Prediction of Wine type using Deep Learning

We use deep learning for the large data sets but to understand the concept of deep learning, we use the small data set of wine quality. You can find the wine quality data set from the UCI Machine Learning Repository which is available for free. The aim of this article is to get started with the libraries of deep learning such as Keras, etc and to be familiar with the basis of neural network. About the Data Set : Before we start loading in the data, it is really important to know about your data. The data set consist of 12 variables that are included in the data. Few of them are as follows –

```
    1. Fixed acidity : The total acidity is divided into two
groups: the volatile acids and
       the nonvolatile or fixed acids.The value of this variable is
represented by in gm/dm3 in the data sets.

    2. Volatile acidity: The volatile acidity is a process of wine
turning into vinegar.
       In this data sets, the volatile acidity is expressed in
gm/dm3.

    3. Citric acid : Citric acid is one of the fixed acids in
wines. It’s expressed in g/dm3 in the data sets.

    4. Residual Sugar : Residual Sugar is the sugar remaining after
fermentation stops, or is stopped.
       It’s expressed in g/dm3 in the data set.

    5. Chlorides : It can be a important contributor to saltiness
in wine.
       The value of this variable is represented by in gm/dm3 in
the data sets.

    6. Free sulfur dioxide : It is the part of the sulfur dioxide
that is added to a wine.
       The value of this variable is represented by in gm/dm3 in
the data sets.

    7. Total Sulfur Dioxide : It is the sum of the bound and the
free sulfur dioxide.
       The value of this variable is represented by in gm/dm3 in
the data sets.
```

Step #1: Know your data.

In [2]:
```
# Loading the data.

# Import Required Libraries
import matplotlib.pyplot as plt
import pandas as pd
```

```
import numpy as np

# Read in white wine data
white = pd.read_csv("http://archive.ics.uci.edu/ml/machine-learning-databases/wine-

# Read in red wine data
red = pd.read_csv("http://archive.ics.uci.edu/ml/machine-learning-databases/wine-qu
```

In [3]:
```
# First rows of `red`
red.head()
```

Out[3]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4

In [4]:
```
# Last rows of `white`
white.tail()
```

Out[4]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcoh
4893	6.2	0.21	0.29	1.6	0.039	24.0	92.0	0.99114	3.27	0.50	1
4894	6.6	0.32	0.36	8.0	0.047	57.0	168.0	0.99490	3.15	0.46	9
4895	6.5	0.24	0.19	1.2	0.041	30.0	111.0	0.99254	2.99	0.46	9
4896	5.5	0.29	0.30	1.1	0.022	20.0	110.0	0.98869	3.34	0.38	12
4897	6.0	0.21	0.38	0.8	0.020	22.0	98.0	0.98941	3.26	0.32	1

In [5]:
```
# Take a sample of five rows of `red`
red.sample(5)
```

Out[5]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcoh
792	7.1	0.61	0.02	2.5	0.081	17.0	87.0	0.99745	3.48	0.60	9
39	7.3	0.45	0.36	5.9	0.074	12.0	87.0	0.99780	3.33	0.83	10
56	10.2	0.42	0.57	3.4	0.070	4.0	10.0	0.99710	3.04	0.63	9
1145	8.2	0.20	0.43	2.5	0.076	31.0	51.0	0.99672	3.53	0.81	10
1410	6.6	0.96	0.00	1.8	0.082	5.0	16.0	0.99360	3.50	0.44	1

In [6]:
```
# Describe `white`
white.describe()
```

Out[6]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide
count	4898.000000	4898.000000	4898.000000	4898.000000	4898.000000	4898.000000	4898.000000
mean	6.854788	0.278241	0.334192	6.391415	0.045772	35.308085	138.360657
std	0.843868	0.100795	0.121020	5.072058	0.021848	17.007137	42.498065
min	3.800000	0.080000	0.000000	0.600000	0.009000	2.000000	9.000000
25%	6.300000	0.210000	0.270000	1.700000	0.036000	23.000000	108.000000
50%	6.800000	0.260000	0.320000	5.200000	0.043000	34.000000	134.000000
75%	7.300000	0.320000	0.390000	9.900000	0.050000	46.000000	167.000000
max	14.200000	1.100000	1.660000	65.800000	0.346000	289.000000	440.000000

In [7]:
```
# Check for null values in `red`.

# Double check for null values in `red`
pd.isnull(red)
```

Out[7]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcol
0	False	False	False	False	False	False	False	False	False	False	Fa
1	False	False	False	False	False	False	False	False	False	False	Fa
2	False	False	False	False	False	False	False	False	False	False	Fa
3	False	False	False	False	False	False	False	False	False	False	Fa
4	False	False	False	False	False	False	False	False	False	False	Fa
...	...	...	...	...	...	...	...	...	...	...	
1594	False	False	False	False	False	False	False	False	False	False	Fa
1595	False	False	False	False	False	False	False	False	False	False	Fa
1596	False	False	False	False	False	False	False	False	False	False	Fa
1597	False	False	False	False	False	False	False	False	False	False	Fa
1598	False	False	False	False	False	False	False	False	False	False	Fa

1599 rows × 12 columns

Step #2: Distribution of Alcohol.

In [8]:
```
#Creating Histogram.
# Create Histogram
fig, ax = plt.subplots(1, 2)
```

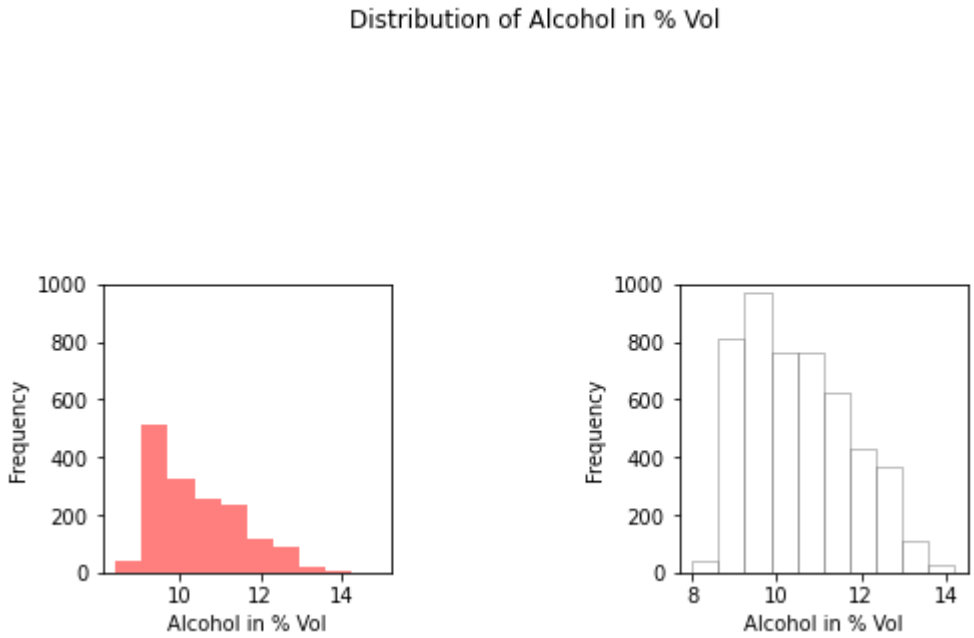
```
ax[0].hist(red.alcohol, 10, facecolor ='red',
                        alpha = 0.5, label ="Red wine")

ax[1].hist(white.alcohol, 10, facecolor ='white',
                ec ="black", lw = 0.5, alpha = 0.5,
                label ="White wine")

fig.subplots_adjust(left = 0, right = 1, bottom = 0,
                        top = 0.5, hspace = 0.05, wspace = 1)

ax[0].set_ylim([0, 1000])
ax[0].set_xlabel("Alcohol in % Vol")
ax[0].set_ylabel("Frequency")
ax[1].set_ylim([0, 1000])
ax[1].set_xlabel("Alcohol in % Vol")
ax[1].set_ylabel("Frequency")

fig.suptitle("Distribution of Alcohol in % Vol")
plt.show()
```



In [9]:
```
# Splitting the data set for training and validation.
```

In [14]:
```
# Add `type` column to `red` with price one
red['type'] = 1

# Add `type` column to `white` with price zero
white['type'] = 0

# Append `white` to `red`
wines = red.append(white, ignore_index = True)
```

```
C:\Users\DELL\AppData\Local\Temp\ipykernel_9084\120391132.py:8: FutureWarning: The
frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  wines = red.append(white, ignore_index = True)
```

In [19]:
```
wines.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6497 entries, 0 to 6496
Data columns (total 13 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         6497 non-null   float64
 1   volatile acidity      6497 non-null   float64
 2   citric acid           6497 non-null   float64
 3   residual sugar        6497 non-null   float64
 4   chlorides             6497 non-null   float64
 5   free sulfur dioxide   6497 non-null   float64
 6   total sulfur dioxide  6497 non-null   float64
 7   density               6497 non-null   float64
 8   pH                    6497 non-null   float64
 9   sulphates             6497 non-null   float64
 10  alcohol               6497 non-null   float64
 11  quality               6497 non-null   int64  
 12  type                  6497 non-null   int64  
dtypes: float64(11), int64(2)
memory usage: 660.0 KB
```

In [20]:
```
wines.head()
```

Out[20]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8
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4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4

In [21]:
```
wines.tail()
```

Out[21]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcoh
6492	6.2	0.21	0.29	1.6	0.039	24.0	92.0	0.99114	3.27	0.50	1
6493	6.6	0.32	0.36	8.0	0.047	57.0	168.0	0.99490	3.15	0.46	9
6494	6.5	0.24	0.19	1.2	0.041	30.0	111.0	0.99254	2.99	0.46	9
6495	5.5	0.29	0.30	1.1	0.022	20.0	110.0	0.98869	3.34	0.38	12
6496	6.0	0.21	0.38	0.8	0.020	22.0	98.0	0.98941	3.26	0.32	1

In [31]:
```
# Import `train_test_split` from `sklearn.model_selection`
from sklearn.model_selection import train_test_split
X = wines.iloc[:,0:11]
y = np.ravel(wines.type)

# Splitting the data set for training and validating
X_train, X_test, y_train, y_test = train_test_split(
                X, y, test_size = 0.34, random_state = 45)
```

Step #3: Structure of Network

In [28]:
```
# Import `Sequential` from `keras.models`
from keras.models import Sequential

# Import `Dense` from `keras.layers`
from keras.layers import Dense

# Initialize the constructor
model = Sequential()

# Add an input layer
model.add(Dense(12, activation ='relu', input_shape =(11, )))

# Add one hidden layer
model.add(Dense(9, activation ='relu'))

# Add an output layer
model.add(Dense(1, activation ='sigmoid'))

# Model output shape
model.output_shape

# Model summary
model.summary()

# Model config
model.get_config()

# List all weight tensors
model.get_weights()
model.compile(loss ='binary_crossentropy',
optimizer ='adam', metrics =['accuracy'])
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_3 (Dense)             (None, 12)                144

 dense_4 (Dense)             (None, 9)                 117

 dense_5 (Dense)             (None, 1)                 10

=================================================================
Total params: 271
Trainable params: 271
Non-trainable params: 0
_________________________________________________________________
```

Step #4: Training and Prediction

In [ ]:
```
# Training Model
model.fit(X_train, y_train, epochs = 3,
                batch_size = 1, verbose = 1)

# Predicting the Value
y_pred = model.predict(X_test)
print(y_pred)
```