Importing the Dependencies

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
```

Data Collection

```
# loading the dataset to a Pandas DataFrame
wine_dataset = pd.read_csv('/content/winequality-red.csv')
```

```
# number of rows & columns in the dataset
wine_dataset.shape
```

```
    (1599, 12)
```

```
# first 5 rows of the dataset
wine_dataset.head()
```

	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

```
# checking for missing values
wine_dataset.isnull().sum()
```

```
    fixed acidity           0
    volatile acidity        0
    citric acid             0
    residual sugar          0
    chlorides               0
    free sulfur dioxide     0
    total sulfur dioxide    0
    density                 0
    pH                      0
    sulphates               0
    alcohol                 0
    quality                 0
    dtype: int64
```

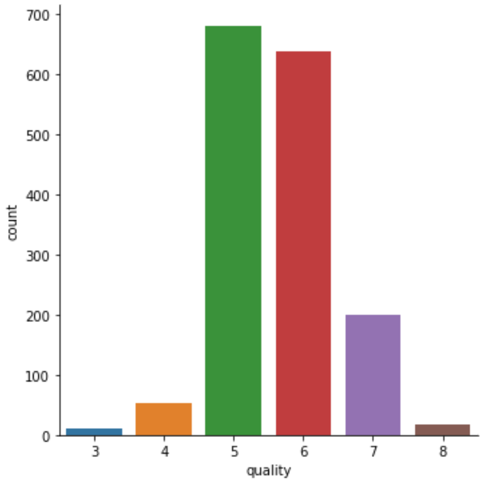
Data Analysis and Visulaization

```
# statistical measures of the dataset
wine_dataset.describe()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	dens
count	1599.000000	1599.000000	1599.000000	1599.000000	1599.000000	1599.000000	1599.000000	1599.000
mean	8.319637	0.527821	0.270976	2.538806	0.087467	15.874922	46.467792	0.996
std	1.741096	0.179060	0.194801	1.409928	0.047065	10.460157	32.895324	0.001
min	4.600000	0.120000	0.000000	0.900000	0.012000	1.000000	6.000000	0.990
25%	7.100000	0.390000	0.090000	1.900000	0.070000	7.000000	22.000000	0.995
50%	7.900000	0.520000	0.260000	2.200000	0.079000	14.000000	38.000000	0.996
75%	9.200000	0.640000	0.420000	2.600000	0.090000	21.000000	62.000000	0.997
max	15.900000	1.580000	1.000000	15.500000	0.611000	72.000000	289.000000	1.003

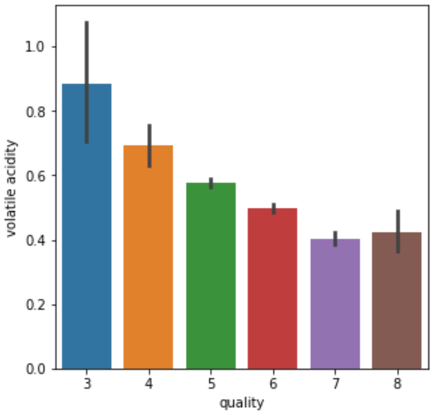
```
# number of values for each quality
sns.catplot(x='quality', data = wine_dataset, kind = 'count')
```

```
<seaborn.axisgrid.FacetGrid at 0x7fb106addb50>
```



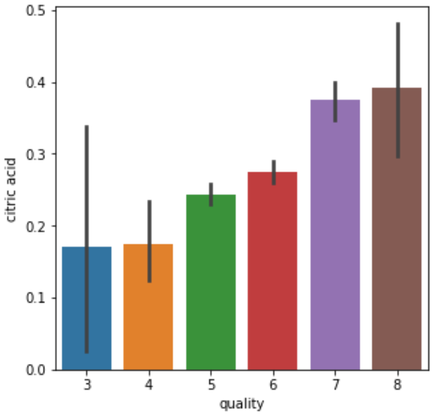
```
# volatile acidity vs Quality
plot = plt.figure(figsize=(5,5))
sns.barplot(x='quality', y = 'volatile acidity', data = wine_dataset)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb10649bbd0>
```



```
# citric acid vs Quality
plot = plt.figure(figsize=(5,5))
sns.barplot(x='quality', y = 'citric acid', data = wine_dataset)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb106506a10>
```



Correlation

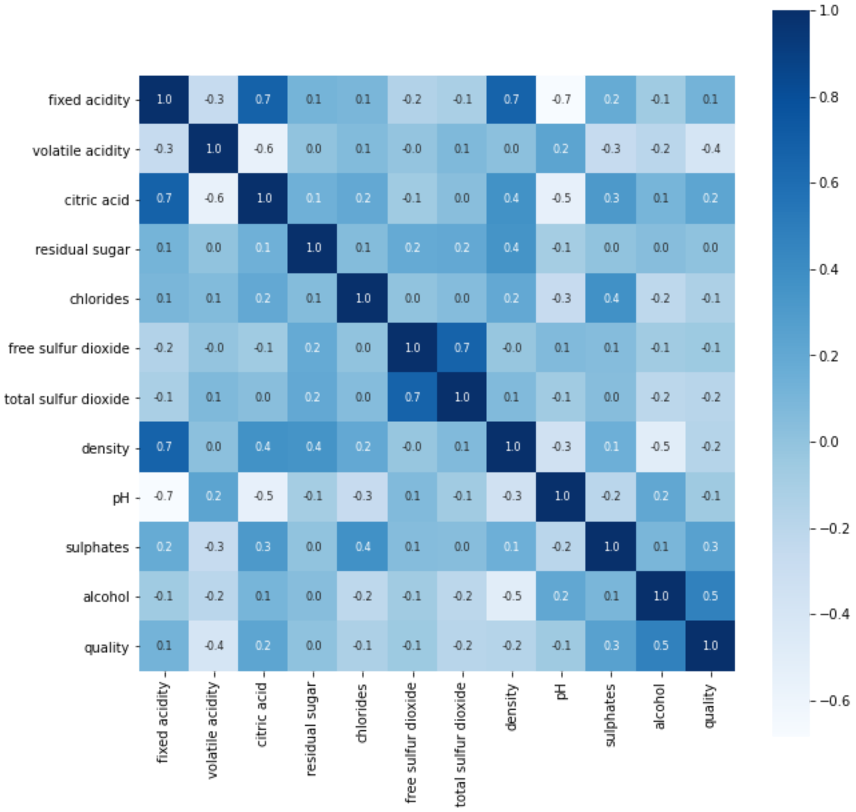
1. Positive Correlation
2. Negative Correlation

```
correlation = wine_dataset.corr()
```

```
# constructing a heatmap to understand the correlation between the columns
plt.figure(figsize=(10,10))
```

```
sns.heatmap(correlation, cbar=True, square=True, fmt = '.1f', annot = True, annot_kws={'size':8}, cmap = 'Blues')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb0fd356950>
```



Data Preprocessing

```
# separate the data and Label
X = wine_dataset.drop('quality',axis=1)
```

```
print(X)
```

```
      fixed acidity  volatile acidity  citric acid  ...    pH  sulphates  alcohol
0               7.4             0.700         0.00  ...  3.51       0.56      9.4
1               7.8             0.880         0.00  ...  3.20       0.68      9.8
2               7.8             0.760         0.04  ...  3.26       0.65      9.8
3              11.2             0.280         0.56  ...  3.16       0.58      9.8
4               7.4             0.700         0.00  ...  3.51       0.56      9.4
...             ...               ...          ...  ...   ...        ...      ...
1594            6.2             0.600         0.08  ...  3.45       0.58     10.5
1595            5.9             0.550         0.10  ...  3.52       0.76     11.2
1596            6.3             0.510         0.13  ...  3.42       0.75     11.0
1597            5.9             0.645         0.12  ...  3.57       0.71     10.2
1598            6.0             0.310         0.47  ...  3.39       0.66     11.0

[1599 rows x 11 columns]
```

Label Binarizaton

```
Y = wine_dataset['quality'].apply(lambda y_value: 1 if y_value>=7 else 0)
```

```
print(Y)
```

```
0       0
1       0
2       0
3       0
4       0
       ..
1594    0
1595    0
1596    0
1597    0
1598    0
Name: quality, Length: 1599, dtype: int64
```

Train & Test Split

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=3)
```

```
print(Y.shape, Y_train.shape, Y_test.shape)
```

```
(1599,) (1279,) (320,)
```

Model Training:

Random Forest Classifier

```
model = RandomForestClassifier()
```

```
model.fit(X_train, Y_train)
```

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

Model Evaluation

Accuracy Score

```
# accuracy on test data
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)
```

```
print('Accuracy : ', test_data_accuracy)
```

```
Accuracy :  0.925
```

Building a Predictive System

```
input_data = (7.5,0.5,0.36,6.1,0.071,17.0,102.0,0.9978,3.35,0.8,10.5)

# changing the input data to a numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the data as we are predicting the label for only one instance
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

prediction = model.predict(input_data_reshaped)
print(prediction)

if (prediction[0]==1):
  print('Good Quality Wine')
else:
  print('Bad Quality Wine')
```

```
[0]
Bad Quality Wine
```