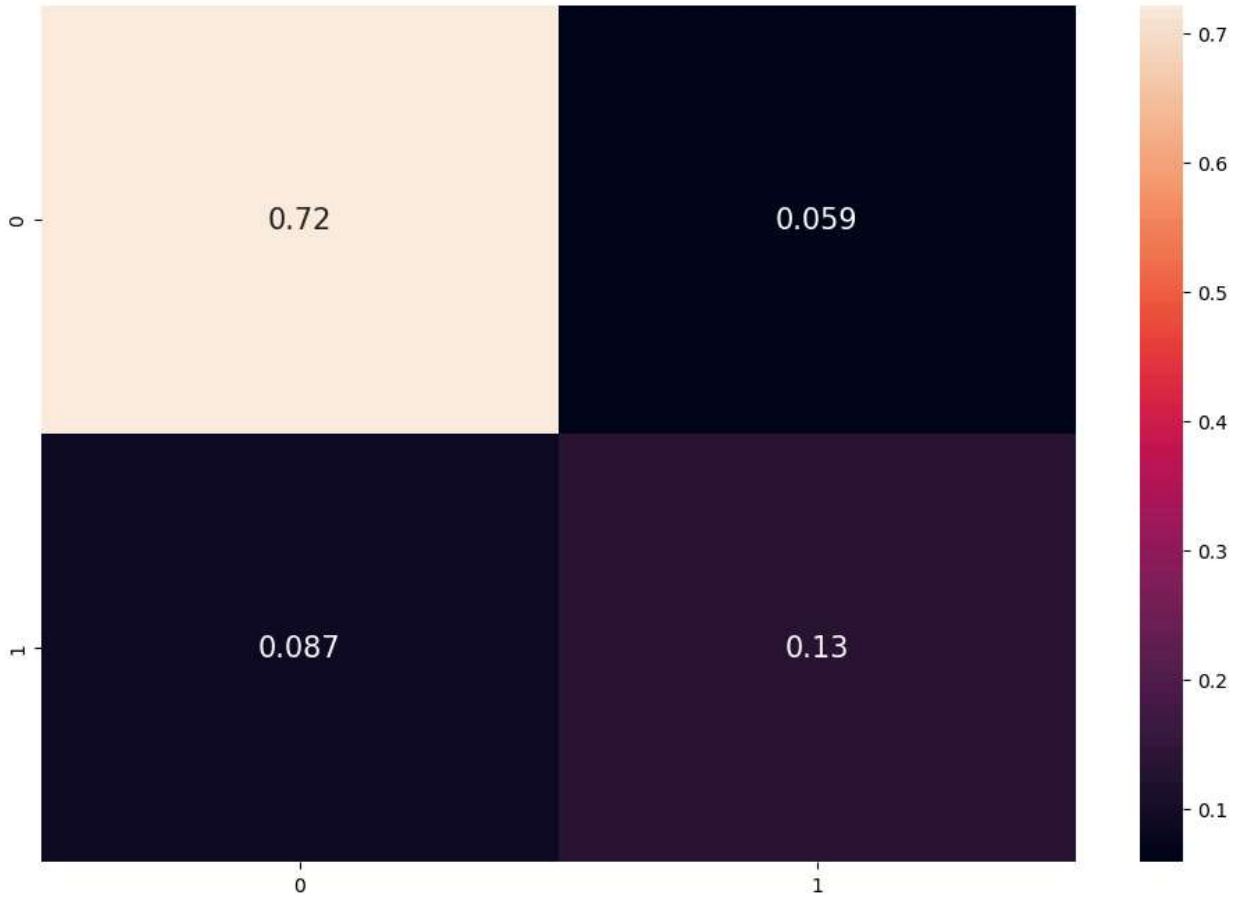
Model Prediction

In [31]:
```
y_pred = model.predict(scaled_X_test)
y_pred = (y_pred > 0.5)
```

```
353/353 [==============================] - 0s 930us/step
```

In [32]:
```
import seaborn as sns
from sklearn.metrics import confusion_matrix,classification_report
plt.subplots(figsize=(12,8))
cf_matrix = confusion_matrix(y_test, y_pred)
sns.heatmap(cf_matrix/np.sum(cf_matrix), annot = True, annot_kws = {'size':15})
```

Out[32]: <Axes: >



In [33]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.89      0.92      0.91      8799
           1       0.69      0.61      0.65      2485

    accuracy                           0.85     11284
   macro avg       0.79      0.77      0.78     11284
weighted avg       0.85      0.85      0.85     11284
```

Results

Model accuracy = 85%

No rain prediction f1-score = 0.91

Will rain prediction f1-score = 0.65